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A
TREATISE
ON
INSECTS,
GENERAL AND SYSTEMATIC;

BEING THE ARTICLE "ENTOMOLOGY," FROM THE SEVENTH EDITION OF THE
ENCYCLOPÆDIA BRITANNICA.

WITH
FIVE HUNDRED AND FORTY FIGURES.

BY
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AND OF THE ENTOMOLOGICAL SOCIETY OF FRANCE.

ADAM AND CHARLES BLACK, EDINBURGH;
SIMPKIN, MARSHALL, & CO., WHITTAKER & CO., AND HAMILTON, ADAMS, & CO.,
LONDON; AND JOHN CUMMING, DUBLIN.

M.DCCC.XXXV.

NOTE BY THE AUTHOR.

THE Proprietors of the Seventh Edition of the *ENCYCLOPÆDIA BRITANNICA* (now in the course of publication) having expressed to me their desire to reprint the article *ENTOMOLOGY* of that work in a separate and single volume, I think it right to apprise the reader of the treatise in its disjoined form, of the source from which it has been drawn, and of the fact of its having been originally written for the work just named. That I should do so, is rendered necessary by the circumstance of my having treated but slightly of several important parts of the subject, such, for example, as the natural history of Ants and Bees. The remarkable economy and surprising instinctive labours of those hymenopterous insects had in fact been previously explained in the *Encyclopædia* (in the order of alphabetical occurrence), by an abler hand,—that of an honoured and accomplished coadjutor, Dr Roget;—and I thus deemed it worse than useless to the readers of the work, either to reproduce his interesting observations, or to bring forward any of my own. It has, however, been deemed advisable, for the sake of those who may purchase the disjoined treatise, without possessing the main body of the *Encyclopædia*, to add the special articles now referred to, and they are accordingly reprinted herewith. I am not without hope that the combined production may thus prove useful to the uninitiated, by exhibiting a general view of modern systematic Entomology, with an introductory sketch of the structure and physiology of insects, and interspersed notices, of a popular nature, regarding their history and habits.

I have added to the present Edition of the treatise a catalogue, accompanied by a few brief biographical notices, of some of the principal works on Entomological Science.

J. W.

WOODVILLE, EDINBURGH, JULY 1835.

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NOTICES

REGARDING THE

PRINCIPAL AUTHORS IN ENTOMOLOGY, AND THEIR WORKS.

CONRAD GESNER, a physician at Zurich, was born in 1516, and died in 1565. His works were published posthumously, and do not contain much information upon insects. He was one of the first, after the revival of learning, to form collections of objects in natural history, his predecessors having chiefly confined themselves to writing commentaries on the ancients, not seldom rendering "confusion worse confounded," and darkening knowledge by a multiplicity of vain words. Gesner was a man of singular learning,—*monstrum eruditionis*, as he is termed by Boerhaave, his biographer. He is regarded by many as the greatest naturalist from the days of ARISTOTLE up to a comparatively recent time.

ULYSSES ALDROVANDUS, also a learned and laborious compiler, was contemporary with Gesner. He was a nobleman of Bologna, professor in the university there, was born in 1525, and died blind in 1605. He wrote fourteen folio volumes on "Natural History," which Baron Cuvier has termed "an indigested and wearisome compilation." It is certainly not very methodical, but many parts of it may be read with amusement, if not with instruction. It was published chiefly by his successors. There are two editions in folio of his treatise on insects, termed *De Animalibus Insectis libri septem*. He divides them into terrestrial and aquatic, and the orders are formed from the presence, the number, and the disposition, of the legs and wings. His groups are often arbitrary and unmeaning. He may be likened to Pliny, as one who made a collection of almost all that was known on the subjects of which he treated prior to his own time. The desirable power of discriminating truth from fiction was not, however, among his characteristics.

HÆFNAGEL was a painter, and a man of good observation. He left behind him very exact representations of a number of insects, which were engraved at Antwerp in 1630 and 1646, under the title of *Diversæ insectorum volatilium icones ad vivum depictæ*. The plates constitute its chief excellency, the letter-press being of less value.

THOMAS MOUFFET, an English naturalist and physician, died about 1600. His entomological work, which is remarkable as the first special one on insects, is entitled *Insectorum sive minimorum Animalium Theatrum*. It was published by Theodore Mayerne, a Frenchman, and physician to James the First, in one volume folio, with 500 wood cuts, London, 1634. It is somewhat in the style of Gesner, to whose manuscripts he appears to have had access, and from which he borrowed largely.

It was about this period that the celebrated Harvey ventured to controvert the ancient opinion regarding the equivocal or spontaneous generation of insects; and although his philosophical aphorism of *omnia ex ovo* was some time of receiving a general approval, yet his own experiments, and those more especially of Redi and Malpighi, soon afforded a firm and incontrovertible basis for the maintenance of that opinion.

FRANCESCO REDI of Arezzo, a physician, and man of excellent literary attainments, was born in 1626, and died in 1698. His observations were first published in Italian, at Florence, in 1668, and afterwards at Amsterdam in 1671 and following years, under the title of *Experimenta circa Generationem Insectorum*, 3 vols. 12mo, with plates.

JOHN GOEDART published a work in Dutch, which was afterwards translated into Latin: *Metamorphosis et Historia Naturalis Insectorum*, 3 volumes in 8vo, 1662-7, with plates. It contains some original facts, and the figures of the species are still recognisable.

MARCELLUS MALPIGHI was the author of some excellent treatises on the anatomy of insects. His *Dissertatio de Bombyce* explains the structure of the silk-worm. It forms a small volume of 100 pages 4to, with twelve plates, published in London in 1669, and is reprinted in the second volume of his *Opera Omnia*, 1686.

JOHN SWAMMERDAM, the most remarkable writer on the anatomy of insects, was a Dutch physician, born at Amsterdam in 1637. He died in 1680. He published a general history of insects in Dutch, about the year 1669, which was translated into both French and Latin. We may here observe, that the methodical arrangement of articulated animals, from the time of Aristotle and other ancient writers, down to so late a period as the days of the great Dutch observer, was extremely simple. The principal divisions were formed in relation to the medium which they inhabit, the presence, the consistence, and the number, of the feet and wings. But the work of Swammerdam, republished at Leyden in 1737-8, under the title of *Biblia Naturæ, sive Historia Insectorum in classes certas redacta*, &c. two volumes folio with plates, created an epoch in the science. The great merit of this remarkable writer consists in the light which he threw upon the mysteries of metamorphoses; and a marked character of his classification results from his having partly based it upon the nature of those transformations.

Swammerdam disposes of his articulated animals under four principal orders:—The first comprehends all insects (so called) which leave the egg in a completed state, and provided with all their members; they increase in size by degrees, and their metamorphoses consist, not in any striking transformation, but rather in a simple casting of the skin. He here places spiders, lice (of the structure of which he gives a very circumstantial account), ticks, wood-lice or *slaters*, entomostraca, scorpions, earth-worms, leeches, and others. His second order contains such as leave the egg with six feet, and arrive at the perfect state through the medium of nymphæ, of active habits, and furnished with the rudiments of wings. They become perfect by the casting of their skin, and the great and rapid expansion of their wings. Here we have the *Libellulæ* or dragon-flies, the *Nepæ* or water scorpions, the *Ephemera*, and other tribes, which, in the modern systems, are classed under the different orders of NEUROPTERA, ORTHOPTERA, and HEMIPTERA. Swammerdam's third order is composed of such insects as exhibit distinct members in the nymphæ state, but are incapable in that condition of locomotion, such as the coleopterous and hymenopterous tribes; he also here includes such as undergo a more complete metamorphosis, for example, the lepidopterous order, of the singular and previously unexplained transformations of which he gives an admirable account, by narrating his own observations on the nettle and cabbage butterflies. His fourth order comprehends those species which change into an egg-like or *obtect* chrysalis, and corresponds to the order DIPTERA of our modern systems. The work in general is of the greatest value in the study of the organization of insects, and abounds in curious facts illustrating the natural history and anatomy of animals. "It was a great point gained in the science," says Mr Kirby, "to introduce the consideration of the metamorphosis, and to employ it in the extrication of the natural system; for though when taken by itself it will, as in the table just given, lead to an artificial arrangement, it furnishes a very useful clue when the consideration of insects in their perfect state is added."¹

MARTIN LYSTER, an English naturalist, and physician to Queen Anne, died in 1711. He published in 1685 a methodical edition of Goedart, *cum Scarabæorum Anglicanorum quibusdam tabulis mutis*. He was a contemporary and coadjutor of Ray, and by his various writings threw great light on many points of Entomology. His character as an entomologist, or rather as an arachnologist, was, however, chiefly established by his excellent treatise *De Araneis*, in which he describes the spider tribes with great accuracy.

MADAME SIBILLA MERIAN, a Dutch lady of German family, was born in 1647, and died in 1717. She composed several entomological works, some of which were published posthumously. They are remarkable for the beauty of the plates; and being rare from the small number of examples thrown off, are rather sought after by the bibliographical naturalist. Their titles are, *Metamorphosis Insectorum Surinamensis*, Amstel. 1705;—*Erucarum Ortus, alimentum et paradoxa metamorphosis*, Amstel. 1718, with fifty plates. She also wrote a history of European insects, translated into French by M. Mairët, one vol. folio, 1730. There seem to be various editions of her works, in all of which, however, the plates are the same.

ANTONY LEUWENHOECK, a Dutch naturalist, famous

for his microscopical observations, and one of the improvers of the microscope itself, was born at Delft in 1632, and died in 1723. He published a work in five small 4to volumes; entitled *Arcana Naturæ, ope Microscopiorum detecta*, Delphis, 1695, 1721. His *Select Works* were published in English by Samuel Hoole, two vols. 4to, 1798. There is no arrangement in his works, the objects being described as they happened to occur; and though the style is rather tedious, from the laborious minuteness of his investigations, he has thrown great light upon the history of gall-insects, ants, bees, gnats, and the larvæ of the genus *Tenthredo*.

ANTONIO VALLISNIERI, an Italian naturalist, of a noble and ancient family, was born in 1661, and died in 1730. He was a man of learning, and an admirable observer and narrator. His first work was published at Venice in 1700, under the name of *Dialoghi sopra la curiosa origine, sviluppi e costumi di varii Insetti*. His collected works form three small folio volumes, with many plates, exceedingly well engraved, and contain a mass of interesting information, original at that period, and still held in estimation.

JOHN RAY, an English divine, was born in 1628, and died in 1705. He is admitted by Baron Cuvier to have been the first true methodiser of the animal kingdom, and the principal guide of Linnæus in that department of natural science. He published his *Methodus Insectorum, seu Insecta in methodum aliqualem digesta* in 1705; but his larger work, the *Historia Insectorum* (which, as appears from his *Philosophical Letters*, was a kind of joint production of his own and Willughby's) was published by Lister after his death.

About this same period Sir Hans Sloane flourished in England. His collections formed the original nucleus of the British Museum, and he greatly contributed, by his zeal and disinterestedness, to the general extension of knowledge in natural history.

ELEAZER ALBIN, an English painter, published a work under the title of *Insectorum Angliæ Naturalis Historia*, with notes and observations by W. Derham. London, 1731.

RENE-ANTOINE FERCHAULT DE REAUMUR, born in 1683, died in 1757, was the author of one of the most important works which has ever appeared on any branch of natural history. It bears the title of *Mémoires pour servir à l'Histoire des Insectes*, and is composed of 6 vols. in 4to, which made their appearance from 1734 to 1742. His skill and patience in the observance of the manners of insects have never been excelled, and the only objection to his incomparable work is its want of systematic arrangement. It contains numerous plates.

ALBERT SEBA, an apothecary of Amsterdam, born in 1665, died in 1736, published many figures of insects in his *Thesaurus*, a work in 4 folio volumes, Amsterdam, 1734, 1765. The plates are good, though badly coloured. The text is of no value. The author was a zealous and successful collector of objects in natural history.

CAROLUS LINNÆUS, "the immortal Swede," professor at Upsal, and the great founder or reformer of the modern systems and nomenclature of natural history, was born in 1707, and died in 1778. One of his many great merits consists in his having given *definitions* of those generic groups which his predecessors had merely distinguished by

¹ *Introduction to Entomology*, vol. iv. p. 431.

the imposition of vague *names*. Another noted excellence was the invention of *trivial* names. The older naturalists, as Mr Kirby has remarked, used to treasure in their memories a short description of each species, by which, when they desired to mention it, they made it known. For example, in speaking of our common Lady-bird, they would call it “the Coccinella with red coleoptra having seven black spots.” This long enunciation was first called the *titulus* or *title*, and afterwards the *nomen specificum*, or specific name. But as the number of species increased, it became no easy matter to remember even a few thousands of these definitions; and, with a view to remedy that inconvenience, Linnæus invented what is called the *nomen triviale*, which expresses any species by a single term added to its generic appellation, such as *Coccinella septem-punctata*, for the species just alluded to. In his definitions he confined himself to twelve words, a whimsical restriction, which, while it avoids prolixity, too often, in our now immensely swollen faunas, confounds the species, by rendering the same ex-

pressions applicable to several different kinds. He did not sufficiently bear in mind the hint of Horace,

.....Brevis esse laboro,
Obscurus fio.

Although his system is professedly artificial, his tact for the discovery of natural groups in general seems to have been almost intuitive.¹

The entomological system of Linnæus is founded on the presence or absence of the wings, their number, consistence, surface, respective position in repose, and the presence or absence of a sting. This classification, so far as the orders are concerned, has served as the basis of all that have been since promulgated; and it underwent various modifications and improvements in the course of the numerous editions of the *Systema Naturæ*, which were published in the author's life time. The following table presents a view of the entomological *orders* of the great Swedish naturalist.

Wings	4,	{ Superior	{ crustaceous, with a straight suture,	COLEOPTERA,	1st order.
			{ semicrustaceous, incumbent,	HEMIPTERA,	2d ...
		{ All	{ imbricated with scales,	LEPIDOPTERA,	3d ...
			{ membranous. Anus {unarmed } 		

JOHN LEONARD FRISCH, rector of the gymnasium of
Breslau, was born in 1666, and died in 1743. Besides his
well-known work on Birds, he wrote on German entomology,—*Beschreibung von Insecten in Teutschland*, 1 vol. in
4to, with plates, Berlin, 1730.

GEORGE EDWARDS, an English naturalist, and librarian to the College of Physicians, gave figures of several insects, both European and exotic, in his *Gleanings of Natural History*, a work which, along with the *Natural History of Rare Birds*, forms a single series (in 7 vols. 4to) of 362 plates, accurate and expressive, though not highly finished. The letter-press is of little value. Edwards was born in 1693, and died in 1773.

ROESEL DE ROSENHOF, a painter of Nuremberg, was born in 1705, and died in 1795. He was an ingenious and accurate observer, and represented subjects of natural history with fidelity. He published an entomological work, called *Insecten Belustigungen*, in 4 vols. 4to, with excellent coloured plates, Nurem. 1746, *et seq.* Besides the beauty of the illustrations, the author enters into many interesting details relating to the structure, the manners, and the metamorphoses of insects. A supplement (forming the 5th vol.) to Roesel's work was published by Kleeman, his son-in-law: *Beyträge zur Natur Oder Insecten geschichte*, Nuremb. 1761.

CHARLES BONNET, a noted philosopher and naturalist of Geneva, was born in 1720, died 1793. At twenty years of age he published an excellent Memoir on the Aphides, or *pucerons*, which is combined with many others in his *Traité d'Insectologie*. His works were published in 9 vols. 4to, in 1779. He was an excellent observer.

JACOB ADMIRAL published a Dutch folio on butterflies in 1740. It contains twenty-five coloured plates, deservedly esteemed by naturalists.

CHARLES DE GEER, a Swedish baron, marshal of the court, and member of the Academy of Stockholm, was

born in 1720, and died in 1778. His work is written in French, though published at Stockholm, in 7 vols. 4to, 1752-1778, and bears the same title as that of Réaumur, to which it may be regarded as a sequel. The first two volumes are rare, and a general abridgment of the whole was given by Rctzius in a Latin work entitled *Genera et Species Insectorum*, 1 vol. 4to, Lipsiæ, 1783. There is also a German translation, enlarged by Goetz.

These celebrated *Mémoires* are very similar in their scope to those of Réaumur; but they are conducted, especially the last five volumes, in a much more methodical manner. The first volume contains sixteen memoirs on caterpillars, and a seventeenth in which he describes their enemies the Ichneumonidæ, and other foes. The second volume is divided into two parts, and is devoted to the history of those insects which possess four naked wings; it is preceded by several general discourses on the habitations, food, generation, and transformations of insects. The same volume contains the insects with farinaceous wings; those with membranaceous wings, the mouth without teeth or trunk, which the author distinguishes from such as, likewise possessing membranaceous wings, are provided with teeth, and are inter-distinguished by the absence or possession of a sting. In the third volume we find the history and description of those four-winged insects of which the wings are sometimes entirely membranaceous, sometimes demicoriaceous, and provided with a beak or sucker; likewise of those which correspond to the orthopterous order. The fourth and fifth volumes contain the history of the coleopterous tribes, classed according to the number of the articulations of the tarsi. We may here note, that these volumes appeared in 1774-5, that is, ten years after Geoffroy's publication, to be afterwards mentioned, to which we owe the first establishment of the characters drawn from the articulations. The sixth volume is devoted to the dipterous or two-winged insects, and to the Coccus tribe or kermes. The seventh volume contains the history of the apterous insects. The system of De Geer, which is contained in a posthumous volume published in 1778, may be regarded as interme-

¹ *Introduction to Entomology*, vol. iv. p. 440.

diate between that of Linnæus and Fabricius, because, though based, like the former, upon the organs of flight, and in its ternary groups equivalent to the Linnæan orders, it likewise takes into consideration the parts of the mouth, or organs of manducation, and may thus, as Mr Kirby has remarked, have been the means of suggesting to the latter the first idea of assuming the last-mentioned instruments as the basis of a new method. "But though partaking of both, it is nearer to nature than either; and had its illustrious author laid less stress upon the number and substance of the organs of flight, it would probably have been as near perfection in this respect as most that have succeeded it. But following too strictly these

characters, he has been led to place in different classes, or rather orders, insects that ought not to have been so separated, as in the case of the two sections of the *Hemiptera* and the *Coccidæ*. In other respects, the whole of De Geer's *Mémoires* are a storehouse of valuable observations, in which he has furnished many a clue for threading the labyrinth of nature, and given most complete and interesting histories of the whole economy and habits of many tribes and genera, as of the *Trichoptera*, *Aphides*, *Ephemerina*, &c."¹ The importance attached, both actually and historically, to this celebrated system, induces us to present its principal features to the reader in the following tabular view.

GENERAL CLASSES.

ORDERS.

CLASSES.

INSECTS.	I. Having wings.	I. Four wings without wing-cases.	I. <i>Wings</i> covered with scales. <i>Tongue</i> spiral. LEPIDOPTERA.
			II. <i>Wings</i> membranous, naked. <i>Mouth</i> without teeth or tongue. TRICHOPTERA, EPHEMERINA.
			III. <i>Wings</i> membranous, equal, reticulated. <i>Mouth</i> with teeth. Rest of NEUROPTERA.
			IV. <i>Wings</i> membranous, unequal, nervures mostly longitudinal. <i>Mouth</i> with teeth. A <i>sting</i> or <i>borer</i> in the female. HYMENOPTERA.
			V. <i>Wings</i> membranous. <i>Tongue</i> bent beneath the breast. HOMOPTERA of Leach.
	II. Without wings.	II. Two wings covered by two wing-cases.	VI. <i>Elytra</i> half coriaceous and half membranous, crossed. A pair of membranous <i>wings</i> . <i>Tongue</i> bent beneath the breast. HEMIPTERA of Leach.
			VII. <i>Elytra</i> coriaceous or semi-crustaceous, aliform. A pair of membranous <i>wings</i> . <i>Mouth</i> with teeth. ORTHOPTERA.
			VIII. <i>Elytra</i> hard and crustaceous. A pair of membranous <i>wings</i> . <i>Mouth</i> with teeth. COLEOPTERA.
			IX. A pair of membranous <i>wings</i> . A pair of <i>poisers</i> . <i>Mouth</i> with a <i>tongue</i> without teeth. DIPTERA.
			X. A pair of membranous <i>wings</i> . No <i>poisers</i> , <i>tongue</i> , or <i>teeth</i> in the male. No <i>wings</i> , but a <i>tongue</i> in the breast of the female. Coccus, L.
		III. Two wings uncovered.	XI. No <i>wings</i> . Six <i>legs</i> . <i>Mouth</i> with a <i>tongue</i> . APHANIPTERA.
		IV. Undergoing a metamorphosis.	XII. No <i>wings</i> . Six <i>legs</i> . <i>Head</i> and <i>trunk</i> distinct. HEXAPOD APTERA, TERMES, PSOCUS.
		V. Undergoing no metamorphosis.	XIII. No <i>wings</i> . Eight or ten <i>legs</i> . <i>Head</i> united to the <i>trunk</i> . OCTOPOD APTERA, ARACHNIDA, CRUSTACEA.
			XIV. No <i>wings</i> . Fourteen <i>legs</i> or more. <i>Head</i> distinct from the <i>trunk</i> . POLYPOD APTERA, CRUSTACEA. ²

We shall merely add, that the two principal divisions of winged and apterous insects, divided into the fourteen orders above enumerated, comprised 1446 species, referable to 100 genera. How meagre such an amount appears when compared with the extended lists of modern days!

CHARLES CLERK, a Swedish painter, and a pupil of Linnæus, published a 4to volume in the Swedish and Latin languages, entitled *Aranei Suecici descriptionibus et figuris illustrati*, 1757, in which the habits of spiders are well described. He was also the author of *Icones Insectorum rariorum*, 1759-64, useful as an index to the Lepidoptera described by Linnæus from the collection of Queen Frederica Ulrica.

JOHN HENRY SULZER composed a work in German on the characters of insects, *Die Kennzeichen der Insecten*, with figures, 1 vol. 4to, Zurich, 1761.

PETER LYONNET, interpreting secretary to the united provinces, was born in 1707, and died in 1789. He was the author of the celebrated *Traité Anatomique de la Chenille de Saule*, 1 vol. 4to, 1762. He himself engraved the plates to the work, and both the letter-press and illustrations are masterpieces in their way. They were declared by the excellent Bonnet to afford a *demonstration* of the existence of God. Lyonnet was a man of fine accomplishments, spoke nine languages, and was one of the greatest insect anatomists that the world ever saw. The work above named is an extraordinary example of skill and patience. There are 4061 muscles enumerated as existing in the head, body, and around the intestines of the caterpillar of the *Cossus ligniperda*,—a number greater by about 3532 than is known to exist in the whole human body. Dr de Haan of Leyden has lately published a posthumous work of the same great observer, entitled *Recherches sur l'Anatomie et les Metamorphoses de différentes espèces d'Insectes*, 4to, 1st and 2d parts, Paris, 1832.

¹ Introduction to Entomology, p. 442.

² Ibid. p. 442.

CHR. SEPP is the author of a work in Dutch, on the insects of the Low Countries, entitled *Beschouwing der Wonderen Gods in de Minstgeachte Schepzelen of Nederlandsche Insecten*, 3 vols. 4to, Amsterdam, 1762, &c. This work came out originally in numbers, and perfect sets are now extremely rare. The plates, in Mr Swainson's opinion, have never been equalled, far less excelled, by the most successful efforts of modern art.

J. A. SCOPOLI, professor of botany and chemistry at Pavia, born in 1723, died in 1788. He was the author, among other works, of the *Entomologia Carniolica*, 1 vol. 8vo, 1763. The general arrangement of Scopoli, in his *Introductio ad Historiam Naturalem* (Pragæ, 1777), is bad; but his genera are frequently well grouped, and their characters judiciously constructed. Not a few of them may be found in more recent systems under other names. He appears to have published an incompleted sequel of plates to the work first named. It is but little known.

GEOFFROY, a celebrated French physician, was the author of the *Histoire abrégée des Insectes des Environs de Paris*, 2 vols. with plates, 1764. It is a methodical work, and deservedly esteemed by entomologists. His divisions, deduced from the characters of the wings, accord closely with those of Linnæus; but the Hymenoptera and Neuroptera are included in the same order, and the Orthoptera form only a section of the coleopterous tribes. He was the first to signalise and make use of the number of articulations of the tarsi, as we have already stated in our notice of De Geer. The *Entomologia Parisiensis*, 2 vols. 8vo, 1785, a youthful work of Fourcroy, the great French chemist, appears to be a mere abridgment of that above named.

JOHN CHRISTIAN SCHÆFFER, a clergyman of Ratisbonne, was born in 1718, and died in 1799. He published a large collection of plates of the insects of his own neighbourhood, *Icones Insectorum circa Ratisbonam Indigenorum*, 3 vols. 4to, 1769. The designations are those of Linnæus. The work is well executed, and presents a careful development of the most important characters. He also at the same time published a separate volume under the title of *Elementa Entomologica*, likewise with coloured plates, 135 in number. To these he added a supplement in 1777. Although the names of his classes are different, yet the classes themselves coincide with those of Geoffroy.

O. F. MULLER, among numerous noted works in other departments of natural history, published a *Fauna Insectorum Fredrichsdalina*. Hafniæ, 1764.

MARTIN THOMAS BRUNNICH, a Danish naturalist, and professor at Copenhagen, was the author of *Entomologia, sistens insectorum tabulas systematicas*, Hafniæ, 1764. It contains plates in outline, representing the characteristic parts of insects. In a short introduction he also presents a view of the structure of insects, and then furnishes us with a classification, not only of the insects themselves, but of entomologists, or *Insectistæ*, as he is pleased to call them. The reader may perhaps like to see his arrangement of these people. It is as follows:

I. Entomologists. A. COLLECTORS: 1°, Ancients or Fathers (Patres), such as Aristotle, Pliny, Dioscorides; 2°, Commentators, the same; 3°, Ichniographers or figurists, such as Goedart, Hoefnagel, Merian, Vallisnieri, Albin, Frisch; 4°, Metamorphosists, such as Swammerdam; 5°, Describers, such as Ray and Linnæus; 6°, Monographists, such as Lister, Schæffer, and Clerk; 7°, Curiosists,

such as Catesby, Ström, Pontoppidan; 8°, Museographers, such as Linnæus and Poda; 9°, Topographers, such as Albin and Frisch; 10°, Voyagers, such as Marcgrave, Rumphius, Sloane, Hasselquist, and Osbeck.—B. METHODISTS: divided into, 1°, Philosophers, such as Swammerdam, Réaumur, De Geer, and Linnæus; 2°, Systematists, the same; 3°, Nomenclators.

II. Entomophilists. 1°, Anatomists, such as Malpighi, Swammerdam, Leuwenhoeck, Lyonnet, &c.; 2°, Physicians, such as Dioscorides, Galen, Aldrovandus, Mathioli, Glauber, Dale, &c.; 3°, Miscellanei, such as Bochart, Lesser, Derham, &c.

Then follow the systematic and analytical tables which lead to the determination of the genera and sub-genera, by the successive and compared examination of the various parts of the bodies of insects.

J. E. VOET,—*Catalogue raisonné ou systematique du genre des Insectes qu'on appelle Coleoptérées*, 4to, Haye, 1766:—*Icones Insectorum Coleopterorum Synopsis, Observationibus Commentariisque perpetuo illustravit* D. W. F. Panzer, 4to, Erlangæ, 1794. The plates are characteristic of the species,—the letter-press is of little value.

J. R. FORSTER, born at Dirchaw in Polish Prussia, died in 1798, was the companion of our great circumnavigator Cook. In our present department he published *Novæ species Insectorum Centuria*, 1 vol. 8vo, Lond. 1771;—and a *Catalogue of British Insects*, 8vo, Warrington, 1770.

BENJAMIN WILKES published *One hundred and twenty copperplates of English Moths and Butterflies*, 4to, London, 1773.

PETER SIMON PALLAS, one of the greatest zoologists of modern times, was born at Berlin in 1741, and died in 1812. He was a copious writer, but his only entomological work with which we are acquainted is the *Icones Insectorum, præsertim Rossicæ Sibericæque peculiarum*, published in a small 4to volume at Erlangen in 1781. He spent most of his life under the patronage of the Russian government.

D. DRURY, an English goldsmith, collected a fine cabinet of insects, and published a work in 3 vols. 4to, entitled *Illustrations of Natural History*, 1770–82. It has scarcely been surpassed in beauty, and accuracy of execution, even by the more sumptuous efforts of the present day. The figures are by Moses Harris.

MARIE DOMINIQUE JOSEPH ENGRAMELLE, an Augustine friar of Paris, was born in 1727, and died in 1780. He is known as the author of the descriptive portion of a noted work, the *Papillons d'Europe*, published in eight volumes small folio, containing many hundreds of coloured plates, from 1779 to 1793. The text is held in no great estimation, but the plates are faithful, and generally represent the species in their various states. They were executed after drawings by Ernst, an artisan of Strasburg, who possessed an extraordinary and self-acquired talent for the representation of lepidopterous insects.

PETER CRAMER, a merchant of Amsterdam, was the author of another magnificent work on Lepidoptera, entitled *Papillons exotiques des trois parties du Monde, l'Asie, l'Afrique, et l'Amerique*. It is written in Dutch and French, consists of 4 vols. 4to, and contains 400 coloured plates. Dated from 1779 to 1782. There is a supplementary volume to the above by Casper Stoll, a Dutch physician. It was published at Amsterdam (in Dutch and French) in

1 vol. 4to, 1790 *et seq.*, and contains many interesting representations of insects in their larva and pupa states. In execution these works are inferior to those of Harris, but they are nevertheless highly esteemed by amateurs of books in natural history.

JOHN CHRISTIAN FABRICIUS, a pupil of Linnæus, and professor of natural history and rural economy at Kiel, in Holstein, was born at Tundern, in the duchy of Sleswick, in 1742, and died in 1807. He was one of the greatest entomologists of modern times, and published numerous systematic works on insects. The important influence which his writings exercised on the science renders it desirable that we should present an account, however brief, of his performances, and of the principles on which they were conceived and executed.

The entomological system of Fabricius is founded on the number, proportion, form, and situation of the parts which constitute the mouth of insects, and is hence not unfrequently known under the name of the *cibarian* or *maxillary* system. His intention appears to have been to effect for entomology what his great master had done for botany, by erecting his system upon a fixed and restricted foundation; and as Linnæus had assumed the fructification of plants for his botanical basis, so the entomologist of Kiel, perceiving no doubt how important was the employment of the teeth and jaws in the classification of the vertebrated tribes, determined to make use of the analogous organs, so much more varied and numerous in the insect world. De Geer had previously employed the parts of the mouth, in addition to the organs of flight; but Fabricius followed out the system both more minutely and with greater extension, and adopted the *trophæ*, or parts of the mouth, as the sole support of his superstructure. "Though nothing," observes Mr Kirby, "seems to have been farther from his intention than to follow Nature, since he complains that Linné, by following her too closely, had lost the Ariadnean thread of system,¹ yet it is singular that, by building upon this seemingly narrow foundation, he has furnished a clue, by the due use of which, instead of deserting her, his successors have been enabled with more certainty to extricate her groups; since the parts in question, being intimately connected with the functions and economy of these animals, where they differ materially, indicate a corresponding difference in their character and station."

The foundations of this new system were first exhibited in his *Systema Entomologiæ, sistens Insectorum classes, ordines, genera, et species*, 1 vol. 8vo, 1775. In the ensuing year he published his *Genera Insectorum*, and his *Philosophia Entomologica* appeared in 1778. In 1781 he put forth his *Species Insectorum*, in 2 vols. 8vo; and to these, at an after period, was added a kind of supplement, with the title of *Mantissa Insectorum, sistens eorum species nuper detectas*, likewise in two 8vo volumes. From 1792 to 1796 he published the same works, remodelled and amended, under the name of *Entomologia systematica emendata et aucta*, 4 vols. 8vo; and to these a supplementary volume was added in 1798. His systems of the different orders, or *classes*, as he has chosen to name the primary groups, then made their appearance, each in a separate form, according to the following titles and dates: *Systema Eleutheratorum* (Coleoptera), 2 vols. 8vo, 1801; *Systema Rhynogotorum* (Hemiptera), 1 vol. 8vo, same year; *Systema Piezatorum* (Hymenoptera), 1 vol. 8vo, 1804; *Systema Anthiatorum* (Diptera), 1 vol. 8vo, 1805. The *Systema Glossatorum* (Lepidoptera) was on the eve of publication

when the author was removed from his accustomed sphere of action, and called to that tribunal which awaits entomologists in common with other men. Illiger has given us an extract from it in his *Magazin für Insektenkunde*, and the English reader will find it exhibited in the *Philosophical Magazine and Annals* for February 1830. The publication of so great a number of works proves the devoted constancy of the author, and his unwearied desire to perfect his favourite department of science.

E. T. C. ESPER, professor at Erlangen, published, from 1777 to 1794, a great work on the Lepidoptera of Europe, under the name of *Europäische Schmetterlinge*, 5 vols. 4to, of which the first and fourth are divided into two. The figures are exact and well coloured, and although the publication was never brought to a conclusion, it is highly prized by naturalists, even in its incompleted state.

CASPAR STOLL, formerly mentioned as the author of a *Supplement* to Cramer's *Papillons Exotiques*, also published some excellent figures of hemipterous and orthopterous species. His *Représentation exactement coloriée d'après Nature, des Spectres, des Mantes, des Sauterelles, &c.* consists of eight numbers 4to (Dutch and French), 1787, *et seq.* There are ten numbers of his other work, entitled *Représentation exactement coloriée d'après Nature, des Cigales et des Punaises*. These two works are of great value, on account of the figures of the very singular tribes of which they treat; but the letter-press is defective in point of observation, and faulty in its synonyms.

MOSES HARRIS, an English painter, and naturalist of the old school, is known as the author of *An Exposition of English Insects*, in English and French, 1 vol. 4to, with coloured figures, London, 1781. He also wrote *The Aurelian, or Natural History of English Insects, namely, Moths and Butterflies*, folio, Lond. 1778; and was the author of an earlier and more portable volume, entitled *The English Lepidoptera, or the Aurelian's Pocket Companion*, 8vo, Lond. 1775. Harris was a first-rate entomological artist.

F. DE P. SCHRANK, a Bavarian naturalist, born in 1747, professor at Ingoldstadt, published, under the unassuming title of a catalogue of Austrian Insects, *Enumeratio Insectorum Austriæ indigenorum*, a large 8vo volume, in 1781. This work is remarkable for a careful synonymy, and the exactness of its descriptions. The Lepidoptera are intentionally omitted, that order having been taken up, over the same territory, by Schrank's compatriot Schiffermüller.

I. N. DE LAICHARTING, professor at Inspruck, born 1747, wrote upon the insects of Tyrol,—*Verzeichniss der Tyrolen Insecten*, 2 vols. 8vo, with plates, Zurich, 1781-4. It appears to contain only Coleoptera.

DOMINIQUE CIRILLO, a Neapolitan physician, unfortunately executed for a misdemeanour in 1796, was the author of a work in 1 vol. folio, with coloured plates, entitled *Entomologiæ Neapolitanæ specimen*, 1787.

VINCENT PETAGNA, another Neapolitan, composed a work on the *Elements of Zoology*, in 2 vols. 8vo. He also wrote *Specimen Insectorum Ulterioris Calabriae*, in 4to, Frankfort, 1787.

CHARLES DE VILLERS, a naturalist of Lyons, is the author of *C. Linnæi Entomologia*, in 4 vols. 8vo, with re-

¹ *Philos. Entomolog.* vi. sect. 2; *Syst. Ent.* Prolegom.

spectable plates, Lugduni, 1789. This compilation was useful in its time, and contains additional descriptions of many species characteristic of the southern departments of France.

JOHN CHARLES ROEMER is the compiler of *Genera Insectorum*, Linnæi et Fabricii, Iconibus illustrata, 1 vol. 4to, 1789. This is chiefly a revised edition of Sulzer's *Kennzeichen der Insecten*, with some additional plates.

CHARLES PETER THUNBERG, professor at Upsal, was born in 1743. He travelled in Africa and Japan, and published descriptions of many Swedish insects. He was also the author of *Characteres generum Insectorum*, reprinted at Gottingen, with notes by Meyer, in 1791.

PIETRO ROSSI, an Italian naturalist, professor at Pisa, now deceased, composed the *Fauna Etrusca, sistens Insecta quæ in Provinciis Florentina et Pisana præsertim collegit Petrus Rossius*, &c. 2 vols. in 4to, with coloured plates, Liburn. 1790;—also *Mantissa Insectorum, exhibens species nuper in Etruria collectas a Petro Rossio*, &c. 2 vols. 4to, with coloured plates, Pisa, 1792–1794.

DR GEORGE SHAW, of the British Museum, has done more in the way of compilation than of original description. He is the author of the *Naturalist's Miscellany*, consisting of above 260 numbers, Lond. 1789, *et seq.*; of *General Zoology*, in 14 vols. 8vo (of which the latter form a continuation by Mr Stephens); and of two volumes in 8vo, called *Zoological Lectures*. His works contain numerous figures,—la plupart copiées, as observed by Baron Cuvier.

ANTOINE GUILLAUME OLIVIER, member of the Academy of Sciences, professor of zoology at the veterinary school of Alfort, was born at Draguignan in 1756, and died in 1814. Besides his *Voyage dans l'Empire Ottoman, l'Egypte, et la Perse*, 3 vols. 4to, 1807, he wrote two important works on entomology: 1st, The subject *Insectes*, of the *Encyclopédie Méthodique*, 4 vols. 4to. In this voluminous article he follows the principles of the Linnæan classification, with certain modifications from the works of Geoffroy, Schœffer, and De Geer. He draws his primary characters from the number and consistence of the wings and elytra, and he then makes use of the wings, along with the parts of the mouth and the articulations of the tarsi, for his secondary subdivisions. The following is his nomenclature and arrangement of the orders:—Lepidoptera, Neuroptera, Hymenoptera, Hemiptera, Orthoptera (this is his own denomination, now generally received, and substituted by Olivier for the term Dermaptera used by De Geer), Coleoptera, Diptera, and Aptera. Each of these orders is divided into many sections. In the last-named order are comprehended all those insects of which the mouth is variable, but which have no wings in either sex. Of these some have six feet (pediculi), others eight (spiders),—while a great number (crabs and Julidæ) have a still greater number. We may here note, in regard to the entomological portion of the *Encyclopédie Méthodique*, that several other authors have contributed to its later volumes. Of these we may name more particularly MM. Adolphe Brogniart, Latreille, Lepelletier de St Fargeau, De Serville, Desmarests, and Godard. 2d, The other great work of Olivier is the *Histoire Naturelle des Coléoptères*, in six large 4to volumes, containing 363 coloured plates, and 3162 historical and descriptive pages. It appeared at intervals from 1789 to 1808. It is a work of authority, ably executed, and professes to describe and figure all the known species of the period. Vast additions have been made to entomology since the time of its conclusion, but it still presents the

largest collection of coloured representations of the coleopterous order which we yet possess. In the later portions, the number of species in certain genera having greatly increased, the author was obliged to depart from his original plan of including all the known kinds. This is chiefly perceptible in the great families of *Curculionidæ* and *Chrysomelidæ*.

JOHN DANIEL PREYSLER wrote *Verzeichniss Boehmischer Insecten*, 1 vol. 4to, Prag. 1790.

JOHN BERKENHOUT, M. D. in his *Synopsis of the Natural History of Great Britain and Ireland*, 2 vols. 8vo, Lond. 1795, enumerates our native insects.

WILLIAM LEWIN, F. L. S. was the author of *The Papilios of Great Britain systematically arranged and painted from Nature*, 1 vol. 4to, Lond. 1795.

DAVID HENRY HOPPE, an apothecary of Ratisbon, was the author of *Enumeratio Insectorum elytratorum indigenorum*, with coloured plates, Erlangæ, 1795,—a work with which we are not acquainted, but which is said to be a useful auxiliary in the study of the genus *Donacia*.

SIR JAMES EDWARD SMITH, our great Linnæan botanist, is connected with entomology as having published *The Natural History of the rarer Lepidopterous Insects of Georgia, collected from the Drawings and Observations of Mr John Abbot*, 2 vols. fol. Lond. 1797. "The plates are the last and best of Harris's performance."—Swainson.

LEONARD DE PRUNNER is the author of *Lepidoptera Pedemontana*, 1 vol. 8vo, Turin, 1798.

ANTOINE JEAN COQUEBERT, a naturalist established at Rheims, besides various notices in the *Bulletin des Sciences*, is known as the author of *Illustratio iconographica Insectorum quæ in Musæis Parisinis observavit, J. Chr. Fabricius*, 3 decad. in 4to, Paris, 1799–1804.

CHRISTIAN CREUTZER published *Entomological Essays*, in German (*Entomologische versuche*), 8vo, with coloured figures, Vienna, 1799.

PIERRE ANDRE LATREILLE, of the Royal Academy of Sciences, &c. was born at Brives in 1762, and died in 1833. The importance attached to the numerous productions of this "Prince of Entomologists," as he is called by Comte Dejean, inclines us to present the reader with a short historical sketch of the principles and progressive improvement of his system, in combination with our chronological notice of his various volumes.

Latreille's first work was published at Brives in 1796, under the title of *Precis des caractères génériques des Insectes, disposés dans un ordre naturel*, 1 vol. 8vo. He there divides the insecta of Linnæus into fourteen classes, of which the first seven comprehend such as are winged, and are ranged in the following orders: Coleoptera, Orthoptera, Hemiptera, Neuroptera, Hymenoptera, Lepidoptera, and Diptera. The other seven classes are apterous, or without wings, and are named and characterised as follows: 1°, Les Suceurs, *Suctoria* (Rhynchota of Fabricius),—head distinct, antenniferous, trunk articulated, enclosing a sucker of two bristles; two scales at the base; six feet: 2°, Les Thysanoures, *Thysanoura* (Synistata of Fab.),—head distinct, antenniferous; mouth furnished with mandibles, a pair of maxillæ, an upper and an under lip, and antennulæ (palpi); six feet;—here are ranged *Lepisma*, *Forbicina*, and *Podura*: 3°, Les Parasites, *Parasiti* (Antliata, Fab.),—head distinct, antenniferous; a

very short tube enclosing a sucker; in some a slight appearance of mandibles or maxillæ; six feet;—*Ricinus* and *Pediculus*: 4°, *Les Acéphales*, *Acephala* (*Unogata* et *Antiliata* of Fab.),—organs of the mouth appearing to replace the head; no antennæ; from six to eight feet (this is the class since distinguished by the name of *Arachnides*, and already discussed under that title in this *Encyclopædia*): 5°, *Les Entomostracés*, *Entomostraca* of Müller (*Synistata* et *Agonata*, Fab.),—head confounded with the body, which is inclined under a covering of one or two pieces; antennæ frequently branched, mandibles without antennulæ; two ranges at most of maxillary leaflets; no under lip; generally from six to eight feet;—*Monoculus*, *Cypris*, *Cytherea*, *Daphnia*, *Argulus*, *Limulus*, &c.: 6°, *Les Crustacés*, *Crustacea* (*Agonata*, Fab.),—head confounded with the body, which is usually enclosed beneath a carapace; four antennæ; many ranges of maxillary leaflets, of which two are inserted and couched upon the mandibles; no lips; generally ten feet: 7°, *Les Myriapodes*, *Myriapoda* (*Synistata*, *Mitosata*, *Unogata*, Fab.),—head distinct from the body, antenniferous; mandibles with a conical advancement at their base; scaly teeth implanted on the contour of the extremity; two rows of maxillæ at most; an under lip; fourteen feet, or more;—*Asellus*, *Cyamus*, *Oniscus*, *Julus*, *Scolopendra*.

Latreille's next publication was the *Histoire générale et particulière des Crustacés et des Insectes*, 14 vols. 8vo, with figures, 1802–5. It forms a portion of the edition of Buffon's works published by Sonnini. His *Genera Crustaceorum et Insectorum*, 4 vols. 8vo, was published in 1806–7, and contains a further, and certainly very skilful development of what he regarded as a natural system. In 1810 appeared his *Considérations générales sur l'ordre naturel des animaux composant les classes des Crustacés, des Arachnides, et des Insectes, avec un tableau méthodique de leurs genres distribués en familles*, 1 vol. in 8vo. It may be regarded as a review of his last-mentioned work, of the material parts of which it proposes few alterations,—but the groups are fewer in number, and are sometimes founded on more rigorous characters. We shall here give a brief abstract of his classification at this time. The Linnæan class *Insecta* is divided into three distinct classes—*Crustacea*, *Arachnides*, and *Insecta* properly so called. It is of course with the latter only that we are now concerned. He divides them into eight orders—*Coleoptera*, *Orthoptera*, *Hemiptera*, *Neuroptera*, *Hymenoptera*, *Lepidoptera*, *Diptera*, and *Suctoria*.

1st, The *COLEOPTERA* are divided into five sections: 1. *Pentamera*, including nineteen families, viz. *Cicindeletæ*, *Carabici*, *Hydrocanthari*, *Gyrinites*, *Sternoxi*, *Malacodermi*, *Clerii*, *Necrophagi*, *Staphylinii*, *Palpatores*, *Ptiniore*, *Dermestini*, *Byrrhii*, *Hydrophilii*, *Sphæridiota*, *Coprophagi*, *Geotrupini*, *Scarabæides*, and *Lucanides*: 2. *Heteromera*, including six families, viz. *Pimeliariæ*, *Tenebrionites*, *Pyrochroides*, *Mordellonæ*, *Cantharidiæ*, and *Cedemeritæ*: 3. *Tetramera*, including ten families, viz. *Bruchelæ*, *Curculionites*, *Bostrichini*, *Paussili*, *Xylophagi*, *Cucujupes*, *Cerambycini*, *Criocerides*, *Chrysomelinæ*, and *Erotylenæ*: 4. *Trimeræ*, including the family of *Coccinellidæ*: 5. *Dimera*, including that of the *Pselaphii*.

2d, The order *ORTHOPTERA* contains six families, viz. *Forficulariæ*, *Blattariæ*, *Mantides*, *Gryllides*, *Locustariæ*, and *Acrydii*.

3d, The order *HEMIPTERA* is composed of two sections: 1. *Heteroptera*, containing the three families, *Corisiæ*, *Cimicidæ*, and *Hydrocorisæ*: 2. *Homoptera*, containing the four families of *Cicadariæ*, *Psillidæ*, *Aphidii*, and *Gallinsecta*.

4th, The order *NEUROPTERA* is likewise bisected: 1. *Subulicornes*, consisting of two families, *Libellulinæ*,

Ephemerinæ: 2. *Filicornes*, consisting of nine families, *Panorpata*, *Myrmeleonides*, *Hemerobini*, *Megaloptera*, *Raphidinæ*, *Termitinæ*, *Psoquillæ*, *Perlariæ*, and *Phryganites*.

5th, The order *HYMENOPTERA* also forms two sections: 1. *Terebrantia*, including eight families, viz. *Tenthredinæ*, *Urocerata*, *Evaniales*, *Ichneumonides*, *Diplolepariæ*, *Cynipsera*, *Proctotrupii*, and *Chrysidides*: 2. *Aculeata*, including thirteen families, viz. *Formicariæ*, *Mutillariæ*, *Scolietæ*, *Sapygitæ*, *Pompilii*, *Sphegimæ*, *Bembecides*, *Larratæ*, *Crabronites*, *Vespiariæ*, *Masarides*, *Andrenetæ*, and *Apiariæ*.

6th, The order *LEPIDOPTERA* is divided into three sections: 1. *Diurna*, composed of two families, *Papilionides* and *Hesperides*: 2. *Crepuscularia*, also composed of two families, *Sphingides* and *Zygenides*: 3. *Nocturna*, composed of eight families, *Bombycites*, *Noctuo-bombycites*, *Teneites*, *Noctuælitæ*, *Phalænites*, *Pyalites*, *Crambites*, and *Pterophorites*.

7th, The order *DIPTERA* comprises three sections: 1. *Proboscidea*, consisting of fourteen families, *Tipulariæ*, *Stratiomydæ*, *Tabani*, *Rhagionides*, *Dolichopodes*, *Mydasii*, *Asilici*, *Empides*, *Anthracii*, *Bombyliarii*, *Inflata*, *Syrphiæ*, *Conopsariæ*, *Muscides*: 2. *Eproboscidea*, containing the family *Coriaceæ*: 3. *Pthiromyia*, including merely the genus *Nycteribia*.

8th, The order *SUCTORIA* is formed entirely by the genus *Pulex*.

In the year 1817 the *Règne Animal distribué d'après son organisation*, &c. was published by Baron Cuvier, in 4 vols. 8vo. Of that signal work the entomological portion, forming volume third, was contributed by M. Latreille. In addition to the preceding works, he had also at different times contributed a great proportion of the articles on entomology in the first and second editions of the *Nouveau Dictionnaire d'Histoire Naturelle*. He was likewise the author of many papers in the *Annales du Muséum*, the *Encyclopédie Méthodique*, and in the *Dictionnaire Classique d'Histoire Naturelle*, as well as of a separate volume of papers (chiefly, however, extracted from his previous labours in the *Ann. du Mus.*) entitled *Mémoires sur divers sujets de l'Histoire Naturelle des Insectes*, &c. &c. 8vo. 1819. In 1825 he published his *Familles Naturelles du Règne Animal*, which contains a compendious summary of zoological classification, and an arrangement of the insect tribes. In 1829 he gave to the world his completed views on entomological arrangement in the third and fourth volumes of the second edition of the *Règne Animal* of Cuvier. As it is by this final exposition that we are chiefly guided in the systematic portion of the ensuing treatise, we need not here enter into further details. Before proceeding, however, with our catalogue of authors, we may remark, that an excellent, and, we believe, novel feature in the system of Latreille consists in the bestowal of family names upon the groups of genera. The modern families correspond in numerous instances to the old and undivided genera of Linnæus; and when, in the progress of improvement, and the great increase in the number and nature of species, it became necessary to subdivide these genera into others of a less comprehensive character, the retention of the old generic name with a different termination, and its application as a comprehensive term to all the cognate genera, was an ingenious and useful device.

The practice, indeed, was previously well known in other departments of natural history, but it does not appear to have been properly applied to Entomology prior to the example of Latreille. There is a want of uniformity, however, in the nomenclature of his families, so that, unless his work is kept in hand, we cannot ascertain from

the name of a group whether it signifies an actual family, or some other sectional division. To remedy this defect, Mr Macleay, in his *Horæ Entomologicæ*, follows the suggestion of Mr Kirby, and designates his family groups by the patronymic termination in *idæ*, which, though not classically correct when the primitive has a feminine termination, is preferable to any other plan, both for uniformity's sake, and *euphoniæ gratia*. The latest work by M. Latreille with which we are acquainted is his *Cours d'Entomologie*, an uncompleted publication, in one volume 8vo, 1831.

GEORGE WOLFGANG FRANCIS PANZER of Nuremberg, born in 1755, is the author of several excellent works on Entomology, of which the earliest is the most important. It is called *Deutschlands Insekten*, or *Faunæ Insectorum Germanicæ initia*, and has continued to be published at intervals between the years 1793 and the present time. It is composed of numerous *cahiers*, or small collections of unstitched leaves, each of which corresponds to a coloured plate of an insect, of which it bears the description. According to this plan, the figures and letter-press may be arranged according to any system preferred by the possessor of the work. Each fasciculus contains the figures and descriptions of twenty-four species of insects; and as the fasciculi (continued, we believe, by Ahrens and Germar) now amount to above 120, the total number represented and described is great. It is consequently one of the most extensive collections which we possess in this branch of science; and as the plates are extremely correct, and the synonyms carefully selected, it may be regarded as a publication of the highest value of its kind. "The figures are drawn and etched by the famous Sturm, the best entomological artist on the Continent, and are simply but accurately coloured,—while the descriptions, although frequently too short, are written by the hand of a master." (Swainson.¹) Panzer has published several other

works on insects, of which we shall here make mention of only two, that on the Hymenoptera, entitled *Entomologischen versuch über die Turineschen Gattungen der Linneischen Hymenoptern*, 1 vol. in 12mo, 1806; and the *Index Entomologicus, pars prima, Eleutherata*, same form, 1813. This author has confined himself to the description of the external aspect of insects, and does not appear to have devoted himself at any time to the observance of manners, or the examination of internal structure. Non omnia possumus omnes.

AUGUSTUS WILLIAM KNOCK, a professor at Brunswick, formed a collection of insects, which now composes a portion of the Royal Museum of Berlin. He is author of *Neue beyträge zur Insektenkunde*, 1 vol. in 8vo, with figures, Leipsic, 1801.

JAMES HENRY LASPEYRES, a municipal officer of Berlin, composed a work entitled *Sesie Europeæ iconibus et descriptionibus illustrata*, 1 vol. 4to, 1801. He is likewise the author of *Critical Observations on the Systematic Catalogue of the Lepidoptera of the environs of Vienna*, inserted in Illiger's *Magazin*.

CLAIRVILLE, an Englishman, as we understand, by birth, but an inhabitant of Switzerland, published a work in French and German, called *Entomologie Helvétique*, 2 vols. 8vo, with excellent figures. Indeed Schellenberg the engraver was his colleague in the undertaking. Both volumes were printed at Zurich, the first in 1798, the second in 1806. The chief defect of this work consists in the entire and unnecessary change in the nomenclature of his predecessors, affected by the author, as will be seen by the following analytical table of his systematic arrangement. We add the ordinary names of the orders, which he is pleased to regard in the light of sectional divisions.

SECTIONS.

INSECTA.	{ Pterophora, winged.	{ Mandibulata.	1. Elytroptera: crustaceous wings. (Coleoptera.)
			2. Deratoptera: coriaceous wings. (Orthoptera.)
	{ Aptera, wingless.	{ Haustellata.	3. Dictyoptera: reticulated wings. (Neuroptera.)
			4. Phlebotoptera: veined wings. (Hymenoptera.)
			5. Halteriptera: wings with poiscrs. (Diptera.)
			6. Lepidoptera: scaly wings. (Lepidoptera.)
			7. Hemimeroptera: mixed wings. (Hemiptera.)
			8. Rophoteira: suckers.
			9. Pododunera: runners.

Clairville's work is not complete in the description of genera and species. The first volume, indeed, contains only the coleopterous family of the Curculionidæ, and is furnished with sixteen plates illustrative of eleven genera. It is a minutely laboured publication, beautifully executed, but more sumptuous than accurate in its typography.

JOHN FREDERICK WILLIAM HERBST, a preacher at Berlin, born 1743;—*Natursystem aller bekanten in und Ausländischen Insekten*, &c. von. Carl. Gustaf Jablonsky forgesetz, von J. F. W. Herbst, 10 vols. 8vo, with coloured plates, Berlin, 1785 and following years.

J. CASP. FUESSLY published *Archiv der Insekten geschichte*, 1 vol. 4to, with coloured plates, 1781–6. There is a French translation, with the same plates, Winterthour, 1794.

WILLIAM LEWIN, F. L. S. contributed to Entomology *The Insects of Great Britain*, 1 vol. 4to, London, 1795. It contains the *Papiliones* only.

FREDERICK WEBER, a German naturalist, and professor at Kiel, wrote *Observationes Entomologicæ*, 1 vol. 8vo, Kiel, 1801.

J. C. G. ILLIGER, professor at Berlin, an excellent naturalist, who died in early life. He terminated the catalogue of Prussian insects commenced by Theophilus Kugelann, under the title of *Verzeichniss der Käfer Preussens*, 1 vol. 8vo, 1798. Between 1801 and 1807 he published the *Magazin für Insektenkunde*, 7 vols. 8vo; and during that first-mentioned year his *Systematisches Verzeichniss von den Schmetterlingen der Wiener gegend*, in two vols. 8vo, likewise made its appearance. It is a revised edition of

¹ In *Preliminary Discourse on the Study of Natural History*, p. 71.

the systematic catalogue of the environs of Vienna. Illiger continued the edition of the *Fauna Etrusca* of Rossi, commenced by Hellwig, in 8vo, Helmstadt, 1807.

JOHN FREDERICK WOLFF, a German physician, has published four fasciculi of a work entitled *Icones Cimicum descriptionibus illustratæ*, in 4to, Erlangæ, 1804.

THOMAS MARSHAM, an English entomologist, is well known as the author of *Entomologia Britannica, sistens Insecta Britannicæ indigena secundum methodum Linnæanæ disposita*, t. 1, Coleoptera, 8vo, Lond. 1802. It is a meritorious publication for the period, and has been serviceable to the science; but prodigious advances have been made in all the departments of British Entomology since the time of its appearance. Marsham also published a *Monograph of the genus Notoclea*, in the 9th vol. of the *Linn. Trans.* These insects are peculiar to New Holland, and are now better known under the name of *Paropsis*, bestowed upon them by Olivier.

WILLIAM KIRBY, A. M. &c. author of *Monographia Apum Angliæ*, 2 vols. 8vo, Ipswich, 1802, and (jointly with Mr Spence) of *Introduction to Entomology*, 4 vols. 8vo, London, 1815-26. These admirable works are too well known to require our praise. The latter has been the chief means of producing whatever may exist of a general taste for Entomology in Britain. Mr Kirby is likewise the author of several minor, but not less meritorious, contributions. Of these we shall here name only the following:—*The genus Apion of Herbst's Natursystem considered*, &c. *Linn. Trans.* vol. 9th, p. 1;—*Strepsiptera, a new order of Insects proposed, and the characters of the order, with those of its genera, laid down*, *ibid.* vol. 11th, p. 86;—*A Century of Insects, including several new genera*, &c.;—and *A description of several new species of Insects collected in New Holland*, *ibid.* vol. 12th, pp. 375-454.

WILLIAM SPENCE, F. L. S., &c., Mr Kirby's able and accomplished coadjutor in the principal work above named, is also the author of various minor essays in entomology, of which we shall name merely his *Monograph of the British species of the genus Choleva*, *Linn. Trans.* vol. 11th, p. 123.

ADRIAN HARDY HAWORTH was the author of *Lepidoptera Britannica*, 8vo, 1803, a standard work on the subject of which it treats, even at the present day.

J. R. SCHELLENBERG, a painter and engraver of Zurich, is known to entomologists as professionally connected with two works, of which the text is anonymous. *Cimicum in Helviæ aquis et terris degens genus*, 1 vol. 8vo, with figures, Turici, 1800; *Genus des Mouches diptères*, 1 vol. 8vo, in French and German, with coloured plates, Zurich, 1803.

JOHN WILLIAM LEWIN, an English painter, son of William Lewin, already mentioned, published a *Natural History of Lepidopterous Insects of New South Wales*, 1 vol. 4to, with coloured plates, London, 1805.

GASPARD DUFTSCHMID has published descriptions of numerous families of Coleoptera in his *Fauna Austriæ*, 2 vols. 1805-12.

A. A. H. LICHTENSTEIN, a professor of oriental languages at Hamburg, published *A Dissertation on Two Natural Genera hitherto confounded under the name of Mantis*, in the 6th vol. of the *Linn. Trans.*

PALISOT, Baron de Beauvois, of the Academy of Scien-

ces, was born in 1755, and died in 1820. He is the author of a handsome work in folio, with coloured plates, entitled *Insectes recueillis en Afrique et en Amerique*, &c. Paris, 1805 et seq.

HENRY SMEATHMAN has published a *History of the Termites or White Ants*, in the 71st volume of the *Philosophical Transactions*.

MAXIMILIAN SPINOLA, a Genoese of noble birth, and an accomplished naturalist, is the author of *Insectorum Liguria species novæ aut rariores*, 2 vols. in 4to, with figures, Gen. 1806-1808. To him we also owe an *Essai d'une nouvelle classification générale des Diplolépaires*, in the *Ann. du Mus. d'Hist. Nat.*

CHRISTIAN STEVEN, director of the imperial botanic garden of Odessa, has published a *Description de quelques Insectes de Caucase et de la Russie Meridionale*, in the *Mém. de la Soc. Imper. des Naturalistes de Moscou*, t. ii.

P. L. VANDER LINDEN (lately deceased), professor of natural history at Brussels, has published two Latin memoirs in 4to, containing descriptions of the *Libellulidæ* of the territory of Bologna, and also an octavo volume containing descriptions of all the species of that family found in Europe. He has moreover furnished the three following communications to the *Annales Générales des Sciences Physiques*, Brussels, 1819 et seq.: *Observations sur les Hyménoptères d'Europe, de la famille des Fouisseurs*: the first fasciculus of a work entitled *Essai sur les Insectes de Java et des îles voisines*: *Notice sur une empreinte d'Insecte renfermée dans un calcaire schisteux de Solenhofen en Bavière*.

GUSTAVUS PAYKUL, a royal councillor, and member of the academy of Stockholm, is the author of several very valuable works. His earlier publications were monographs of the genera *Carabus*, *Curculio*, and *Staphylinus*, afterwards incorporated in his *Fauna Suecica (Insecta)*, 3 vols. 8vo, Upsal, 1800. These contain only the coleopterous tribes. The descriptions are careful and complete. Of the same author, the *Monographia Histeroidum*, 1 vol. 8vo, Upsal, 1811, is deservedly held in the highest estimation.

H. M. GAEDE has published *Beytrage zur Anatomie der Insekten*, &c. 4to, Altona, 1815.

H. T. L. REICHENBACH has published a *Monographia Pselaphorum*, one small volume, with figures, Leipsie, 1816.

JOHN WILLIAM MEIGEN, a German naturalist, has published a very complete work on European Diptera: *Beschreibung der Europäischen Zweyflügeligen Insecten*, 6 vols. 8vo, 1818-30. It is accompanied by coloured plates representing a species of each genus, with the details, chiefly deduced from the antennæ, of the generic characters.

LOUIS JURINE, professor of anatomy and surgery at Geneva, is the well-known author of the *Nouvelle Méthode de classer les Hyménoptères et les Diptères*, avec fig. Hyménoptères, tom. 1, in 4to, Geneve, 1807. His classification is based on the ramifications of the nervures of the wings, and an acquaintance with his work is indispensable to a knowledge of the Hymenoptera. He also published a memoir in 4to, entitled *Observations sur les Xenos Vesparyum*, 1816; and *Observations sur les ailes des Hyménoptères*,—"ouvrage d'une admirable patience," says Latreille. The latter appeared in the 24th volume of the *Mémoires de l'Académie de Turin*.

FRANÇOIS HUBER of Geneva, born in 1750, died in 1831, the celebrated author of the *Nonvelles Observations sur les Abeilles* (2d edition), 2 vols. 8vo, 1814, was, though deprived of sight, one of the most accurate and original observers of the habits of the insect world. The second volume of the work just named is by

PIERRE HUBER, the son of the preceding. The younger Huber was also the author of *Recherches sur les Mœurs des Fourmis indigènes*, 1 vol. 8vo, 1810; and of *Observations sur les Bourdons*; the latter was published in the 6th vol. of the *Linn. Trans.*

CHARLES JOHN SCHÖNHERR, a Swede, has published a work under the name of *Synonymia Insectorum*, 3 vols. 8vo, 1806–8–17. It contains only coleopterous insects, and although not completed even in relation to those tribes, it is a work of great labour, extreme accuracy, and consequently high value. It is of indispensable service to those who desire to trace the mystified stream of synonyms, so frequently confused and contradictory among the subjects of Entomology. Schönherr is also the author of an excellent work, entitled *Curculionidum Dispositio methodica*, 1 vol. 8vo, Leipsic, 1826; and he has very recently brought out a much more complete and extended publication on the same great tribe, under the title of *Genera et Species Curculionidum, cum Synonymia hujus familiæ*.

LEONARD GYLLENHAL, another noted entomologist of Sweden, is the author of a work in several parts, called *Insecta Suecica*, 1808–27. This is one of the few works on the Coleoptera which has not been left in an uncompleted state; and the great accuracy of the descriptions, expressed in language remarkable alike for precision and perspicuity, renders it a publication of the very highest value.

EDWARD DONOVAN, an English naturalist, has published a considerable variety of illustrated works on natural history. We shall here mention only his entomological productions: 1st, *An Epitome of the Natural History of the Insects of China*, 1 vol. in 4to; *An Epitome of the Natural History of the Insects of India*, in 4to; *General Illustrations of Entomology*, part i.; *An Epitome of the Insects of Asia*, 1 vol. 4to; *The Natural History of English Insects*, 16 vols. 8vo. The preceding were valuable and praiseworthy publications for their time, though not in every respect characterised by the scientific accuracy or critical skill which distinguish so many of the entomological works of the present day.

DRAPIEZ, professor of chemistry at Brussels, has published *Mémoires sur un nouveau genre d'Insectes Coléoptères*, and *Description de quelques nouvelles espèces d'Insectes*, in the *Annales Générales des Sciences Physiques*.

FERDINAND OCHSENHEIMER is the author of a German work on the Lepidoptera of Europe, *Schmetterlinge von Europa*, highly esteemed for its critical accuracy and excellent descriptions of the species. The first volume was published in 8vo, at Leipsic, in 1806. The author died in 1822, leaving his work in an uncompleted state, only four volumes having been published during his life-time, the last of which appeared in 1816, consisting chiefly of an improved sketch of his arrangement, from the first to the eighty-seventh genus. Before his death, however, only the first forty-three genera were published in detail, with the characters and descriptions of their respective species; these occupy the first three volumes, the last of

which terminates with the genus *Eyprepia*,—for the fourth contains, besides the sketch of the arrangement, only notes concerning some of the species published in the preceding volumes. The work is being continued by M. Frederick Treitschke, and the specific descriptions are completed to the one hundred and sixteenth genus inclusive. M. Treitschke has also given a further sketch of the arrangement, including ten additional genera, consisting of the *Phalæna Pyralides* of Linnæus. The last volume of which we are cognisant is the seventh, published towards the end of 1829. It contains ten genera, from *Hermia* to *Eunychia* inclusive. Of this work, and its continuation, the English reader will find an abstract by J. G. Children, Esq. F. R. S. &c., with a list of the species of each genus, and references to one or more of their respective icones, in the *Philosophical Magazine and Annals* for 1829. Where the generic characters appeared meagre or defective, Mr Children has given additional ones from the writings of other entomologists; and he has also indicated in numerous notes the new lepidopterous genera (chiefly by Stephens and Curtis), to which the British species mentioned in the text are now to be referred.

JAMES HUBNER, a painter of Augsburg, has published a work in the German language on the *Lepidoptera of Europe*. It is one of the most complete which has hitherto appeared on the beautiful order of which it treats. It has also the advantage of being proportionally less expensive than many other illustrated works, and it exhibits a great variety of *larvæ*. The letter-press portion, however, is not so highly esteemed. The author has commenced a corresponding publication on *Exotic Lepidoptera*. The plates of these works (in large 8vo) amount to nearly one thousand.

CHARLES FREDERICK FALLEN, professor of natural history in the university of Lund, is chiefly known as the author of *Diptera Suecica*, in 4to, 1814–17.

Under this head we may also name the following:—*Monographia Tenthredinum Sueciæ*, præside Fallen, 8vo, 1829; a work consisting of three theses by different authors.

Bombi Scandinaviæ monographia tractati et iconibus illustrati. Specimen Academicum quod subjicit Gustav. Dahlbom, respondenti P. W. Brandsten, 8vo, 1832; an interesting treatise on the humble bees of Scandinavia, thirty-six in number. We have also, by M. Dahlbom, *Monographia Pompiliorum Sueciæ*, 8vo, Lond. Gott. 1829.

Exercitationes Hymenopterologicæ ad illustrandam Faunam Suecicam, by three young Naturalists, Lond. Gott. 1831.

Monographia Tanypodum Sueciæ, præside Fallen, subjicit B. F. Fries, 8vo, fig. 1823.

Hemiptera Sueciæ quorum descriptionem venia ampt. facult. Philos. Acad. Land., præside C. F. Fallen, 8vo, Lond. Goth. 1826. This volume consists of five theses, by as many authors, on the family of *Cicadariæ*. Another volume was published under the same auspices and title, containing eleven dissertations on the *Heteropterous Hemiptera* of Latreille, Lond. Goth. 1829.

FRANCIS KLUG, M. D. of Berlin, and one of the directors of the museum there, has contributed many treatises to Entomology. Of these we may indicate the following: *Monographia Siricum Germaniæ*, &c. 1 vol. 4to, with coloured plates, Berlin, 1803;—a *Critical Review* of the genera of Fabricius, derived from *Apis* of Linnæus, published in Illiger's *Magazin für Insectenkunde*, 1807;—*Entomologische Monographien*, 1 vol. 8vo, with figures, Berlin, 1824;—*Proscopia novum genus Insectorum Orthopterorum*,

in folio, with plates;—*Entomologiæ Brazilianæ Specimen*. Dr Klug has also published in German (*Bericht Über, &c.*) a *Rapport* on a collection of coleopterous insects from Madagascar, 1 vol. 4to, with plates; and he is moreover the author of an *Entomological Annual*—*Jahrbucker der Insecten kunde*, of which we are acquainted with only a single volume, published at Berlin in 1834.

JOHN LOUIS CHARLES GRAVENHORST, of Gottingen, a skilful entomologist, has composed the following works: *Coleoptera microptera Brunsvicensia*, 1 vol. 8vo, 1802;—*Monographia Coleopterorum micropterorum*, 1 vol. 8vo, 1806;—*Monographie du genre Ichneumon*, 1 vol. 8vo, with figures, 1814;—*Monographia Ichneumonum Pedemontæ regionis*, forming a portion of the twenty-fourth volume of the *Mém. de l'Acad. des Sciences* of Turin;—*Monographie des Ichneumons Aptères*, 1 vol. 8vo, with figures; *Conspectus generum et familiarum Ichneumonidum*, in 4to, conjointly with Nees ab Esenbeck;—*Beitrag zur Entomologie*, 1 vol. 8vo;—lastly, *Ichneumonologia Europæa*, in 3 large 8vo volumes, 1829, containing above 2800 pages, devoted to the Ichneumonidæ alone.

CHARLES SCHREIBERS, director of the imperial cabinet of natural history at Vienna, among his other writings has given us descriptions of various *Coleopterous Insects*, with figures, in the 6th vol. of the *Linn. Trans.*

MARCEL DE SERRES, professor of mineralogy to the Faculty of Sciences of Montpellier, has composed many excellent articles on the anatomy of insects, printed in the *Mém. du Museum* and elsewhere (see especially his observations on the *Vaisseau dorsal*, *ibid.* 1819), and has published a *Mémoire sur les yeux composés et les yeux lisses des Insectes*, &c. 1 vol. 8vo, with figures, 1813.

WILLIAM ELFORD LEACH, M. D., F. R. S., &c. an English naturalist of great zeal and intelligence, continued Dr Shaw's work, under the title of the *Zoological Miscellany*, 3 vols. 8vo. He is also the author of various elaborate treatises on insects, published in the *Linn. Trans.*, and in the British and foreign *Encyclopædias*. His early enthusiasm for Entomology has been productive of great advantage to the study in this country,—and of an advantage which has now spread insensibly far beyond the benefit directly derivable from his own particular labours.

NEES AB ESENBECK, a noted botanist, has lately published *Hymenopterorum Ichneumonibus affinium Monographiæ*, vol. 1st and 2d, Stuttgart, 1834.

C. A. WALCKENAER, besides his *Faune Parisienne*, and his works on the *Aranéides*, has published *Mémoires pour servir à l'Histoire Naturelle des Abeilles solitaires*, 1 vol. 8vo, Paris, 1817.

WILLIAM SHARPE MACLEAY, A. M. is the author of a work named *Horæ Entomologicæ, or Essays on the Annulose Animals*, 1 vol. 8vo, in two parts, 1819–21, remarkable for its elucidation of the circular progression of affinities. It is a production of great value. The same author has published *Annulosa Javanica*, part 1st, and has contributed various papers to the *Linn. Trans.*, the *Zoological Journal*, and the *Transactions* of the Zoological Society.

FRANÇOIS ETIENNE GUERIN is the author of several articles on Entomology in the *Encyclopédie Méthodique*, and of a beautiful and useful work, now in progress, named *Iconographie du Règne Animal*. He is also editor of the *Magazin de Zoologie* (a portion of which, sold separately,

is devoted exclusively to insects); and has recently announced (conjointly with M. Pereheron), a work under the title of *Genera des Insectes, ou exposition détaillée de tous les caractères propres à chacune des genres de cette classe d'Animaux*.

The Rev. LANDSDOWN GUILDING, of St Vincent's, lately deceased, was one of the most active of the naturalists stationed within the tropics. He is the author of several entomological papers published in the *Transactions of the Linnæan Society* and the *Zoological Journal*.

JOHN JAMES HAGENBACH, who died in 1826, was one of the conservators of the Royal Museum of Leyden. He made known a singular coleopterous insect from Java, in his *Mormolyce novum genus*, 1 vol. 8vo, with a plate, Nuremberg, 1825. We believe he was also the author of *Symbola Faunæ Insectorum Helvetiæ*, fascie. 1, with plates.

AROLD DAVID HAMMEL wrote *Quelques Observations sur la Blatte Germanique*, in 8vo, Petersburg, 1821; and between that year and 1827 he published six numbers of *Essais Entomologiques*.

LEPELLETIER DE ST FARGEAU is known as the author of a *Monographie des Chrysis des environs de Paris*, in the *Ann. du Mus. d'Hist. Nat.* No. 58, and of a *Monographia tenthredinetarum Synonymia extricata*, 1 vol. 8vo, Paris, 1823. He has communicated to the Academy of Sciences *Observations sur les accouplements de diverses espèces de Volucelles, genre de Diptères*; and has composed, jointly with M. de Serville, the tenth volume of *Entomologie de l'Encyclopédie Méthodique*.

C. R. G. WIEDEMANN, professor at Kiel, has written *Diptera exotica*, 1 vol. in 8vo, part first, with figures, Kiel, 1821. He is likewise the author of *Analecta Entomologica*, in 4to, with plates, Kiel, 1824, and of other works.

C. L. SAHLBERG, professor of natural history at Abo in Finland, commenced an Entomology of that country, under the title of *Dissertatio Entomologica Insecta Fennica enumerans*, 8vo, 1817–1823. He is also the author of *Periculi Entomographici*, 1 vol. 8vo, with plates, Abo, 1823.

GEORGE DAHL of Vienna, an entomological merchant, or dealer in insects, and a well-instructed entomologist, has printed catalogues of the different orders, particularly *Coleoptera und Lepidoptera*, Vienna, 1823, 1 vol. 8vo.

M. CHARPENTIER is favourably known as the author of *Horæ Entomologicæ adjectis tabulis novem coloratis*, 4to, 1825.

JOHN WILLIAM DALMAN, not long since deceased at Stockholm, where he was director of the museum, is known as the author of the following works:—*Analecta Entomologica*, with plates, 1 vol. 4to, Holmiæ, 1823; *Prodromus Monographiæ Castniæ*, with a plate, 1 vol. 4to, 1825; *Om nagra svenska arter af Coccus*, with plates, 4to, Stockholm, 1826; a monograph on the *Chalcidites*, or *Pteromalini* of the author, 1 vol. 8vo, 1820; a *Synoptical Table of the Butterflies of Sweden*, published in the *Mémoires de l'Académie de Stockholm*, 1816; *Ephemerides Entomologicæ*, 1 vol. 8vo, Holmiæ, 1824; a memoir on certain *Ichneumonides*, 1 vol. 8vo, 1826; also of a memoir in the Swedish language, on the *Insects inclosed in Amber*, 1 vol. 8vo, 1826.

GOTTHIELF FISCHER DE WALDHEIM, a German natu-

ralist, is director of the Imperial Museum of Moscow. He has published numerous works, of which the following relate to Entomology:—*Description de quelques Insectes, dans les Mémoires des Naturalistes de Moscou*, 1 vol. in 4to, 1806; *Entomographia Imperii Russici*, 3 vols. in 4to, with good coloured plates, 1820 and subsequent years; *Notice sur une Mouche carnivore, nommée Medetère*, in 4to, with figures, 1819; *Notice sur l'Argas de Perse*, in 4to, 1823; *Lettre sur le Physodactyle, nouveau genre de Coléoptère Elatéroïde*, in 8vo, 1824. M. Fischer is also the author (jointly with M. Eversmann) of *Lepidopterorum variorum Russiae Observationes*, recently published.

CONSTANT DUMERIL, a professor in the Garden of Plants (Jardin des Roi), and member of the Academy of Sciences, was born at Amiens in 1774. He is the author of the articles on Entomology in the *Dictionnaire des Sciences Nat.*; and of a separate volume, with plates, entitled *Considérations générales sur la classe des Insectes*, Paris, 1823.

LEON DUFOUR, a physician in Saint Sever (Landes), is the author of several highly esteemed contributions to Entomology. We shall here mention *Mémoire Anatomique sur une nouvelle espèce d'Insecte du genre Brachine*, in the 18th vol. of the *Annales du Museum d'Hist. Nat.*:—*Mémoires sur l'Anatomie des Coléoptères, des Cigales, des Cicadelles, des Labidoures or Forficulæ*;—*sur une nouvelle espèce d'Ornithomyia*;—*sur le genre Ocypète*:—all printed in the *Annales des Sciences Naturelle*. He has also written *sur l'Anatomie des Scolies*, in the *Journal de Physique*; besides describing many new species of *Coleoptera*, and the anatomy of *Ranatra linearis*, and of *Nepa cinerea*, in the *Annales Générales des Sciences Physiques*. The latest work with which we are acquainted by this author is entitled *Recherches Anatomiques et Physiologiques sur les Hémiptères, accompagnées de considérations relatives à l'histoire naturelle et à la classification de ces insectes*, 1 vol. in 4to, with plates, Paris, 1833.

A. J. DUPONHEL is the continuator of the *Histoire Naturelle des Lépidoptères de France*, of the late M. Godart. He has moreover published a *Monographie du genre Erotyle*, with plates, in 4to, printed in the 12th vol. of the *Mémoires du Museum*; and is at present engaged with his *Iconographie des Chenilles*, a work intended as supplementary to M. Godart's *Hist. Nat. des Lépidoptères*, to be afterwards mentioned.

ROBINEAU DESVOIDY, a physician of St Saver, has written several elaborate treatises relating to Entomology, such as *Recherches sur l'organisation vertébrale des Crustacés, des Arachnides, et des Insectes*, 1 vol. 8vo, Paris, 1828; *Essai sur la tribu des Culicidés*, in the 2d vol. of *Mém. de la Soc. d'Hist. Nat. de Paris*; and a work *sur les Diptères de la tribu des Muscides*, printed in the *Mém. des Savants Etrangers de l'Acad. des Sciences*.

JOHN CURTIS, F. L. S., &c., an English entomologist, commenced some years ago a work entitled *Illustrations of the Genera of British Insects*, "Leurs caractères," says Baron Cuvier, "y sont représentés avec la plus grande fidélité." The 10th volume of this work is now in progress, if not by this time completed. It may be safely asserted, that for elegance of design and accuracy of execution, combined with the most beautiful and exquisitely finished mode of colouring, it is a matter of doubt whether any rival to its plates can be found within the entire range of entomological productions. Mr Curtis has also published a *Guide to an arrangement of British Insects*, 8vo, 1831.

JAMES FRANCIS STEPHENS, F. L. & Z. S., published a *Systematic Catalogue of British Insects*, in one large volume 8vo, 1829. Although it presents merely a list of names and synonyms, this is a most praiseworthy and valuable work, and was the first to exhibit a systematic view of our indigenous species. It enumerates 10,012 names of native insects, a number greatly surpassing what could have been anticipated a few years back. Mr Stephens is likewise the author of a well-known work, still in progress, under the name of *Illustrations of British Entomology*, in which the coleopterous and lepidopterous orders are now completed. It is pleasingly adorned in a pictorial point of view, and, containing very excellent descriptions, has not failed in being classed by competent judges with the most successful efforts in its line. By the same writer we have also the *Nomenclature of British Insects* (of which there has been recently a second edition)—a useful compendium in its line.

WILLIAM SWAINSON, F. R. S. &c., a noted ornithologist, has published, in his *Zoological Illustrations* (first series, 3 vols. 8vo, 1820–3, second series, 3 vols. 8vo, 1832–3), many beautiful figures of new and rare insects, chiefly *Lepidoptera*. The careful study of Mr Swainson's Illustrations, as well as of those of Mr Curtis, must prove delightful, not alone to the mere entomologist, but to every eye accustomed to receive pleasure from the tasteful representation of nature. The figures of our present author are almost all drawn by himself on stone.

W. WOOD, F. L. S. is author of *Illustrations of the Linnean Genera of Insects*, 2 vols. 12mo, London, 1821; and of *Index Entomologicus, or a complete illustrated Catalogue of the Lepidopterous Insects of Great Britain*. (Still in progress.)

THOMAS HORSFIELD, M. D. an English naturalist now or formerly in the service of the Honourable East India Company, is the author of *Catalogue of Lepidopterous Insects* in the museum of that Company, parts i. and ii. royal 4to, London, 1828–29,—a work of great interest, from its excellent representation of the *metamorphoses* of many Javanese butterflies.

FRANCIS GEBLER, a Russian physician and naturalist, stationed at Barnaoul in Siberia, has published a memoir in 4to, entitled *Observationes Entomologicae*, besides various papers in the *Mémoires de la Soc. des Naturalistes de Moscou*.

ERNEST FREDERICK GERMAR, a German naturalist, wrote a *Dissertatio sistens Bombycum Species*, &c. in 4to, and continued Illiger's *Magazin für Insektenkunde*, already mentioned.

E. FRANCIS GERMAR, professor of mineralogy at Halle, is the author of the *Magazin der Entomologie*, 4 vols. 8vo, Halle, 1813, 1821; and of *Insectorum Species novæ aut minus cognitæ*, &c., 1st vol. 8vo, with figures, 1824. He has likewise continued the *Fauna Insectorum Europæ* of Ahrens, which is itself a continuation of Panzer's *Fauna Insectorum Germanicæ initia*, and published a book of travels, *Reise in Dalmatien*, in which he gives brief notices of the insects he encountered. Professor Germar has particularly applied himself to the *Circulionidæ*, and in his *Insectorum Species novæ*, in which he describes 891 *Coleoptera*, 318 belong to the family just named. He has there established a great many new genera.

JEAN BAPTISTE GODART compiled the article *Papillons*

of the *Encyclopédie Méthodique*, and wrote the first five volumes of the *Histoire Naturelle des Lépidoptères ou Papillons de France*, commenced in 1822, and now continued (Godart being dead) by M. Duponchel.

FRANCIS BONELLI, director of the cabinet of natural history, and professor of zoology, at Turin (now deceased), was the author, among other works, of *Observations Entomologiques*, in two parts, published in the *Mémoires de l'Académie des Sciences de Turin*. Their object is the genus *Carabns* of Linnæus, which he has greatly divided; and most of his new genera have been received and adopted by entomologists. In the thirtieth volume of the above-named memoirs, Professor Bonelli has also published *Descrizioni de sei nuovi insetti lepidopteri della Sardegna*.

CHARLES GUSTAVUS CARUS, professor at Dresden, is the author (we need not here mention his well-known works on physiology and comparative anatomy) of a *Memoir on the Circulation of the Larvæ of Neuropterous Insects*, in German, Leipsic, 1827.

J. CHABRIER has composed a series of memoirs on the flight of insects, in which the muscular economy is well described. They are now published in a collected form, with the title of *Essai sur le Vol des Insectes*, 1 vol. 4to, Paris, 1823.

C. G. MANNERHEIM, a councillor of the Emperor of Russia, has contributed to Entomology: *Eucnemis insectorum genus*, 1 vol. 8vo, with plates, 1823: *Observations sur le genre Megalope*, in the tenth volume of the Memoirs of the Imperial Academy of Sciences of St Petersburg, 1824: *Description de quarante nouvelles espèces de Scarabæides du Brésil*, in 4to, with plates. M. Mannerheim is likewise the author of a work which we have not yet seen, but of which we give the title: *Précis d'un nouvel arrangement de la famille des Brachélytres*, in 4to, Petersburg, 1830.

STRAUS DURCKHEIM is the author of a very admirable work,—*Considérations générales sur l'Anatomie comparée des animaux articulés, auxquelles on joint l'anatomie descriptive du Hanneton*, 1 vol. 4to, with plates, Paris, 1828.

FREDERICK TREITSCHKE, a German naturalist, is the continuator of Ochsenheimer's work on the *Lepidoptera of Europe*. The last volume (1829) contains the *Pyralides*.

JEAN MACQUART is the author of a series of memoirs on the *Insectes diptères du Nord de la France*, with figures of the wings; inserted in the *Mémoires de la Société Royale des Sciences*, &c. De Lille, 1826–1829;—and of *Histoire Naturelle des Insectes (Diptères)*, 2 vols. 8vo, with plates, 1834–5.

JOHN WILLIAM ZETTERSTED, a Swedish naturalist, has published *Orthoptera Suecica*, 1 vol. 8vo, Lund, 1821; and *Fauna Lapponica*, 1 vol. 8vo, Hammone, 1828.

JEAN VICTOR AUDOUIN, M. D. sub-librarian to the Institute of France, and assistant naturalist in the Jardin du Roi, is the author of several valuable contributions to entomological science. Among these we shall mention: *Recherches Anatomiques sur le thorax des Animaux articulés, et celui des insectes hexapodes en particulier (Annales des Sciences, tom. i. p. 97–416)*; *Lettres sur la generation des Insectes* (ibid. tom. ii. p. 281); *Recherches Anatomiques sur la famille du Drele, et sur le male de cette espèce* (ibid. p.

443); *Recherches Anatomiques pour servir à l'histoire naturelle des Cantharides* (ibid. tom. ix. p. 31); and, conjointly with

MILNE EDWARDS, M. Audouin is the author of *Résumé d'Entomologie, ou d'Histoire Naturelle des Animaux Articulés*, 2 vols. in 18mo, Paris, 1829.

J. A. BOISDUVAL, conservator of the collection of the Comte Dejean, is the author of an *Essai sur une Monographie des Zygenides*, 1 vol. 8vo, 1829. Attached to the preceding, we find, by the same author, *Europæorum Lepidopterorum index methodicus*. M. Boisduval is at present engaged in a work on the Lepidoptera of North America, entitled *Iconographie de Lépidoptères et de Chenilles de l'Amerique Septentrionale*, conjunctly with M. Lecomte. He is also conjoined with Comte Dejean in the publication of *Iconographie et Histoire Naturelle de Coléoptères d'Europe*, in 8vo, 1827 and subsequent years; and he has recently commenced four new works, under the titles of *Icones Historiques des Lépidoptères Européens, nouveaux ou peu connus*, with coloured plates;—*Collection Iconographique et Historique des Chenilles, ou description et figures des Chenilles d'Europe*;—*Entomologie Général des Environs de Paris*, containing a description of the insects of every order, found within a radius of from fifteen to twenty leagues of the French capital (this last-named work is undertaken conjointly with M. Lacordaire);—and *Faune Entomologique de Madagascar, Bourbon, et Maurice (Lépidoptères)*; avec des Notes sur les mœurs, par M. Sganzin. Livraisons 1–8. Paris, 1835.

COMTE DEJEAN, peer of France, and lieutenant-general in the army, &c. &c., one of the most noted collectors of coleopterous insects of modern times. He has published the *Catalogue de Coléoptères* of his own collection, 1st edition, 1821,—2d edition (as yet uncompleted) 1833–5. This little work is interesting, as exhibiting the extent of species in each genus, and as indicating the localities of the numerous species. The author has also published, 1st, conjointly with M. Latreille, *Histoire Naturelle et Iconographie des Coléoptères d'Europe*, three fasciculi, in 8vo, 1822; 2d, a continuation of the same work, with the aid of M. Boisduval, instead of that of the veteran Latreille, entitled *Iconog. et Hist. Nat. des Coléop. d'Europe*, and now amounting to thirty-five numbers; 3d, *Species Général des Coléoptères*, 5 vols. 8vo, 1825–1831,—a work which, although it describes only the species possessed or examined by Dejean, and as yet embraces but a small segment of the great circle of coleopterous insects, will undoubtedly form, when completed, the most indispensable guide to the study and arrangement of that numerous, diversified, and most interesting order.

M. DELAPORTE is the author of *Etudes Entomologiques, ou description d'Insectes nouveaux*, &c. 1 vol. 8vo, with plates, 1834 or 5; *Essai d'une classification systématique de l'ordre des Hémiptères (Hétéroptères)*; and (conjointly with M. Gory) of *Hist. Nat. et Iconographie des Insectes Coléoptères*, published in the form of *Monographs*, of which that on the magnificent *Buprestida* has just appeared.

M. GORY (in addition to the work just named) is engaged (with M. Percheron) in a *Monographie des Cetoines*, in livraisons, with plates, 1834–5; and has recently published a *Monographie du genre Sisyphe*.

M. PERCHERON (besides the joint work above alluded to) is engaged in the publication of a *Monographie des*

Passales, 1 vol. 8vo, with plates; and (jointly with M. Guérin) in the *Genera des Insectes*, formerly mentioned.

M. LACORDAIRE is the author of an *Essai sur les Coléoptères de la Guyane Française*, in the *Nouv. Ann. du Mus.* t. ii. p. 35. He has likewise published, in one vol. 8vo (suites à Buffon), an *Introduction à l'Entomologie*, Paris, 1834; and is at present engaged (with M. Boisduval) in an *Entomologie Générale des Environs de Paris*.

M. POEY has written a recent work named *Centurie de Lépidoptères de l'Isle de Cuba*, with coloured plates, Paris, 1834.

M. AUDINET-SERVILLE, a labourer in the entomological portions of the *Faune Française*, and of the *Encyclopédie Méthodique*, published the last fasciculus of the work by the late Palisot de Beauvois, on the *Insectes recueillis en Afrique et en Amérique*, already mentioned. He is also the author of a *Nouvelle Classification de la Famille des Longicornes* in the *Annales de la Société Entomologique de France*, 1833-4.

M. A. CHEVROLAT is at present engaged in describing *Coléoptères du Mexique*, a work published in livraisons, each containing twenty-four species.

C. AUBE has published *Peslaphiorum Monographia cum Synonymia extricata*, with plates, 1835.

M. PERTY has recently published descriptions of the insects collected in Brazil by Drs Spix and Martius, under the title of *Delectus animalium articulatum quæ in itinere, &c.*

F. J. PICTET of Geneva is the author of an excellent and elaborate work entitled *Recherches pour servir à l'Histoire et à l'Anatomie des Phryganides*, 1 vol. 4to, with plates, 1834.

M. EHRENBURG has lately published, in the *Symbolæ Physicæ*, an account of *Insects collected in Egypt, Nubia, and Arabia*.

R. A. PHILIPPI, in the form of an inaugural dissertation, has recently published *Orthoptera Berolinensis*.

A. C. H. BOHSMAN has recently published *Novæ Coleopterorum Species descriptæ*.

GUSTAVE SILBERMANN is the editor and publisher of the *Revue Entomologique* of Strasbourg, a monthly work now in progress (and at present amounting to three volumes 8vo), containing original essays, and descriptions of species, with critical and explanatory notices of recent entomological works (chiefly those of France and Germany). It is a useful publication.

We may here name such of our native periodicals as bear most immediately upon our present subject. Entomology does not appear as an important (scarcely as a perceptible) feature in our scientific magazines or philosophical journals in general, but in the *Zoological Journal* of London there are various contributions to the subject. Neither is it at all disregarded in Mr Loudon's excellent *Magazine of Natural History*. A recent quarterly work, the *Entomological Magazine* (multa joca solent esse in epistolis, *Cic.*), is exclusively devoted to it; and the *Entomological Society* of London has commenced the publication of its *Transactions*. In these works various British writers are now engaged, with great zeal and intelligence, in the elucidation of Entomology.

We shall conclude our enumeration by naming a publication which we observe announced as *sous presse* in Paris, and which will no doubt prove a better and more extensive guide than our preceding notices:—*Bibliographie des Insectes, par ordre alphabétique d'auteurs, avec un table par ordre de matières*, par M. A. Percheron, 2 vols. in 8vo.

ENTOMOLOGY.

Definition. ENTOMOLOGY (from *έντομον*, *insect*, and *λογος*, *discourse*), is that branch of natural science which treats of the history and habits of the insect tribes. Its subjects are the most numerous and diversified of any of those topics which engage the attention of the student of nature; and as they exemplify in a most surprising and admirable manner, both by their structure and instincts, the wisdom of the author and creator of all things, and form a highly interesting department of human knowledge, we deem their elucidation deserving of a lengthened dissertation.

The English term insect is no doubt derived from the Latin word *insectum* or *intersectum*, signifying *cut into* or *intersected*, in allusion to the obvious divisions of head, thorax, and abdomen, of which their general forms consist. The Greek word bears the same signification.

CHAPTER I.

DEFINITION OF INSECTS—THEIR ORDERS EXPLAINED—AND THEIR STUDY DEFENDED.

In the article ANIMAL KINGDOM of this work (see vol. iii. p. 179), we have given a view of the primary divisions of the subjects of zoological science. The third primary division, that of the articulated animals, consists of four great classes:—1. *Annelides*, such as *serpulæ*, *neréids*, *leeches*, *earthworms*, &c.; 2. *Crustacea*, such as *crabs*, *lobsters*, and *shrimps*; 3. *Arachnides*, such as *spiders*, *scorpions*, and *mites*; and 4. *Insecta*, or true insects, such as *beetles*, *butterflies*, and *moths*. The class *Insecta* of Linnæus included not only those last named, but also *Crustacea* and *Arachnides*, and was thus almost co-extensive with what we now regard as a primary division under the term *Articulata*. We have, however, already discussed those two branches as distinct classes, under their respective titles (see *ARACHNIDES* and *CRUSTACEA*), and we shall not repeat the important characters by which they are distinguished from genuine insects.

The term insect was anciently applied to a much more extended series of beings than are now included under that designation. It seems to have comprised whatever was destitute of an internal skeleton, and exhibited a body composed of articulated parts. In this sense it accords with its application in the writings of Aristotle and Pliny, with certain restrictions however, for these authors were in advance of their successors, in as far as they distinguished the *Crustacea* from insects. Swammerdam and Ray adopted the definition of the ancient authors, but erred in classing the *Vermes* or worms with insects, a combination which does not appear for certain to have entered into Aristotle's

views. Linnæus wisely separated these two classes, but at the same time injudiciously joined the *Crustacea* with insects, placing them in his order *Aptera*, along with spiders and scolopendræ. Fabricius in that respect followed the same general plan, and included all those living creatures in the same class, notwithstanding the better example shown by Brisson, who had separated all the species possessed of more than six feet, that is, the *Crustacea* and *Arachnides* of Lamarck. Since the death of the great Swedish naturalist, our improved knowledge of the anatomy and physiology of the invertebrated classes has thrown a clearer light upon the subject, and many modifications have taken place in the arrangement of the insect tribes.

Insects, properly so called, may be defined as *animals without vertebræ, six-footed, with a distinct head furnished with two antennæ and a pair of composite immoveable eyes, and breathing through stigmatic openings which lead to interior tracheæ*.¹

As we shall have occasion to mention many terms which may not be familiar to the general reader, we deem it advisable, instead of taking his knowledge for granted, to commence with a brief enumeration and explanation of the various orders in Entomology, so that their names, when subsequently brought forward, may be associated with some definite idea. We shall consider all insects as included under eleven different orders, as follows.

1. *COLEOPTERA* (from *κόλος*, *a sheath*, and *πτερά*, *wings*), including all those kinds commonly called *beetles*. Their membranous wings, which are the true organs of flight, are protected by a superior and anterior pair of harder consistence, called *elytra*. They are all masticators, and are provided with mandibles and maxillæ. Plates CCXXI–VII.

2. *ORTHOPTERA* (from *ὀρθος*, *straight*, and *πτερά*, *wings*), including crickets, grasshoppers, locusts, &c. The upper wings are of the consistence of parchment, reticulated, and more or less incumbent. The mouth is provided with mandibles and maxillæ. Plate CCXXVIII.

3. *HEMIPTERA* (from *ἡμισυ*, *the half*, and *πτερά*, *wings*), including the cinnices or bugs, the water scorpions, cicadæ or froghoppers, aphides, &c. A portion of their upper wings is frequently membranaceous, or of the same consistence as the inferior pair. The mandibles and maxillæ are replaced by a sheath and sucker. Plate CCXXIX.

4. *NEUROPTERA* (from *νεῦρον*, *nerve*, and *πτερά*, *wings*), including libellulæ or dragon-flies, ephemeræ, &c. Both pairs of wings are membranous, naked, and finely reticulated. Mouth adapted for mastication, and furnished with mandibles and maxillæ. Plate CCXXX.

5. *HYMENOPTERA* (from *ὑμην*, *a membrane*, and *πτερά*, *wings*), containing wasps, bees, ichneumon-flies, &c., and characterized likewise by membranous naked wings, which

¹ The above definition excludes those many-footed species called *Juli* and *Scolopendræ*, which, though still included by some modern writers among insects, were established as a distinct class by Dr Leach (*Edinburgh Encyclopædia*, vol. viii.; and *Linn. Trans.* vol. ix.) under the title of *Myriapoda*, and were recognised as such by Latreille in his *Familles du Règne Animal*, p. 322. Although we did not allude to this class in our exposition above referred to (art. ANIMAL KINGDOM), we think that the removal of the two genera just named from the *Insecta* is advisable, as it leaves the latter in a state to be more clearly defined, as well as actually composed of more natural constituent parts, or, as MM. Audouin and Milne Edwards have expressed it, *plus homogène*. “En effet,” say these authors, “tous les animaux qui la composent alors ont le corps divisé en trois parties distinctes, une tête, un thorax, et un abdomen; trois paires de pattes sont fixées au thorax; souvent deux ou quatre ailes sont suspendues à la même partie; la tête porte deux antennes et deux yeux immobiles; la bouche est garnie d’une série d’appendices modifiés pour broyer les aliments solides, ou pour pomper ceux qui sont liquides; un système particulier de vaisseaux sert à la respiration, et porte le nom de *trachées*; il existe un vaisseau dorsal qui n’est autre chose qu’un cœur rudimentaire; mais il n’y a point de véritable système circulatoire; les sexes sont distinctes; enfin, la plupart de ces êtres éprouvent, pendant les premiers temps de leur vie, des métamorphoses plus ou moins complètes; mais jamais ils n’acquièrent, après leur sortie de l’œuf, de nouveaux segmens à leur corps.” (*Résumé d’Entomologie*, p. 12.) All true insects, then, are *hexapod*, or *six-footed*; and the few genera now or lately classed with them, but of which the amount of feet is greater than six, belong to the *MYRIAPODA*.—under which term the reader, in due time, will find their history and classification.

Definition. however, present fewer nervures, and are not reticulated, as in the preceding order. The mouth is furnished with mandibles and maxillæ, and the abdomen of the female is terminated either by an ovipositor or sting. Plates CCXXXI-II.

6. LEPIDOPTERA (from *λεπίς*, a scale, and *πτερά*, wings), containing all butterflies and moths, and generally characterized by the farinaceous or scaly aspect of the organs of flight, and the tubular or thread-like extension of the parts of the mouth. Plates CCXXXIII-VII.

7. STREPSIPTERA (from *στρεψίς*, a turning or twisting, and *πτερά*, wings), including a few peculiar and parasitical species belonging to the genera *stylops* and *xenos*. This order corresponds to the *Rhipiptera* of Latreille, but we adopt Mr Kirby's denomination, as possessing a prior claim. Plate CCXXXI.

8. DIPTERA (from *δίς*, twice or double, and *πτερά*, wings), including the house fly, and other two-winged kinds. The mouth is furnished with a proboscis, and there are two organs called poisers or balancers (*halteres*) placed behind the true wings, one on each side. Plate CCXXXVIII.

9. SUCTORIA (so designated from their sucking propensities) is constituted by the genus *Pulex* of Linnæus, and differs from the ensuing apterous orders in undergoing a regular metamorphosis, and possessing what some regard as the rudiments of elytra.¹ Plate CCXXXIX. fig. 13, 13 a, 14, 14 a, 14 b.

10. THYSANOURA (probably from *θιάζω*, to dance, and *ουρά*, tail),² likewise an apterous order, including the *Poduræ* and other tribes. Plate CCXXXIX. fig. 7, 8, 12, and 12 a.

11. PARASITA (so named from their parasitical or adhesive propensities, because they dwell on the bodies of other animals) contains the genus *Pediculus* of Linnæus, and the *Nirri* or bird-lice.³ Plate CCXXXIX. fig. 10, 11, and 11 a.

The study of the structure and habits of this numerous and diversified class of beings has long been a favourite occupation with men of science in all the continental countries of Europe, and has assumed of late years in the southern parts of our own island a character of considerable and increasing importance. Works have been recently published in this country which need fear no comparison with the most finished examples of pictorial representation; and when we consider how sparingly the subject of Entomology has been hitherto patronized by the public, we cannot sufficiently esteem the exertions of those who have thus devoted their time and talents to a pursuit which brings with it no other reward than the delight which every instructed mind necessarily draws from the contemplation of a favourite subject. Entomology, in truth, still stands in a difficult and somewhat dubious position, and presents itself to many under a far less inviting aspect than its beautiful sister-science of Botany. In connection with the latter study, the very mass of mankind, even the *profanum vulgus*, however ignorant of the technical details, have many early formed, and therefore pleasing associations. Every country-house has its flower parterres, and numerous cottages their glowing borders,—botanic gardens have been formed in the vicinity of most of the larger cities, while nursery grounds are frequent in the neighbourhood even of provincial towns,—to say nothing of the “flower enamelled meads” which each sparkling spring and gorgeous summer calls into fleeting but constantly renewed existence. In addition to the more attainable nature of this popular pursuit, some bota-

nical knowledge is also regarded as a requisite branch of Definition. medical education; and although a tin box and a microscope do not constitute a man of science, still the subject derives advantage from that general though it may be superficial culture. But in Entomology every thing exists in a different order of relation. No “trivial fond regards” come in aid of the impaler of insects; and even the creatures themselves are too often regarded with such abhorrence, that one feels the more inclined to admire how those who endeavour to hand them down to an ungrateful posterity, should themselves be accused of cruelty.

The time however is surely gone by when an apologetical defence of the study might be required, or in which the works of Omnipotence were regarded as important in proportion either to their magnitude or immediate subservience to the human race;—and although we desire not to fall into an opposite error by maintaining the greater beauty and excellence of the more minutely elaborated designs of the Creator, we yet feel that they are fully more calculated to awaken our wonder and admiration. It would be easy to say that the richest and most elegant apparel which adorns the human race is the product of a caterpillar; that the blistering medicines so essential to the practice of the sanitary art are compounded from a beetle; that honey and wax, so valuable as articles of domestic economy, are derived from the glad labours of a hymenopterous fly; and that even that splendid and regal dye the “Tyrian purple” of ancient days, supposed to have been obtained from the *Purpura patula*, a shell-fish of the Mediterranean, is superseded by the tinctorial uses of the cochineal, a small and obscure insect, which nevertheless the skill of the chemist has rendered indispensable even to the garment of kings. But in truth far higher and more delightful results ensue from these researches, than can ever be named in the “cui bono” catalogue of a mere economist; for whatever tends to elevate the mind of youth above the grosser pleasures of sense, or even occasionally to disconnect our maturer years from the more turbulent occupations and harassing cares which life is heir to, assuredly carries along with it its own reward. We doubt not that a more sedulous and frequent attention to natural history would in active minds pre-occupy the place which is otherwise in after years too often devoted to more perilous courses. Even the pursuits of literature are often vague and objectless, and not unfrequently engender a sickly sentimentalism, or other morbid affection in nowise akin to genius. But the objects which attract the attention of the naturalist are not the melancholy creations of the human intellect, which present so often but a lurid brightness, or a dim eclipse, in which noble thoughts are obscured by the “darkening scales” of vice or folly. They are the work of HIM who cannot err, and who has doubtless not only peopled the teeming earth and the translucent waters of the “great deep” with all their innumerable and varied wonders, for a wise and beneficent purpose, of which our instruction and amusement form at least a portion, but has, by the implantation of that strong instinctive love of nature which all ingenuous minds possess, demonstrated his desire that we should ennoble our humanity by magnifying his manifold works, the “wondrous works of him that is perfect in knowledge.”

While the beautiful simplicity and regular order observable in those phenomena which proceed under the superintendence of omnipotence, commonly called the operations

¹ This suctorial order is named *Aphaniptera* by Mr Kirby, from *αφανής*, inconspicuous, because there is an appearance of something resembling elytra.

² In allusion, we presume, to the springing propensities of the insects of this order, which leap by means of a setiform process bent beneath the abdomen.

³ Those who assume the occurrence of marked transformations as a basis for the grouping of the orders, will rank the first nine of the above as *Metabola*, or insects undergoing metamorphosis, and the last two as *Ametabola*, or insects undergoing no metamorphosis.

Definition. of nature, are well adapted to the comprehension of understandings laying no claim to the highest order, the more complex relations of the subject present a vast field for speculative or theoretical exercise, sufficient to occupy the faculties of the most powerful minds. It is thus that, in its totality, the subject of natural history holds out to each capacity the allurements of an occupation suited to every gradation of intellectual power; for while in its mysterious interconnection with other branches of natural science, as well as in its own peculiar complexities, it cannot be effectively grasped by mere human understanding, its manifold minor features may be scanned with intelligence by who-ever desires so to do.

If indeed the value of a pursuit is to be estimated by the comparative ease with which it may be followed by persons of the most moderate fortunes, few can rank higher than Entomology. While the specimens sought for by the mineralogist and student of geology are frequently heavy and cumbersome, and not seldom extremely expensive, and while that sad representative of the beauties of the living Flora, called a *Hortus Siccus*, is but a frail and fleeting memorial of the "days of other years," presenting, even after a tedious and troublesome process of preservation (by courtesy so called), no trace of their original brightness, the most exquisite examples of entomological beauty, if not too roughly handled at the period of their capture, remain, with the most ordinary attention, for a lifetime in their pristine state,—and what that state actually is, all may satisfy themselves in the course even of the most superficial examination,—

.....For nature here
Wantons as in her prime, and plays at will
Her virgin fancies.

Exceeding in amount of species all the other subjects of zoology,—unrivalled in the dazzling brilliancy of their colours, which combine the clearness and decision of tint possessed by flowers, with the exquisitely varied markings of the feathered race, and the metallic splendour of the mineral kingdom,—surpassed by no other work of creation in the wonderful structure of their parts, and certainly surpassing all in the adaptation of that structure to the perfect fulfilment of those natural though to us still mysterious instincts, which in every age have excited the admiration of mankind,—is it to be wondered at that the study of insects should occupy a prominent place in our pursuit of knowledge? Much more do we wonder that thousands of the best educated, and in other respects most enlightened minds, should still feel averse to a study which unfolds such a world of unseen wonders.

The subject, too, is literally inexhaustible; and while some who love to methodize, and thereby to circumscribe, the subjects of human knowledge, or who err in their estimate of the perceptive powers of the human mind as applied to other matters of enquiry, may be deterred by the vague boundaries of such a field, a greater number, and with more propriety it is hoped, may be induced to enter it, from the very consideration of such a rich and un-reaped harvest. While a fragment of inert matter, which chemical analysis determines to differ in its constituent proportions from other fragments previously examined, is once in a lustre dignified by the name of a new *species*, and the name of a Haüy or a Dolomieu is bestowed on the unconscious mass,—and while, even in the richer domain of British botany, the student of that science, however much he may extend our knowledge of the localities of plants, labours

with but a feeble chance of adding to the actual list even of indigenous species, and has probably no chance at all of ever refreshing his eyes with the sight of a plant which nobody ever saw before,—it is far otherwise with the innumerable tribes of insect life. The "gilded summer flies" are numerous as leaves in Vallumbrosa. No recess of the forest so obscure but there the "winged messengers" are seen to sport and play; and each summer sunbeam falls not alone on the dewy herbage of the open glades, but lights up the gorgeous hues of those bright creatures which a mystical philosophy has ennobled as the types of the disencumbered human soul, and which even the sombre Dante has named *angelical*.

Non v'accorgete voi, che noi siam vermi
Nati a formar l'angelica farfalla.

Every pool of water is pregnant with life; each lonely moor or old deserted quarry, which scarcely "feels in its barrenness one touch of spring," is the chosen abode of thousands of living creatures, of small dimensions it is true, but of singular beauty both of form and structure, and often adorned with hues,

Which make the rose's blush of beauty pale,
And dim the rich geranium's scarlet blaze.

Even the pastoral melancholy of the green mountains is enlivened by the occurrence of many interesting species. One of the most beautiful of European coleopterous insects (*Carabus nitens*) occurs among the peat *hags*, and other places where heath and turf abound, and where its sparkling coat of gold and green, tinged with a brighter lustre than that of rubies, is singularly contrasted with the blackness of the soil in which it seems imbedded. The desolate and cloud-piercing summits of the highest hills produce several species, which are the more highly prized from their scarcity, and the difficulties with which they are obtained.¹

We have alluded to the ease and *economy* with which the study of Entomology may be pursued, more especially when our attention is confined to the species of a district. Of course the collector of foreign insects labours under some disadvantage, from the more multifarious nature of his subjects, their larger size, higher price, and more scattered localities. But the home collector, especially of the Coleoptera, is more favourably situated.² The total Entomology of most districts may be amply illustrated within the bounds of a cabinet of a few feet square, and the most ordinary attention and regularity suffice for its preservation. Most districts produce species which are comparatively rare in other quarters, and thus by means of interchanges numerous additions may be made from time to time: so that with a moderate share of assiduity and perseverance, a large collection may be amassed with little or no pecuniary outlay. In these and many other pleasant particulars, on which we need not here dilate, Entomology possesses advantages over all the kindred branches of natural history. We shall now pass to a short exposition of some of the more characteristic features in the structure and functions of insects.

CHAPTER II.

THE EXTERNAL ANATOMY OF INSECTS.

Our knowledge of the manners of these creatures presents us with few general results, and this is scarcely to be won-

¹ The foregoing brief "defence of insects" coincides with that which, since the above was written, has appeared in our *Entomologia Edinensis*.

² A glazed frame or drawer, lined with cork, and capable of containing many hundred species, may be made for a few shillings.

External Anatomy. dered at, when we consider with how small a number we have any accurate acquaintance. It may even be doubted whether we are completely informed of the history of any one species within the entire range of Entomology. Of some we know the perfect state, but have never seen the larva; of others the larvæ are well known, but the perfect insect remains in obscurity, so that when we consider the numerous changes which these creatures undergo, from their first hatching to their final metamorphosis, we need scarcely wonder that even the most familiar species present points in their history, which it is by no means easy to unravel.

It is otherwise however with the classification of insects, which, depending mainly on an attentive examination of external characters, is so far independent alike of anatomical investigation and the study of manners, although these, when ascertained, form of course the truest test by which to appreciate the difference between a natural and an artificial system.

The period is comparatively recent during which the internal structure of insects began to be regarded as a subject of interest. Their external characters were the first to attract attention; and as a communicable knowledge of these was necessary for all the practical purposes of classification, as well as to establish the means of mutual understanding among naturalists, it is well that that branch has been rendered so complete and satisfactory. In former times, whatever facts of interest might have been ascertained, were too often but of slight avail, in consequence of our vague knowledge of the species to which they applied. But the most ordinary attention on the part of the anatomist, to the systematic works of modern times, will now suffice to inform him of the place which his subject occupies in the scale of nature; and hence the importance, not seldom overlooked by the physiologist, of even the minutest external characters, when accurately ascertained and clearly described. It has indeed been stated as a truism, that whoever attempts to deduce the real affinities of the animal kingdom from a consideration of the external characters alone, will in most cases mislead both himself and others.¹ But it must also be admitted, that comparative anatomists have too frequently an idea that nothing is or can be of importance which extends beyond the sphere of their own exertions. They forget that the general form and covering, and, in short, the whole of the external characters, however they may labour under the misfortune of being obvious to a common observer, are just as much a part of an animal's organic constitution, as the nerves, viscera, muscles, blood-vessels, and bones, or whatever else is most mysterious and recondite; and that, in fact, without a precise knowledge of the former, the information conveyed by the latter would be uncertain, or of no avail. The chief advantage of the internal structure is, that it is less liable to variation from the influence of local or accidental circumstances: its chief disadvantage results from the difficulty of its ascertainment, and the contrariety of opinion which exists among physiologists regarding the uses of the organs, even after their conformation has been ascertained. A mere knowledge of external character is perhaps nearly as useful as an acquaintance, however intimate, with anatomical structure, when nothing is either known or sought for respecting the external appearance, as a necessary guide to the higher knowledge of animal instincts and modes of life, the uses of living creatures in the general economy of nature, their exquisite adaptation to the circumstances under which they are placed, their distribution over the earth's surface, and other points of philoso-

phical investigation. The mere anatomist may smile at the mere collector of shells and butterflies; and with just as much propriety may the mere naturalist or virtuoso smile in return at him who, knowing, or supposing that he knows, every convolution of a viscus, or ramification of an artery, is yet unable to recognise, amid the perplexingly multiplied varieties which may be presented to him, the precise animal which has been the subject of so much anxious and careful investigation. But when anatomy and natural history go hand in hand, the obscure labyrinth of nature, so far as human capacity can penetrate, receives its noblest illumination.

Notwithstanding the meritorious labours of Swammerdam, Malpighi, Réaumur, and Lyonnet, who were the first greatly to signalise themselves in the difficult field of insect anatomy; in spite of the more recent and scarcely less successful exertions of Cuvier, Comparetti, Ramdohr, Treviranus, Gaede, Sprengel, Savigny, Marcel de Serres, Geoffroy St Hilaire, Carus, Meckel, Audouin, and Dufour (to make no mention of many others who yet deserve to be held in remembrance),—such is the immense extent and variety of this wonderful class of beings, that we fall infinitely short of possessing any thing like a general or completed knowledge of their structure. In this paucity of well-established facts under which we labour, it would indeed be unphilosophical to attempt the induction of general rules; and all that we shall here attempt shall be to record such observations as seem likely to bear substantially upon the subject, and to have formed an actual advance in our knowledge of the anatomy and physiology of insects.

The study of the interior structure of these creatures does not at first sight hold out the promise of much that is either interesting or useful. The enormous distance which seems to separate all invertebrated animals from man, and even from the lower mammiferous and other vertebrated tribes, has induced the belief that no practical results can ever spring from such a source. But the philosophical observer, who knows how important is frequently the connection between the greatest and the least of things, and how, like the thread of Ariadne, the tracing of a slender chain may lead to unforeseen conclusions of the highest value, will not despise the lights which a better knowledge even of insect anatomy may be one day destined to throw upon some of the many still obscure points in the physiology of man. The observations of M. Dufour and others have already shown us what an admirable simplicity presides in these despised tribes over the exercise of those most important functions, which in red-blooded animals require such a complicated organic structure as to be almost incomprehensible. But as we descend in the scale of nature, we see more clearly the distinction between what is necessary, or merely accessory or superfluous, and thus by degrees we may attain to a knowledge of the essential characters of things.

Even in its more superficial bearings on natural history, the dissection of insects is necessary to ascertain several disputed points regarding the sexual distinctions of species, and to verify our views of the structure of the organs of the mouth, the antennæ, tarsi, and other external parts, on which our establishment of tribes and genera mainly depends. When it is desired to dissect an insect, it ought to be placed on a piece of cork, immersed in pure water; and the various parts, as they float in the liquid, may be fixed in their most appropriate position by means of needles. With a view to prevent deception from any alteration in the relative position of the internal organs, it is desirable

¹ Wilson's *Illustrations of Zoology*, vol. i. pref. p. 4.

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to fix the insect in its natural horizontal posture, and to commence the dissection from the dorsal region downwards.

The following observations on the dissection of the minute animals may be of service to the student. "The first thing that I have to observe is, that all dissections of small and soft objects, *e. g.* worms, zoophytes, insects, mollusca, &c. where it is desirable to obtain even tolerably accurate results, should be performed *under water*, by which the parts are kept floating and separated from each other, and consequently present themselves more distinctly. A very simple contrivance for investigations of this kind may be prepared in the following manner: A mass of tough wax (not too soft) is to be laid upon one or more porcelain saucers or capsules of different sizes, which are then to be put in a warm place until the wax melts so as to cover the surface evenly to the depth of a half or a third of an inch. If the object to be examined be laid upon this surface, it may be fixed by needles in any position that is wished; and, when covered with clear water, developed and dissected by means of suitable instruments. Of these, the best are very delicate forceps; pointed, well made, sharp-cutting scissors; and small knives like cataract needles, some round, others with cutting edges, and fixed in slender wooden handles. For separating parts I have also employed small horn probes and fine brushes; whilst for examining them a good magnifying glass is frequently indispensable. If it is wished to preserve a preparation thus made, wax coloured at pleasure, as for the purpose of injections, is to be formed into little tablets about a quarter of an inch thick; one of them is then to be placed upon the saucer or capsule containing the preparation; the latter may then be transferred to it, arranged suitably upon it, fixed there by means of short needles, and both together placed in alcohol. Nor must I forget to mention, that the examination of very delicate organizations may frequently be conducted with greater facility and accuracy, if the object be previously allowed to remain some time in spirit, and thereby to become harder and contracted. This applies particularly to the dissection of nervous organs, and to the examination of very small embryos, of mollusca, and worms. There are various ways of destroying worms, insects, &c. for the purpose of dissecting, without injuring their organization. Mollusca, snails for example, as Swammerdam has remarked, are to be allowed to die in water, because by that means their body swells, and all the parts become more distinctly visible; they may afterwards be kept in spirit (though not too long) for dissection. Worms, the larger zoophytes (for the smaller must be examined whilst alive), caterpillars, &c. are best destroyed by means of spirit; insects, on the contrary, by being dipped rapidly in boiling water, or in oil of turpentine."¹

SECT. I.—THE EXTERNAL COVERING OF INSECTS.

Our knowledge of the structure and anatomy of this class may be said to be still in its infancy; for although many important facts have been legitimately generalized, we are still in ignorance of the formation of a thousand species for every one which has been examined. As the harder parts of insects, to which the muscles are attached, are superficial, the class has been described as bearing their skeletons externally; and a transcendental anatomy has not scrupled to determine the exact analogy which each portion of their covering bears to the bony frame-work of the vertebrated tribes. This comparison has been instituted

by M. Geoffroy St Hilaire, an eminent physiological naturalist of France, who maintains, with many of his countrymen, that all animals are vertebrated. The doctrine, whatever may be its other merits, is not entitled to the credit of novelty, as an English writer of the name of Willis had, so far back as the year 1692, published his opinion that the external envelope of the body of insects represented the internal articulated column of the vertebrated tribes. M. de Blainville, on the other hand, regards the corneous covering of insects rather as analogous to the skin or cutaneous system of the higher classes.

The hardness of the calcareous or horny envelope of the greater number of insects is owing, in Latreille's opinion, to the consistence of the excretion interposed between the dermis and the epidermis, or what is termed in man the *mucous tissue*. This excretion also contains the brilliant and varied colours which add so greatly to the beauty of the class.² According to M. Odier, who has attentively examined the composition of the harder parts of insects, the substance of this envelope is of a peculiar nature. He has named it *chitine*. He observes that the phosphate of lime forms the great proportion of all the salts contained in the teguments of insects, while that ingredient is but trifling in the covering of the Crustacea, although the latter abounds in the carbonate, which is not found in the other class.³ The facts stated by him militate against the analogies attempted to be established on the subject; and the observations of M. Straus go far to demonstrate that these teguments do not form a true skeleton, but really represent the skin of the vertebrated classes. When we use the word skeleton, then, in relation to insects, the reader will understand its application merely to the external covering.

On analysing the elytra of the cockchafer, M. Odier ascertained the existence, *1st*, of albumen; *2d*, of an extractive matter, soluble in water; *3d*, of a brown-coloured animal substance, soluble in potass and insoluble in alcohol; *4th*, of a coloured oil, soluble in alcohol; *5th*, of three salts, viz. subcarbonate of potass, phosphate of lime, and phosphate of iron; *6th*, of a peculiar substance which constitutes a fourth-part in weight of the elytron. Albumen is so generally distributed among the animal organs that its presence was to be expected. But the oil is deserving of further experimental observation. Robiquet found it of a green colour in cantharides; while, according to Odier, it is brown in the cockchafer, and red in a species of *crioceris*. Now as each of these insects is itself of a corresponding hue, it is natural to suppose that the oil is the colouring matter. The peculiar substance which forms so large a proportion of the elytra is named *chitine* by M. Odier. If we plunge a coleopterous insect into a solution of potassium, and keep up a pretty high temperature, we shall observe that the so-called skeleton neither dissolves nor changes its form; it merely becomes discoloured during the operation, while all the viscera and interior muscles disappear; and whatever remains of the insect is *chitine*. This substance exists in the whole of the envelope, and is also found to occur in the more solid covering of the Crustacea.

If however we compare the preceding results with those obtained by M. Chevreul in the course of his experiments on crustaceous animals, we shall perceive some remarkable distinctions in the constitution of their harder parts. The presence of subcarbonate of potass is a striking character among insects. It does not occur in the class Crustacea. The phosphate of lime, a sparing ingredient among the latter,

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¹ Carus's *Introduction to Comparative Anatomy*, translated by Gore, vol. ii. p. 389.

² *Règne Animal*, t. iv. p. 2.

³ *Mém. de la Soc. d'Hist. Nat.* t. i. p. 29.

External Anatomy. forms a preponderating part of the salts in the envelope of insects, while the carbonate of lime is absent, although it forms the base of the carapace or covering of crabs and lobsters. It has been stated as a regulating law in animal chemistry, that the bones of the higher orders have more of the phosphate and less of the carbonate of lime in their composition, while the proportions were reversed among the inferior tribes. But the observations of M. Odier show the inadequacy of chemical character to serve as a basis on which to found our analogies of organization; for if strictly applied to insects, that class must be removed from the place which they now occupy in our system, and be combined with others of a higher nature, with which in truth they have no connection.

The harder and more solid parts of insects are certainly to them what the internal skeleton is to the vertebrated tribes. They form the support and frame-work of the body. It is on this account that the term *skeleton*, though not strictly applicable, has been used, both in ancient and modern times, to designate the *corneous external system* of these creatures. This comparatively solid system is itself formed by the union of many parts, which however have received no general name; so that, while in discussing the vertebrated tribes we merely say that their skeleton is formed of bone, all that we advance in regard to insects is, that it is composed of pieces. In the higher tribes each individual bone is well known by its own distinctive name; but the insect tribes in that respect have been but obscurely defined. Guided by the light of human anatomy, observers have sought to discover in insects all those parts to which they could apply previously established names; but analogies based upon mere appearance are incapable of great or useful extension; and insects would certainly have been better known had they been studied in the first place individually, and no far-fetched comparisons instituted till after a more ample knowledge of actual organization. But instead of this, the best determined functions of the superior animals have been assumed as points of departure, and all the parts of insects which seemed to fulfil the same purposes have been determinately regarded as analogous. Now it is quite admissible to say, that in insects, as among the vertebrated tribes, there is progression, vision, manducation, &c. because these are the attributes, more or less general, of all living beings; but it has not always been demonstrated that particular and more special functions are always performed by the same or apparently corresponding parts. M. Dufour, however, has announced the following results in relation to the articulated animals themselves: 1st, that the skeleton of the Crustacea and Arachnides (two important classes already described in this work) does not differ from that of insects except by the mode of growth of the rings of which it is composed; 2d, that those two classes of animals and insects themselves do not differ among each other, but by the greater or less extent in the development of the parts of which they are composed.

The same may be asserted in regard to the disparities observable between the different conditions of insects in the larva, the chrysalis, and the perfect state. The various forms under which the same species is exhibited, and the singular and sometimes sudden transformations to which it is subjected, are found to result, when analysed, from the growth of parts. This has been demonstrated by the writings of Swammerdam and other modern writers on the anatomy of caterpillars, as well as by the beautiful and more recent observations of Savigny on the mouths of Lepidoptera in the perfect state, compared with the same parts in their earliest condition.¹ The observation is particularly

applicable to the solid parts of insects. In the larva each segment exists under a nearly uniform development, while in the perfect state several of these segments have acquired a prodigious increase. This is the cause of the vast difference in their exterior envelope at different periods of their existence. The nymph or chrysalis is in the intermediate condition, and is formed, like the larva, of simple rings, which, however, no longer exhibit an equal degree of uniformity. But the perfect insect is the final term of transformation. Considered in a general way, its covering does not essentially differ from that of the larva; but the three segments next the head have acquired a great increase of bulk, to enable them to support the appendages of legs and wings, which were merely rudimentary, or scarcely existent, in its first condition; and the distinction of head, thorax, and abdomen becoming strongly visible, the entire aspect of the insect has undergone a change.

It is highly interesting to observe the influence which the decrease or development of one portion of structure exercises upon another; in other words, the constant and intimate relation of the proportion of parts. The maximum of increase in the metathorax is always in relation to the rudimentary state of the mesothorax, while, on the contrary, the development of the latter produces or accompanies the decrease of the former. Thus also the parts of the mouth, as demonstrated by M. Savigny, are sometimes free, and capable of varied movement, for the purposes of mastication; while in several tribes they are brought close together, lengthened, and as it were amalgamated in the form of trunk or sucker; and so the segments of the thorax, in the different orders, more or less disunited among themselves, support the wings, the balancers, the elytra, according to the various kinds. From these and similar considerations have been deduced the conclusion that the increase of one portion exercises over the neighbouring portions a peculiar influence, which explains whatever differences may be remarked in the individuals of each order, family, and genus. And this general consequence, which results from numerous observations, necessarily includes and accounts for that incoherent series of anomalies so puzzling to the superficial inquirer, but which are only regarded as such, because the labourers in the field of anatomy have but seldom taken into their consideration the totality of the articulated animals, and have more seldom still thought fit to occupy themselves in a careful comparative analysis of the parts which enter into the composition of the external skeleton of these despised tribes.

We shall here briefly consider the essential characters of the so-called skeleton among the articulated tribes. It is composed of segments, which are themselves formed by a determinate number of pieces; but their most obvious character is, that they are provided with a pair of feet, and with two openings to the respiratory organs. But along with such segments as present these parts, we may usually observe many others which are not so provided, or at least in which the feet are wanting; and they may either differ in their size and proportions, or closely resemble each other in those respects. In the latter case, the most simple form is exhibited; and if we ascertain the composition of a single segment, and their amount, we have a knowledge of the entire animal. This simplicity of form, however, is not often observable; for it more frequently happens that the same individual presents great disparity in the size and composition of its segments, and in the appendages with which they are furnished.

The Scolopendræ (belonging to the class MYRIAPODA) ex-

¹ *Mémoires sur les Animaux sans Vertèbres.*

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hibit, according to M. Dufour, one of the most simple forms of the articulated classes, in as far as they present the greatest uniformity of character in the parts of which they are composed. Even in them, however, we may observe, at the anterior portion, some pairs of feet, which are rudimentary, and crowded together towards the head; so that it would be possible to figure an animal still more uniformly composed, by supposing that the feet thus thrown together had been developed uniformly with the appendages of the ensuing segments. We should then have had to recognise merely a head, and a certain number of rings, all of a like nature. But it might be possible still further to reduce and simplify the proposition, by regarding the head itself as an assemblage or union of segments, bearing appendages merely analogous to the feet. Thus, to realize the supposition of a skeleton uniformly constructed throughout all its parts, nothing more would be necessary than to give to the segments of the head a development equal to that of the others, and to restore to its appendages (the feet) their essential usage, that of locomotion, instead of the secondary usage to which they had been subjected. This view has been presented in order to exhibit what has been regarded as the fundamental plan of insect formation; for it is in truth the corresponding or unequal increase of the segments, the union or division of the pieces of which they are composed, the maximum of development in some, the rudimentary condition of others, that form the agreements or differences of character in the entire series of articulated animals.¹ If the development is uniform, or nearly so, in each segment, we have the condition of the *Annelides*, of *worms*, and of the *larvæ* of insects. If, on the contrary, this equilibrium is destroyed, and the maximum of increase takes place in the first, second, and third segments ensuing the head, we have the form and character of a *perfect insect*; if the change is still greater, we reach the *Arachnides*; if greater still, the *decapodous Crustacea*.

The importance of studying the skeleton of insects is greater than even among the higher classes, because, being essential, it forms a genuine basis, and being at the same time external, it offers to the eye of the zoologist a ready mode of determination.

While engaged in the consideration of the various organs of insects, a numerous list of disparities in structure might no doubt be collected, and the term *anomaly*, according to its frequent but by no means philosophical application, brought into constant use. That fatal word, however, has been too often substituted in place of an explicit interpretation of phenomena not in any way difficult of solution, certain general principles being kept in view. Of these, one of the most importance is, that all the differences exhibited by insects, and all the so-called anomalous organs which they present, are the result of a greater or less development of certain parts existing generally throughout the entire class.² The contrariety of opinion among naturalists regarding the existence or proportion of certain parts of structure, has arisen partly from a discordance in the use of terms, and partly from the organs themselves not being submitted to a careful analytical investigation. It is thus, for example, that the names of *sternum* and *scutellum*, in place of being bestowed on portions of which the contours have been precisely determined, have only been applied when these portions happened to exhibit certain accidental and conventional characters. By this means we read in almost every page of classification, that one insect possesses a scutellum and that another does not; or that a particular genus is characterized by its existence, and another by its absence; while the fact is,

that these parts exist in all insects, although the names in their usual application have been bestowed only upon peculiar and not very important variations in the *form*.

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SECT. II.—THE EXTERNAL CHARACTERS OF THE PRINCIPAL SEGMENTS OF AN INSECT'S BODY, VIZ. THE HEAD, THORAX, AND ABDOMEN.

The form of the external covering of insects, even of the same species, differs greatly according to the existing condition of the individual. The segments of which the bodies of larvæ are composed are generally of a uniform size when compared with each other, and the singular phenomena presented by metamorphosis consist chiefly in the greater development assumed by certain segments than by others. The nymph (called *chrysalis* among the *Lepidoptera*) exhibits the intermediate or transitional state. Its segments are unequally developed, and this inequality is greatly increased on the assumption of the final state, in which certain segments are prodigiously enlarged, while others suffer a corresponding diminution. In the imago, or complete condition, the three segments next the head undergo the most notable alteration; for, besides their increase of bulk, they become furnished with wings and articulated legs, which had previously existed in a very rudimentary condition. In that state also the relative proportions of the segments are so changed that the identity of several becomes difficult to recognise, and the most obvious divisions henceforth consist of *head*, *thorax*, and *abdomen*. These parts are severally characterized by peculiar attributes, the nature of which we shall now endeavour to explain.

The *head* is by far the most complicated portion, and it is necessary that its structure should be well understood, as it furnishes the most important characters on which modern genera are founded or made known. The parts most deserving of attention are the *mouth*, *antennæ*, and *eyes*.

The organs of the mouth present in their different combinations a great variety of form among the articulated classes. In relation to all such animals as are provided with a head, more particularly the vertebrated tribes, the term *mouth* is never of ambiguous application, but refers to those parts which are placed exteriorly at the entrance of the intestinal canal, and effect the process of mastication; but in regard to the acephalous or nearly headless tribes, such as *annelides*, *worms*, and the radiated animals, its application is less definite and precise. Among the great series of living beings included by Linnæus in the class of insects, all of which are furnished with a head, the parts of the mouth are no longer doubtful. It has been remarked, however, that the sucker of the larvæ in the last family of the dipterous order being entirely interior when not in use, presents a singular approximation in that particular to the intestinal worms.

It will be readily conceived that the mouth of insects must be adapted to the particular manners of life peculiar to each natural group, and must therefore vary in accordance with their instinctive habits. It was thus that even the earliest naturalists perceived and expressed the distinction between insects provided with teeth or cutting jaws, and those furnished with trunks or suckers. The use of the microscope in modern times, and the deep desire which prevailed towards the conclusion of the seventeenth and commencement of the eighteenth centuries, to illustrate the mysteries of animal organization, produced much more detailed and exact accounts of the parts of the mouth in insects than were previously possessed. The works of Leeuwen-

¹ *Ann. des Sciences Nat.* t. i. p. 115.

² *Ibid.* p. 102.

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The alimentary substances sought for by insects are either comparatively hard and solid, or of a more soft and fluid nature. Thence we find upon examination numerous tribes of insects provided with a mouth so constructed as to tear and masticate the substances on which it is designed to act; while many others are characterized by a tube-like mouth, or one resembling a delicate tongue extended when in action, and spirally rolled upon itself when in repose. Hence the great primary distinctions among the orders of insects, and their recognised division into masticators (*mandibulata*) and suckers (*haustellata*), the former living on solid substances, the latter on such as are fluid. Whatever may be the structure of the mouth in insects, it is to one or other of those types of form that each must be referred. We are indebted to the beautiful researches of Savigny (1814) for the first accurate analysis and elucidation of these parts, and of their relationship throughout the articulated tribes. Latreille, however, had previously instituted a slighter comparison between the mouths of the suctional and mandibulated tribes, as Lamarck has admitted in his report on Savigny's work.

Savigny divides insects formerly so named into two groups, the *hexapodes*, or such as have six feet, and the *apiropodes*, or such as possess a greater number. The mouth of the latter forms two proper types distinct from those of the former; but it is with the polymorphous hexapodes, or such as undergo transformations, that is, insects properly so called, that we are now concerned. We shall first consider the parts of the mouth in the masticating tribes. They are essentially as follows: The *labrum*, the *mandibles*, the *maxillæ*, the *palpi*, the *labium*, and the *mentum*, the two latter, according to the views of different observers, sometimes passing under one and the same name. The reader may here consult Plate CCXX. fig. 1, *a*, *b*, *c*, *d*.¹

The *labrum* or upper lip (fig. 1, *a*) is a flattened somewhat deflexed portion, consisting of a single piece,² placed on the upper side of or above the mouth, and capable of moving upwards and downwards, or vertically. It is variable in form, but is usually somewhat square, often wider than long, and frequently notched or bifid. It is of a horny consistence, sometimes coriaceous, or even approaching to what may be named membranous in certain tribes, and is attached to the anterior portion of the head by a very short articulation.

The mandibles or upper jaws (*mandibulæ*, fig. 1, *bb*) are two strong horny pieces, generally of a triangular form, more or less curved, convex externally, concave on their inner surfaces, and frequently toothed or serrated on their interior edge. They are placed on each side of the mouth by insertion on the sides of the head, immediately beneath the labrum or upper lip, which usually covers their base. They are each composed of a single piece of a hard consistence, and may be said to correspond to the jaws of the vertebrated tribes, the process of mastication being principally performed by them. They differ, however, in this

respect, that their motion, instead of being vertical, is horizontal, or from within outwards, and *vice versa*. They vary greatly both in their actual size and relative dimensions, being small and slender in the glow-worm (*Lampyris*), and very large, projecting, and antler-like in the stag beetle (*Lucanus cervus*), the species which we have selected for our engraved illustration. These internal surfaces are frequently parallel, but their dentations are not always the same in each, the projections of the one being however frequently so arranged as to enter the concavities of the other in order to admit of their closer union. But this is not seldom prevented by the curvature of the tips; and in several instances, where the mouth is wide, and the mandibles rather remote from each other at the base, the blades cross each other a little beyond the centre. The dentations of the mandibles, though sometimes called teeth, are merely projecting parts, although in the orthopterous tribes a coriaceous lamina seems in some respect to distinguish them from the body of the mandible to which they are attached, thus exhibiting an approach to that mode of fixture called *gomphosis*, in which one bone is fixed within another, as in the teeth of the higher tribes. The mandibles are more variable in their forms than the maxillæ, and may occasionally be observed to differ (as in the genus *Lucanus*) even in the sexes of the same species.

Immediately beneath the mandibles are situated the *maxillæ* or under jaws (fig. 1, *cc*), which are likewise placed on each side of the mouth, and take their origin from the inferior and internal part of that cavity, near the origin of the under lip. Like that of the preceding parts, their action is horizontal, but their texture is less rigid, approaching to membranous, their colour usually paler, and their internal edges toothed, or finely fringed with hairs. The different portions of the maxillæ have received different names, such as the *cardo* or hinge, the *stipes* or stalk, and the *lobus* or lobe (one or more) which forms the terminal portion. The last named is the most important portion, as it acts upon the food when preparing for deglutition, and when armed with teeth its substance is as hard as that of the mandibles. "This part," says Mr Kirby, "is either simple, consisting only of one lobe, as you will find to be the case with the *Hymenoptera*, *Dynastidæ*, *Nemognatha*, and several other beetles; or it is compound, consisting of two lobes. In the former case, the lobe is sometimes very long, as in the bee tribes, and at others very short, as in hister, &c. The bilobed maxillæ present several different types of form. Nearest to those with one lobe are those whose lower lobe is attached longitudinally to the inner side of the stalk of the organ, above which it scarcely rises. Of this description is the maxilla in the common dung beetle (*Geotrupes stercorarius*), and rove beetle (*Staphylinus olens*). Another kind of formation is where the lower lobe is only a little shorter than the upper; this occurs in a kind of chafer (*Macraspis tetradactyla*, Macleay). A third is where the upper lobe covers the lower as a shield; as you will find in the *Orthoptera* order, and the *Libellulina*, and almost in *Meloe*. A fourth form is where the upper lobe somewhat resembles the galeate maxilla just named, but consists of two joints. This exists in *Staphylinidæ*, &c. The last kind I shall notice is when the upper lobe not only consists of two joints, but is cylindrical, and assumes the aspect of a feeler or palpus. This is the common character of almost all the predaceous beetles (*Entomophagi*, Latr.)."³ This lobe, which has been usually regarded as an

¹ *a* is the labrum, surmounted by its broad nasus; *b* the mandibulæ; *c* the maxillæ, with their jointed palpi; *d* the bifid labium, with its two palpi and broad basal portion or mentum.

² In the female of a small bee of the genus *Halictus* it is said to be furnished with a slender appendage.

³ *Introduc. to Entom.* vol. iv. p. 442.

External Anatomy. additional palpus or feeler, is strictly analogous, in Mr Kirby's opinion, to the upper lobe in other insects, and he thinks it ought rather to be called a palpiform lobe than a *palpus*. When there are two lobes, the upper one is most commonly the longer; but in many species of the tribe last alluded to, the lower equals or even exceeds the upper in length.¹

Most of the predaceous beetles have the inner lobe of the maxillæ armed with a terminal claw, which, among the Cichindeliidæ, is articulated and moveable, but fixed in the other carabideous kinds. The maxillæ are chiefly serviceable in holding the food, and preventing its falling from the mouth during the action of the mandibles, although in certain cases they no doubt also act their part in comminution. They are more fixed in their forms than the mandibles, and are of more essential service to the naturalist for the purposes of classification. Fabricius, indeed, has deduced the principal diagnostic of ten out of the thirteen orders (or classes, as he terms them), of which his system is composed, from these important parts.

We shall now briefly notice certain appendages of the maxillæ, the existence of which forms another distinction between them and the mandibles or upper jaws, which are never so provided. Towards the middle of the outer edge of the maxillæ are attached two slender articulated filiform processes, known under the name of palpi (see the figure above referred to); the longer pair being the external, the others the internal palpi. Both are called *maxillary*, to distinguish them from the *labial* palpi, afterwards mentioned. According to the view expressed by Mr Kirby in the preceding quotation, the reader will perceive that each maxilla may be regarded as properly possessing only one palpus, although in certain tribes the upper lobe being jointed and *palpiform*, has occasioned its being regarded as one of these organs. The palpi are distinctly articulated, or composed of several jointed parts, and are capable of rapid and extended motion. They derive their name from a Greek word, which signifies to feel, and are supposed to constitute one of the principal organs of touch. Their uses, however, in the insect economy have been variously interpreted. Bonndorf regarded them as the organs of smell; while Knoch, agreeing in that opinion so far as regards the *maxillary* palpi, conceives that those of the *labium* exercise the faculty of *taste*. Cuvier and Kirby favour touch as their true function, and this view is confirmed by the constant use which numerous species make of these organs while walking, by applying them perpetually to the surface of whatever objects they pass over. That they perform that function is rendered extremely probable by their structure, which is beautifully adapted, by its peculiar planity, to the examination of the substances with which they come in contact. They are in some respects analogous to the articulated extremities which form the principal seat of the sense of touch in vertebrated animals. It has also been noticed that several aquatic beetles, while swimming, bend back their antennæ, and stretch forward their palpi, as if to explore their way through the ambiguous and weedy waters. As accessory to the maxillæ, they are no doubt also employed in the selection of the most suitable alimentary portions of whatever substances have been previously seized upon by the more powerful parts of the mouth. In many insects there is only a single palpus to each of the maxillæ.

As the mouth is covered above by the *labrum*, or upper lip, so it is closed below by the under lip, or *labium* (fig. 1, *d*). The latter differs in its structure from the labrum, being more complex than that organ, and composed as it were of two portions joined together. It varies in its form,

is usually notched in front, and frequently furnished with a triangular tooth in the centre, which is sometimes bifid. Mr Kirby defines the labium as a moveable organ, often biarticulate, which, terminating the surface anteriorly, covers the mouth from beneath, and is situated between the maxillæ. It includes the mentum and labial palpi. The more uncovered portion of the labium, or that which projects from the basal portion, is now named *languette* or *ligula* by Latreille, in consonance with the nomenclature of Fabricius. The *mentum*, or chin, is the lower joint of the labium when the latter is jointed; in other cases its base.

Some contrariety of opinion seems to exist in the nomenclature of these parts. Mr Macleay bestows the name of *mentum* on the middle piece of the lower apparatus of the mouth. Its anterior portion, to which the palpi are so frequently attached, he calls the *labium*, while the basal part of the mentum is designated the *stipes*. In this view the labium of Macleay corresponds to the *ligula*, or rather tongue, of Kirby, while the mentum of the latter is analogous to the stipes of the former; for it appears that the term mentum is only applied by the author of the *Introduction to Entomology* to the lower division of the labium, when that organ (as in *Hydrous piceus*) appears to consist of two joints or pieces. When there is no apparent division, or the only separation consists in a transverse elevated line (as in some lamellicorn beetles), or an obtuse angle formed by the meeting of the two parts, then the entire piece (the *mentum* merging in it) is regarded by Mr Kirby as the *labium*.

Among the greater proportion of masticating insects there is placed anteriorly at each side of the ligula a small supporting piece or article, which takes its rise a little above the pharynx, and is terminated by a projecting appendage. These parts were named *paraglossæ* by Illiger; and M. Latreille regards them as the true representatives of the tongue of the higher tribes. The labial palpi (fig. 1, *d*), are inserted on each side of the ligula, and are usually longer than the internal and shorter than the external maxillary palpi. These palpi have never more than four articulations, in which they also differ from the external maxillary, which range from four to six. They are called labial palpi, because in many cases they derive their origin from the labium strictly so called; but in reference to Mr Kirby's nomenclature of the parts, they might with equal propriety be denominated lingual palpi, since they not unfrequently emerge from what that excellent observer considers as the tongue. Among the predaceous Coleoptera, indeed, their source seems common to both these parts, as their base on its upper side is attached to the labium, on its under to the ligula or tongue.

In some insects, such as the Orthoptera and dragon-flies, the membranous portion with which the anterior or internal face of the ligula is furnished, is thick and dilated near the centre, in the form of a little tongue, and is often divided near the middle by a groove. This portion, in the opinion of Latreille, probably occupies the place of the *paraglossæ*; for these latter, in the instances referred to, are wanting, or not to be recognised.

These are the principal parts of the mouth among the masticating insects. At the anterior root of the ligula, and a little lower than the middle of the interior space which intervenes between the mandibles, is placed the *pharynx*. In many Hymenoptera this orifice of the œsophagus opens and shuts by means of an appendage, previously noticed by Réaumur in humble bees, and taken by Latreille for the labrum, in his observations on the structure of wasps. Savigny has since paid particular attention

¹ *Introduc. to Entom.* vol. iv. p. 442.

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to it, and has named it the *epipharynx* or *epiglossa*. Latreille conceives it would be more simple to call it the *sublabrum*, because it is inserted beneath the anterior and superior margin of the head, immediately after the origin of the labrum. It is formed of two flattened portions, entirely or in great part membranous, applied the one upon the other, and of a triangular form. The upper portion is the most advanced. This epipharynx, instead of being peculiar, as some have supposed, to the Hymenoptera, may be safely regarded as existing in the other masticating insects, particularly the Coleoptera, among which it seems represented under a modified form of structure by the membrane which clothes the corresponding portion of the head.

Although the hymenopterous tribes differ from the other mandibulated orders, by the prolongation of the maxillæ and labium, and the valvular aspect of the former, yet the parts of the mouth do not present any essential distinction. A remarkable characteristic of these orders, however, consists, as Savigny informs us, in the absence of the mentum properly so called. They also exhibit this disagreement from the other masticators, in as far as their maxillæ embracing longitudinally the sides of the labium, these parts unite together so as to form a tubular body or trunk (*promuscis*), serving for suction. As their aliments consist of softish substances, or of nectarous juices, which, passing between the maxillæ and the labium, by means of the successive pressure of the former parts upon the latter, eventually arrive at the pharynx, they may in truth be regarded as semi-suctorial. Even the Rhynchophori among the Coleoptera, and the Panorpati in the neuropterous order, are furnished with an apparent trunk or prolongation of the muzzle (*prorostum*); but that peculiarity is nothing more than an extension of the anterior portion of the head; and the organs of manducation, placed at its extremity, though of diminished size, in no way differ in structure from those of the other groups of their respective orders. We may add, that the labium or lower lip in the hymenopterous tribes is generally moveable at its base, as may be observed in the corresponding tribes of the suctorial insects.

In the suctorial or haustellated orders, properly so called, the organs of the mouth appear at first sight to differ entirely from those above described. The parts which are regarded as analogous to the maxillæ, and frequently even those which represent the mandibles, are fixed and immoveable, either entirely so, or towards their base, and (in regard to the maxillæ) as far as the origin of the palpi. When the terminal portion is moveable, it is long, narrow, linear, sometimes in the form of a thread or bristle, sometimes resembling a dart or lancet, and fitted for piercing. The pharynx is the central point around which these portions arrange themselves after the tubular form. Sometimes the lower lip, united with the inferior portion of the maxillæ, and fixed like it, closes the cavity of the mouth, and the maxillæ then constitute a kind of spiral tongue. In other cases it is greatly prolonged, and assumes the form of an articulated tube, or of an elbowed trunk, usually terminated by two lips susceptible of dilatation. In either of the latter states it serves as a sheath to certain portions of a scaly structure and piercing nature, in the form of a bristle or lancet, and representing the other parts of the mouth. Sometimes this sheath (as in *Pulex*) is bivalvu-

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lar, but it more frequently consists of a single piece laterally folded so as to form a tube open on the upper surface. In this longitudinal canal or gutter, the preceding parts are lodged, and compose by their general union the sucker, or *haustellum*. In some instances the palpi have disappeared, in others only two are visible. When there are four of these parts, two of them, the maxillary, are extremely small, or almost imperceptible. Sometimes, as among the pupiparous Diptera, the lower lip is either non-existent or rudimentary, and the palpi become the sheath of the sucker. Though we make frequent use of the latter term, it may be remembered that its application is not strictly correct, as it is not by suction, or the production of a vacuum, that the alimentary juices mount towards the pharynx, but rather by the continuous pressure of the parts upon each other.

Of all the suctorial or haustellated tribes the Lepidoptera are those which differ least from the type of the mandibulated orders in the structure of the mouth,—on which account they have been made to follow in a supposed natural sequence the hymenopterous insects.¹ Their mouth seems to consist of a labrum and of two extremely small mandibles; of a trunk spirally rolled, improperly regarded as a tongue, and presenting interiorly and throughout its entire length three canals, of which, however, the central alone serves for the influx of the alimentary juices, and formed of two linear or filiform bodies, surrounding the pharynx at their origin immediately beneath the labrum. They represent, under peculiar forms and proportions, the terminal parts of the maxillæ, united, hollowed into deep gutters on their internal side, and bearing each a palpus, usually very small and tuberculiform. There is also a labium or lower lip, of a nearly triangular form, immoveable, united, as formerly mentioned, to the inferior part of the maxillæ, which supports the filiform or trunk-like portion, and bearing two triarticulate palpi, covered with scales or hairs, and placed on each side of the trunk, for which they form a kind of sheath. The intermediate canal of the trunk is produced, according to the detailed description given by Réaumur, by the union of the gutters of the internal face of the filiform or extended portions.

The sucker of the hemipterous tribes received from Fabricius the name of *rostrum*, a term translated beak (*bec*) by Olivier and other entomologists of France. A blade more or less linear, coriaceous, divided into three or four articulations, rolled up at the edges so as to form a conical or cylindrical tube, always directed inferiorly while inactive, and presenting along the centre of its upper or anterior surface a kind of canal produced by the opening left between the rolled-up margins,—a sucker composed of four slender, capillary, corneous, flexible, and elastic threads, disposed in pairs, but combined together, with the two inferior portions united in one at a short distance from their origin,—a small piece in the form of a triangular ligula, usually toothed at the extremity, rather coriaceous or almost membranous than of a scaly texture, and covering from behind or from the sides of the tubular body the base of the sucker, and inclosed along with it in the groove of the general sheath,—another piece of the same consistence with the preceding, corresponding by its insertion, and the position which it occupies, to the labrum or upper lip, covering from above the base of the sucker, most frequently itself

¹ See Plate CCXX. Fig. 5 exhibits the structure of the mouth in *Papilio Machaon*; *a* the head viewed in front, exhibiting the round eyes, one turn of the spiral proboscis, with the pilose labial palpi on each side; *b* shows the tubular spiral maxillæ (which by their union form the proboscis), with the vestiges of palpi at their base; the circular apertures on each side at the bottom of the figure indicate the insertion of the labial palpi; *c* represents the cleft labium and the two palpi, the left one being deprived of its scales to show the articulations; *d* is the minute labrum, with the mandibles on each side of it, ciliated on their internal edge. Fig. 6 exhibits the mouth of another lepidopterous insect, the *Lyndia cannarum* of Savigny; *a* the eyes, scaly spiral proboscis, and the four palpi; *b* one of the maxillæ, with its palpus; *c* the labium and palpus; *d* the labrum and mandibulæ.

External Anatomy. likewise inclosed in the sheath, and of a more or less elongated triangular form,—these are the parts which enter into the composition of the beak-like mouth or rostrum of the hemipterous tribes.¹ The single superior portion which Latreille regards as the analogue of the labrum, appears to cover, at least among the Cicadæ, the base of another more elongated and pointed portion, which has been viewed as corresponding to the epipharynx.² The other single and opposing portion, protecting from behind the origin of the sucker, and placed immediately behind the pharynx, represents, according to Savigny, the tongue or hypopharynx. The two superior filaments of the sucker, or those which are exterior, replace, or rather represent, the mandibles, while the two others may be regarded as maxillæ. Finally, the tubular sheath assimilates to the labium or lower lip, even in regard to its articulations. Sometimes the sheath is bifid, as in *Thrips*; sometimes it is divided into two plates, as in *Pulex*. The first of these genera is stated by Latreille to be the only one in which he has discovered palpi. He thinks that the parts taken for such by Savigny in *Nepa Neptunia* (see Plate CCXX. fig. 6, as described in the preceding note), are more probably the rudiments of an articulation of the sheath. Germar indeed admits four palpi as characteristic of a new hemipterous genus of the family of Cicadariæ, named *Cobax*; but Kirby, who about the same period published an account of another generic group under the title of *Otiocerus*, and which offers analogous parts, does not regard these as palpi, but as simple appendages accompanying the antennæ.³

In the dipterous order, such as gnats and common flies, the mouth exhibits a great resemblance to that of the preceding tribes.⁴ The union of the different parts forms what is usually in that order called the trunk or *proboscis*. We can here also distinguish the component parts of sheath and sucker. The former in dipterous insects is divisible into three principal portions; 1st, the *support*, distinguished from the following by an angular elbow, and frequently by a small geniculated article; 2dly, the *stalk*; 3dly, the *summit*, formed by two lips, sometimes membranous, large, vesicular, dilatable, striated, exhibiting through the microscope a great number of tracheal ramifications; sometimes coriaceous, and either small and slightly distinct from the stalk, or slender, elongated, and forming a more obvious article, almost as long as the preceding division (as in genus *Myopa*). The support is remarkable in this, that it results from the prolongation of the cutaneous membrane of the anterior and superior portion of the head, or the epistoma, united with the parts representing the labrum, to the mandibles, the maxillæ, and the inferior portion of the labium, as far as the mentum inclusive. This character particularly distinguishes the present tribes from those of the hemipterous order. In other respects the sheath may be said to be constructed on the same plan.

The centre of the superior face of the stalk also presents a groove or gutter for the reception of the sucker. The number of pieces in the sucker varies according to an arithmetical progression of three terms, of which the difference is always two—2, 4, 6; but in all cases there are always two portions which are not paired, the one superior, representing the labrum; the other inferior, placed behind the pharynx, and the analogue of the tongue or hypopharynx. Among the Diptera, as well as in the suctorial tribe (*Pulex*), the latter portion is always scaly and piercing, and contributes, in common with the others, to the purposes of nutrition. It is otherwise with the Hemiptera, and this distinction forms a new character of separation between that order and the insects now under consideration. The parts representing the maxillæ always exist, and are frequently accompanied each by a palpus; but these maxillæ are soldered to the support, and are indistinct, except where their apical portion becomes moveable and elongated, and presents the form of a seta or horny lancet. This always takes place when the sucker consists of from four to six pieces. In the latter case two of them represent the mandibles; in the other, or where the sucker is composed of only four setæ, these are wanting, or merely rudimentary. Sometimes also the labrum, almost always vaulted and large, seems to offer the vestiges of another piece, which, under a fuller development, might no doubt be regarded as the epipharynx. Sometimes the support is very short, and in this case the pieces of the sucker leave the cavity of the mouth, and the maxillary palpi are inserted on the sides. The Hippoboscæ, or pupiparous Diptera, differ from all the rest in the absence of the sheath; for the palpi, under the form of two coriaceous elongated blades, perform its functions, and advancing in a parallel direction, cover and protect the sucker.

In accordance with the observations of Latreille, as well as with those of Savigny, Leclerc de Laval, and Professor Nitzsch, regarding the structure of the mouth in such of the hexapod insects as undergo no metamorphosis (*hexapodes homotenes*), the general plan of organization seems in these to be the same as among the polymorphous orders. In *Pediculus*, properly so called, the only known suctorial species of that division, the trunk (*rostellum*) consists of a small inarticulate tube, inclosing a sucker, and withdrawing itself at pleasure within a muzzle-shaped advancement of the anterior portion of the head. But the organization of these parasitical species requires a renewed and more careful examination. The genus *Ricinus*, although furnished with mandibles, maxillæ, and an inferior lip, has these parts greatly concentrated, after the manner of the Suctoria; and the labrum seems to perform the office of a cupping glass, a character unique and unexampled in this class of animals, and one which, in combination with certain other features, indicates a peculiar type.⁵

These are the principal modifications exhibited in the

¹ See Plate CCXX. Fig. 4 represents the mouth of *Cimex nigricornis*; *a* is the articulated labium, with the eyes at each side, and the first joint of each of the antennæ; this is the sheath for the other organs, and exhibits the groove on its oral surface; *b* is the sucker viewed from above, covered at the base for one third of its length by the tubulated labrum, and exhibiting at the extremity the straight united tip of the maxillæ, and the recurved ends of the mandibulæ; *c* is a view of the same parts separated, with the labrum removed to exhibit the expanded roots of the mandibulæ and maxillæ, the small opening of the pharynx, and the pointed lingua before it and between the maxillæ. Fig. 6 represents the mouth of another hemipterous insect, the *Nepa Neptunia* of Savigny, the labrum and palate being removed. The mandibulæ appear at the external sides, their summits with reflected spiculæ, and their roots near the pharynx flask-shaped. The tongue (in the interior of the figure) is trifid at the apex, underneath which the maxillæ arise, and exceed the mandibulæ in length. The labium, or central anterior portion, exhibits the groove for the reception of the other parts, and the oval raised marks towards the narrow end are the (supposed) vestiges of palpi.

² Diction. Classique d'Histoire Naturelle, t. ii. p. 434.

³ Linn. Trans. vol. xiii. p. 12.

⁴ See Plate CCXX. fig. 7, where we represent the parts of the mouth of *Tabanus Italicus*. At *a* the mouth is shown as if opened, or the labrum and the mandibulæ and lingua separated, to expose the pharynx; *b* is one of the mandibulæ viewed laterally; *c* is one of the maxillæ with the articulated palpus, the last joint of which is greatly enlarged; and *d* exhibits the labium, with its fleshy lips.

⁵ Diction. Classique d'Hist. Nat. t. ii. p. 436.

External Anatomy. structure of the mouth by hexapod or true insects. In the opinion of Marcel de Serres, the parts named palpi (the antennulæ of some authors) enjoy, at least in the Orthoptera, a peculiar property, that of being the organ of the sense of smell. Lamarck again looks upon the palpi as exercising the faculty of taste. Latreille regards these opinions as ill-founded, so far as concerns a great number of insects, such as those in which the palpi are non-existent, undeveloped, or extremely minute; but he views them in a more favourable light in reference to certain other species. Thus, among the Coleoptera of the sub-family of *Xylotrogi*, the maxillary palpi of the males are lacinated or pectinated like some antennæ. In many other kinds the last article of the palpi is greatly dilated, and terminated by a pulpy substance.

We have not hitherto attended to the singular order Strepsiptera of Kirby (Rhipiptera, Lat.), the characters of which were first given in the *Linneæan Transactions*. If we regard the insects of this order as possessed of genuine mandibles, we must of course include them among the masticating tribes; but as in many of the preceding orders, in which the parts of the mouth are feebly developed, the mandibles are observed to have become obliterated, there is reason to suspect that the parts regarded as such in Strepsiptera are rather maxillary, in which case the structure would approach that of the lepidopterous kinds.

We have entered into the preceding details in consequence of the great importance which is now attached to the study of the parts of manducation. Latreille indeed seems to be of opinion, that whenever it is possible to characterize genera by more obvious organs, the minuter parts should not be had recourse to; and he deems the principles of the Fabrician system liable to abuse, especially when Clairville's example is departed from of employing only the mandibles and palpi. But the truth is, that the use of the compound microscope is scarcely ever required in these examinations; and it cannot be denied that a knowledge of such essential parts is indispensable in the formation of natural generic groups. The general physiognomy is frequently deceptive, and we can rectify our views only by recurring to influential organs. Thus the *Sphex spirifer*, and some analogous species which differ from their congeners in the mode of providing for their young, and which therefore form a good natural group, are also distinguished by an alteration in the structure of the mouth, but could scarcely be separated from the primitive genus by characters drawn from any other parts.

Besides the parts of the mouth, the head of insects presents some other component portions which have received particular names. What Mr Kirby calls the nose is that upper and anterior portion to which the labrum is attached, and which corresponds to the *clypeus* of Fabricius. (See Plate CCXX. fig. 1, *a*, upper portion.) The latter term was originally applied metaphorically to the expanded or shield-like covering of the head of the Scarabæidæ, and the expression was not inapt; but when it came to be used as a general term in relation to the structure of all other kinds, it lost its propriety of application. Hence the term *nasus* or *nose* has been substituted, as well as that of *epistoma*, which signifies the *part above the mouth*. Between the nose and the labrum we find in many species the nostril piece or *rhinarium* of Kirby. It is very obvious in a New Holland beetle, *Anaplognathus viridiæneus*. The *postnasus* may be seen under the form of a triangular piece, below the antennæ and above the nose, and separated from the latter and from the front by a deeply impressed line. It is very distinct in that splendid Chinese beetle

the *Sagra purpurea*. The *frons* or front of insects is the middle part of the face, bounded laterally by the eyes, anteriorly by the nose or after-nose and the cheeks, and posteriorly by the vertex. The *vertex* is the crown of the head, and is bounded laterally by the hinder part of the eyes and the temples, and posteriorly by the occiput, when that part exists. It is the ordinary region of the stemmatic eyes, although these peculiar organs are sometimes found to occur likewise upon the frons. The *occiput*, or hind head, is that part which either forms an angle posteriorly with the vertex, or slopes downwards from it. It is bounded laterally by the temples, and posteriorly by the orifice of the head, or by the neck itself. The cheeks, *genæ*, according to Kirby, usually surround the anterior part of the eyes, lying between them and the mandibles, or their representatives. The temples, *tempora*, form a continuation of the cheeks to the posterior limit of the head, forming its sides and posterior angles.¹

The *subfacies* of an insect is the lower surface or under side of the head, and is composed, 1st, of the *lora*, a corneous angular machine, upon the intermediate angle of which the mentum sits, and on the lateral ones the cardines or hinges of the maxillæ; it is by means of this piece that the parts of the mouth (as in *Hymenoptera*) are pushed forward or retracted; 2d, of the *jugulum* or throat, which is that part of the subface which lies between the temples. The *collum*, or neck, is that narrow portion of a pedunculate head by which it is connected with the thorax.²

The next appendages of the head to which we have to direct the reader's attention are the *antennæ*. These are moveable articulated organs, never exceeding two in number in genuine insects, although their form, and the amount of articulated portions, are extremely various. Their primary use in the animal economy has not yet been ascertained; at least a great diversity of opinion is maintained on the subject. In numerous tribes they seem to exercise a faculty analogous to that of touch, being employed in exploring the depth of crevices, and in ascertaining by contact the nature of any opposing obstacle; while, on the other hand, their extreme shortness in most Diptera, and in many of the neuropterous and hemipterous tribes, does not accord with that usage. Although of considerable importance in our systematic arrangement of insects, the development of the antennæ does not seem subjected to any general or conformable rules, and is therefore of less value than that of several other parts of structure. For example, we frequently find a considerable difference to exist in the form of the antennæ among species in other respects intimately allied; and even between the sexes of the same species a great disparity in size and structure is observable. Where a difference exists, those of the male are generally more developed than those of the female.

The antennæ of insects are usually composed of small cylindrical articulations, containing nervous threads, muscles, tracheæ, and cellular tissue. Various terms are in use to express their form, consistence, and mode of insertion. They are *regular* when the articulations follow a gradual and progressive order in the modifications which they undergo; *irregular*, when their forms alter suddenly; *cylindrical*, when rounded and of equal diameter throughout their length; *filiform*, when the cylindrical shape is finely attenuated, like a thread or hair; *setaceous*, when lengthened, and diminishing insensibly from the base to the point; *subulated* or *awl-shaped*, when slender, but short, cylindrical at the base, and terminated by a stiff and sharpened point; *moniliform*, when each article is rounded like a bead, and of nearly equal thickness; *prismatic*, when ap-

¹ *Introduc. to Ent.* vol. iv. p. 489.

² *Ibid.* p. 366.

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proaching the form of a geometric prism; *ensiform*, when broad at the base, and terminated by an angular point; *fusiform*, when shaped like a spindle; *serrated*, when each article is terminated laterally by a sharp tooth directed forwards; *pectinated*, when these projections are straight, lengthened, and placed above each other, like the teeth of a comb; *ramose* or *branched*, when several appendages project from the main body of the antennæ—they are regarded as *simple* when not in any way so adorned; *perfoliated*, when the articles are flattened from the summit to the base, and appearing as if strung on a thread through the centre (it is usually the terminal portion of the antennæ that is so characterized); *imbricated*, when the articles are threaded as above mentioned, and concave at their summit, so that each covers the base of that which follows; *clavated* or *club-shaped*, when thick or swollen towards the summit. The club is *solid* when its parts are not separated by any apparent space; *perfoliated*, when composed of threaded articulations; *lamellated* or *foliated*, when the parts of the club are connected laterally, and admit of being opened and closed like the leaves of a book; *securiform* or *hatchet-shaped*, when the last articulation assumes the form of a compressed triangle, free at the base, but articulated by the apex. Antennæ are also said to be *uncinated* or *hooked* when the extremity suddenly bends itself towards the base; *bifid*, when divided into two; *obtuse*, when terminated by a round or blunted articulation; *truncated*, when apparently deprived of a portion; *plumose*, when thickly branched on either side, like a feather. Many other terms are in use to express the modifications of these important organs, most of which, however, are of a sufficiently familiar derivation to explain themselves.

The antennæ of the coleopterous order usually consist of ten or eleven distinct articulations. The latter number is the most frequent, although several genera present much fewer joints, as for example *Paussus*, in which there are only two. Others again have many more, such as a species of *Prionus*, of which the antennæ of the female have nineteen joints, of the male twenty. In some orthopterous kinds these articulations amount to a hundred and fifty. The antennæ are inserted on the front of the head, anterior to and rather beneath the region of the eyes. Their particular position varies, but they are always either in the space between the eyes, or that below them. As their various forms, as characteristic of particular groups of species, will be afterwards described in the systematic part of the present treatise, we shall not here enter into further details of structure. The uses of these singular organs are variously viewed by naturalists, and there seems even yet to be more hypothetical reasoning on the subject than precise induction from facts. Some regard them as the seat of smell, others of hearing, a greater number as the organs of the sense of touch. The indurated nature of the outer covering in most insects would certainly lead us, *a priori*, to expect a special provision for the reception of the last-named sense. It is, however, extremely difficult, in the present state of our knowledge, to come to any general conclusion on the subject. We shall state the prevailing opinions when we come to treat of the senses of insects; and under that head we shall likewise explain the structure of the eyes.

The *thorax* forms the second principal portion of an insect's body. It is itself divisible into three parts, and its component segments vary greatly in their relative proportions in the different tribes; the division which is merely rudimentary in one particular group, being sometimes highly developed in another. These parts are named the *prothorax*, the *mesothorax*, and the *metathorax*.

The *prothorax* (from *πρῶτο*, *before*, and *θώραξ*, *thorax*) is the anterior segment, and corresponds to the *corselet* or

collar of M. Latreille; the second segment is named *mesothorax* (from *μεσος*, *middle*); and the third is known as the *metathorax* (from *μετα*, *after*.) Each segment may likewise be distinguished in reference to its inferior, its lateral, and its superior portions; and the whole united constitute the *thorax*, commonly so called. But although the general name of thorax is applied to the parts just named, yet the posterior two, that is, the mesothorax and the metathorax, are the most dependent on each other, and are always intimately united; while the prothorax, as exemplified in the Coleoptera, is often comparatively free and distinguishable. It is this last-mentioned segment which bears the anterior pair of feet, and it considerably exceeds the others in extent. In the coleopterous order, indeed, it is the only part that is visible on the upper surface, the other segments, with the exception of the scutellum, being connected beneath it and the elytra. The mesothorax and metathorax unite strictly with the base of the abdomen, and serve as the points of attachment to the other pairs of feet. Of the mesothorax or central portion, the most obvious characters consist in its serving as a support to the second pair of feet, and to the elytra or first pair of wings. Its form, size, and consistence are extremely various. Slightly developed in the Coleoptera and Orthoptera, it is larger in the Hemiptera, the Neuroptera, and more especially in the Hymenoptera, the Lepidoptera, and the Diptera. Its excessive increase is always associated with a condition more or less rudimentary of the other segments. Thus, in the three orders last named, the prothorax and metathorax are very restricted; while, on the contrary, they are large in the Coleoptera, among which it is observable that the mesothorax is always compressed and narrow. The metathorax serves as the point of attachment to the third pair of feet, and to the second or membranous pair of wings.

We have said that each segment may be described in relation to its inferior, its lateral, and its superior parts. A piece named the *sternum* constitutes the whole of what is called the *inferior* portion. This is not, as too often supposed, an occasional projection, merely characteristic of certain tribes. It occurs in all insects, and forms a distinct character, though more or less defined and perspicuous, according to the genus. It may be regarded as generally composed of three distinct pieces, resembling in this respect the human sternum, which anatomists describe as consisting originally of three bones. Each of these pieces, according to Mr Kirby, is appropriated to a pair of legs, and each of them has been called the *sternum*; thus, in *Elatér* the *prosternum*, in the *Cetoniadæ* the *mesosternum*, and in *Hydrophilus* the *metasternum*, have alike been distinguished by the name. Each of the ordinary *lateral* portions of the thorax is formed of two principal pieces, which, in combination with the sternum, is by some named the *pectus* or breast. The anterior piece rests upon the sternum, and is hence called *episternum* (from *ἐπὶ*, *upon*). The posterior lateral portion, called the *epimera*, is connected with the preceding; it also adheres to the superior portion, and rests in certain cases on the sternum; but it bears a constant relation to the haunches of the segment to which it belongs, and to these it articulates by means of a little piece afterwards mentioned by the name of *trochantin*. It derives its name from *ἐπὶ*, and *μηρός*, *thigh*. Lastly, there exists on these same lateral parts a third piece, in general slightly developed, and sometimes imperceptible. It bears relation to the wing and episternum, always supports itself on the latter, is sometimes prolonged inferiorly along its anterior margin, or, becoming free, passes in advance of the wing, or even places itself above it. It bears the name of *paraptera*, from *παρά*, *near to*, and *πτερόν*, *wing*. Three other portions of some importance may likewise be considered as belonging to the general *pectus*.

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1st, Above the sternum, on its internal face, that is, within the body of the insect, there exists a piece sometimes remarkable for its size. It is placed on the median line, and generally takes its rise from the posterior extremity of the sternum. It assumes various secondary forms, and is generally divided into two branches. Cuvier named it the Y-formed portion, on account of his having observed it assume the shape of that letter. It is called *entothorax* by M. Audouin, from *εντος*, *within*, because it is always placed in the interior of that organ. It occurs in each segment of the thorax, and seems to be in some measure a dependent on the sternum. Its uses are supposed to be the protection of the nervous system, and its isolation in many cases from the digestive apparatus and the dorsal vessel. The entothorax exists not only in the thorax, but in the head, in which case it is named *entocephalus*; it has even been noticed in the first ring of the abdomen in the genus *Cicada*, and the portion named *triangle écailléux* by Réaumur may safely be regarded as its analogue. In this last condition it is denominated *entogaster*.

2d, On the anterior edge of the episternum, sometimes of the sternum, and even on the superior part of the body, a stigmatic opening is observable, surrounded by a small piece, of which the texture is frequently corneous. This is the *peritrema*, so called from *περι*, *round about*, and *τρημα*, *a hole*. It is not always perceptible, both on account of its being sometimes too closely connected with the neighbouring pieces, and because the stigmatic opening is itself sometimes obliterated. But when visible, it is necessary that it should be distinguished, as its position is of importance, and becomes a useful auxiliary in the comparison of parts and in the determination of analogies.

3d, Lastly, it has been already stated in relation to the epimera, that it is connected with the rotule by means of a small articulation, of which the existence was first made known by M. Audouin. This is not an essential part of the thorax; but as it accompanies the epimera, and is associated with the parts of the leg, all of which have received particular denominations, its first describer has thought proper to bestow upon it a name. He calls it *trochantin*, in distinction to *trochanter*, or that portion of the leg which is associated with the rotule and the thigh. The trochantin is sometimes concealed in the interior of the thorax, and is sometimes visible externally, according as the rotule is itself more or less prolonged in its internal portion. The ascertainment of this piece, according to M. Audouin, admits of a direct comparison between the limbs of insects and those of the Crustacea. Hitherto there were only five parts in the former (the tarsi being regarded as one), while there were six in the latter. But the trochantin completes the number six likewise among the insect tribes.

We have now detailed the structure of the chest or pectus of insects; so that whoever desires to view one of these creatures anatomically, should, after dividing the thorax into three segments, seek to ascertain, on the inferior and middle portion of each, the existence of a sternum, and on the flank or lateral portion, an episternum, a paraptera, and epimera. He will also study the structure of the entothorax, of the peritrema, and of the trochantin. Sometimes, however, the union of one or more of these parts with another is so intimate that they cannot be isolated or distinguished; but when we elsewhere, in such numerous cases, perceive that the pectus is formed of a certain number of elementary parts, it is more rational to believe that in all instances these same elements are made use of, than to suppose the frequent requirement of new.

We shall next discuss the superior portion of the thorax of insects. In the coleopterous tribes the prothorax, as be-

fore mentioned, constitutes the principal portion, and its upper part may be called the *thoracic shield*. The only other part sufficiently distinguished prior to the time of M. Audouin, was the *scutellum* or escutcheon. It is highly developed in the Scutellerae, and rudimentary in most of the Hymenoptera, Diptera, Lepidoptera, and some other orders. Its apparent position between the wings has occasioned its being regarded too exclusively as a kind of *point d'appui* in flight. It is usually of a triangular form in the Coleoptera, and projects backwards from the mesothorax, with its point interposed between the elytra and the wings. The scutellum was adopted by Geoffroy as the basis of his arrangement of the genus *Scarabæus*. It is, however, by no means a well-chosen characteristic of the greater divisions in entomology; for the accurate distinction is not, as is usually supposed, whether the scutellum does or does not exist in a lamellicorn insect, but whether it is or is not apparent.¹ It occurs very obviously among many of the coleopterous tribes, but is most conspicuously developed in that genus of the hemipterous order called *Scutellera*, of which *Cimex lineatus* may serve as an example. Naturalists have erred in regarding this portion as characteristic of the mesothorax alone. It is often greatly developed in the posterior segment. Numerous and varied researches have led M. Audouin to conclude that this superior portion of the thorax is composed of four principal pieces, frequently isolated, sometimes intimately united, usually distinct. He has deduced the following nomenclature from their relative position in regard to each other. The anterior portion is named the *præscutum*; it is sometimes very large, and is usually concealed in whole or in part in the interior of the thorax. The second piece is called the *scutum*; it is an important element, often strongly developed, and always articulates with the wings when these exist. To the next piece the original term *scutellum* is applied; it consists of the projecting angular point, generally so denominated by entomologists. The fourth and last piece is called the *postscutellum*; it is almost always entirely concealed within the thorax, sometimes united to the internal face of the scutellum, and confounded with it, sometimes free, and not adhering to the other portions, except by its lateral extremities. These are the parts which constitute the superior portion of the thorax, and to which the general term *tergum* may be applied. Thus we may speak of the tergum of the prothorax, of the mesothorax, or of the metathorax; but when the word tergum alone is used, we are then understood to signify the union of the superior parts, that is, the entire space comprised between the head and the first segment of the abdomen.

We come now to the *abdomen* itself, an important portion in the animal economy. Anatomists in general appear to have advanced from the study of the human frame to that of animals, or at least to have applied to the parts of the latter the same terms which they had previously bestowed upon the former. In so doing, however, they have been guided rather by the analogy of form than of function, and hence the vague nature of many terms, as applied to the inferior orders, and which, however correct in their original signification, become either obscure, or altogether inapplicable in regard to other classes.

The abdomen, among insects, is that part of the body which is attached to the posterior extremity of the thorax, composed of five or six rings or segments, unprovided with locomotive organs, and always containing within it a portion of the digestive canal. If, as many suppose, its existence depends upon that of the thorax, then the entire class of Annelides or red-blooded worms may be said to be deprived of it, as the thorax itself does not exist in that class.

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¹ *Horæ Entomologicae*, part i. p. 9.

External Anatomy. The term body is then made use of to designate generally the whole of the animal. Although the abdomen cannot well exist without the thorax, the converse does not appear to hold good, for the latter in many species seems to constitute the whole body. Many of the *Myriapoda*, such as *Iulus* and *Scolopendra*, are examples of this; for they are composed of a series of segments, all furnished with feet except the last, which has therefore by some been regarded as the abdomen.

But among genuine insects, that is, the hexapod or six-footed kinds, the abdomen is obviously developed, and, especially among the winged tribes, is very distinguishable from the thorax. Among the apterous species the distinction is less perceptible; and the same may be said of most insects in the larva state. Among the hymenopterous kinds, such as wasps, bees, &c. it appears as if it were pediculated or attached to the posterior part of the thorax by means of a slender stalk; but minuter and more accurate observation demonstrates that this neck-like restriction actually takes place on the second segment of the abdomen, the first of which is much more spacious, but so closely attached to the thorax by its anterior edges as to become undistinguishable. In the coleopterous order the abdomen is usually convex, and of a harder consistence beneath, where it is exposed; but it is soft, and either flattish or concave above, where it is covered by the folded wings and elytra. On both sides of its segments there is a small roundish opening called the *stigma*, which serves for the introduction of air for the purposes of respiration, and of which we shall treat in detail when we come to the consideration of that function.

It has been noted that if an insect is naturally more habituated to walking than flying, the breast or lower portion of the thorax is expanded, and is furnished with more powerful muscles than the back; whereas, if flight is the more frequent mode of locomotion, an increase is observable in the dorsal muscles. The locomotive organs are of course the wings and legs, on which we shall now bestow a brief consideration.

SECT. III.—ORGANS OF LOCOMOTION IN INSECTS.

1. The Wings.

These organs exist, effectively, in insects only in the perfect state; for the larvæ do not offer externally any trace of them, and when apparent in the nymph or intermediate condition, they are merely rudimentary. No insect has more than four wings, many have only a single pair, and others are entirely destitute of these parts. When four in number they may be regarded as *anterior* or *superior*, and as *posterior* or *inferior*; and we likewise talk of the *first* or of the *second* pair of wings. The coleopterous order presents some peculiarities in relation to these organs. The anterior pair (in all cases, as already mentioned, united to the mesothorax) consist of a hard or horny substance similar to the envelope of the thorax, and are called *elytra*. When closed, their junction usually forms a straight central line called the *suture*, which is rather apparent than real in certain species in which the inferior wings are wanting, and the elytra form a single undivided piece. They are convex above and concave below, are fixed to the mesothorax, and cover and protect the genuine wings, which are of a much more delicate structure. These latter derive their origin from the metathorax, and are the

actual organs of flight. They are membranous and transparent, and when unemployed are transversely folded beneath their horny covering. We shall here describe the structure of wings, and explain the terms made use of to express the principal modifications which they undergo in their various degrees of development in the different orders.

The wing of an insect consists of two thin flexible membranous transparent plates or leaves, the one superimposed upon the other, and variously intersected by darker lines of a horny consistence, usually known by the name of nervures. These nervures, which at first sight appear like superficial threads, of which the larger follow the longitudinal direction of the wing, are interposed between its membranes, and present two faces, of which the upper, frequently rounded and very horny, adheres closely to the corresponding leaf, and the under, of less firm consistence, and of a flatter form, may by skilful dissection be removed from that portion of the wing by which it is covered. In the opinion of M. Audouin, these threads are in fact so many tubes, which diminish in diameter as they approach the summit of the wing, and each of which contains, throughout its entire extent, a spirally rolled vessel, by some regarded as a genuine trachea. These tracheæ receive air from the interior of the body, and their formation, according to Swammerdam, whose views have more recently been confirmed and adopted by Jurine and Chabrier, is to strengthen the wing by distending it during the action of flight. They are said to experience no sensible dilatation during their progress, whereas the corneous tubes which contain them present in that respect some curious modifications,—for they sometimes spread out suddenly, in such a way as to exhibit, for a short space, a comparatively broad diameter. The colouring matter being then disseminated over a wider surface, assumes so pale an aspect that the nervure which leads into one of those little expansions appears as it were interrupted. Hence the name of *bulles d'air*, or air-bubbles, bestowed upon the latter by the French entomologists. They occur most frequently in the cubital nervures of many Hymenoptera, and their chief use is supposed to be to facilitate the formation of certain foldings of the wing during the periods of repose. The largest of the nervures arise from the base of the wing, that is, from the point of its insertion in the thorax. A most skilful observer, the late M. Jurine of Geneva, has described the wings of hymenopterous insects with great accuracy, in a memoir to which we shall make more special allusion when we come to treat of that particular order.¹

The general character in respect to form and aspect of the wings of insects has received a great variety of names. They are sometimes *equal*, that is, all four of similar size; or *unequal*, when one pair prevails over the other; *lanceolate*, when they become narrow, both at the base and apex; *falcated*, when curved like a scythe or reaping-hook; *linear*, when narrow, with nearly parallel edges; *clavated* or *club-shaped*, when linear in their general extent, but perceptibly enlarged towards their extremity; *rounded*, when they approach a more circular form; *oblong*, when more lengthened than broad, and describing an elongated ellipse, obtuse at both ends; *rhomboidal*, when they are longer from the posterior angle to the summit than from that angle to the base; *deltoid*, when they assume the triangular form of the Greek letter delta; *exserted*, when the inferior wings pass beyond the elytra; *covered*, when entirely protected by those organs; *plaited*, when longitudinally

¹ See *Observations sur les Ailes des Hyménoptères*, in the twenty-fourth volume of the *Mém. de l'Académie des Sciences de Turin*. Consult also, by the same author, *Nouvelle Méthode de classer les Hyménoptères et les Diptères*. Genève, 1807.

External Anatomy. folded, after the manner of a fan; *replicated*, when, after being plaited as just mentioned, they are again folded transversely upon themselves; *incumbent*, when the posterior margin of one covers that of the other; *extended*, when, in a state of repose, they are stretched on either side, leaving the abdomen visible; *erect*, when, in a state of repose, they are raised perpendicularly to the surface of the body; *deflexed*, when the summits and outer margins form as it were a kind of inclined plane from the base and inner margins. These are the principal variations as to form and attitude, or position. The following terms are of frequent use in entomology, when the surface or superficial structure of the wings is sought to be described. They are *striated*, when certain raised lines are perceptible, forming slight parallel and longitudinal furrows; *reticulated*, when these lines are disposed like lace or network; *veined*, when distinct longitudinal nervures are observable, ramifying into more delicate branches; *squamous* or *scaly*, when covered with minute powdery particles, which, when examined with a glass, are found to be small scales imbricated or imposed on each other like slates or tiles on a house top; *farinose*, when sprinkled more irregularly with fine particles resembling flour, and easily removeable by the finger; *pilose* or *hairy*, when the surface is more or less covered by minute hairs; *naked*, when there is no covering of either hairs or scales. Other characters are deduced from the markings of the wings in regard to tint and colour. They are *concolorous*, when similar or unvaried in their hue; *vitreous* or *windowed*, when, opaque over their general surface, certain translucent spots are here and there observable; *ocellated*, when they present circular spots of different colours, resembling an eye; *pupillated*, when the eye-like spot has a coloured point in its centre; *fasciated*, when there are broad coloured lines or bands,—and these are distinguished as transverse, longitudinal, oblique, lanceolated, &c. according to their prevailing direction and characteristic form.

The margins or edges of the wings have likewise received a considerable variety of designations, according to the peculiar characters which they exhibit. They are *crenated*, when they present an alternation of slight incisions and obtuse projections; *dentated* or *toothed*, when these incisions are deeper and narrower, and the projections sharper and more defined; *fimbriated*, when the marginal processes are lengthened, pointed, and close; *cloven*, when the incisions are few and deep; *digitated*, when the parts cut into assume the aspect of a hand; *emarginate*, when the incision is slight, and seems merely to have scooped out a small portion of the wing; *caudated* or *tailed*, when the posterior margin presents a more lengthened appendage; *ciliated*, when the wings are bordered by close-set hairs resembling eye-lashes. The points of the wings are *obtuse*, when terminated by a rounded outline; *truncated*, when they appear as if cut; *acute*, when ending in a point; *acuminated*, when that point is sharp and prolonged.

These details, we doubt not, like all the other technicalities of a complex branch of science, must seem irksome to the general reader. Nevertheless, as they frequently form important and sometimes indispensable elements of knowledge, we must continue their enumeration. The wings, in fact, have furnished the characters from which the names and definitions of the orders in entomology have been derived, and a knowledge of their forms and functions is required during almost every step of our progress. A transcendental anatomy has no doubt thrown its ambiguous light (*lucus a non lucendo*) upon these and other portions of animal economy; and the wings, which in former times were thought sufficiently defined when merely named as the organs of flight, are now regarded by some

as legs, and by others as lungs. We still see, however, that they carry the creatures through the air, and we shall therefore rest satisfied by viewing them in accordance with our accustomed associations. External Anatomy.

Among the more remarkable of the modifications experienced by the upper wings, is that corneous condition in which they are known under the name of *elytra*. These are particularly characteristic of the coleopterous order, and derive their name from *ελυτρον*, a sheath or covering, because they protect the membranaceous wings. They are attached by their base, by means of several small pieces, to the mesothorax. The opposite extremities are called the points or summits, and the margins are known as anterior or external, posterior, and interior,—the last named, when the parts are closed, and meeting over the back, forming what is called the dorsal suture. As to their proportions, they are *elongated*, when they exceed the abdomen; *abbreviated*, when shorter than that organ; and various other terms of obvious application are made use of to express their different degrees.

The elytra differ in their consistence, being sometimes almost *membranous*, or scarcely firmer than the under wings; or they are *coriaceous*, or of the texture of leather; *semi-coriaceous*, when, as among many Hemiptera, the elytra are composed of two parts of different texture; *pergameneous*, or like parchment; *flexible*, when, yielding to a slight impression, they yet return again immediately to their original shape; or *soft*, when they yield to the same impression, but retain the alteration of form for a longer time. As to form, many of the terms already enumerated in relation to the wings in general, apply equally to the elytra. They are also *gibbous*, when greatly rounded or hemispherical; *dilated*, when more flatly expanded; *attenuated*, when they diminish in breadth from the base to the apex. The surface of these parts presents many characters of great importance in the discrimination of species, and even in the formation of sections or subdivisions of genera. They are said to be *chagrined*, when covered by minute raised spots; *punctated*, when these spots are distinct and hollowed; *tuberculated*, when the elevations are distinct and irregular; *scabrous*, when the elevations are distant and unequal; *verrucose* or *warty*, when they are large, cicatrised, and resembling warts; *striated*, when marked with regular longitudinal lines; *striato-punctate*, when in each stria there are depressed points; *punctato-striate*, when the striæ are themselves formed by a consecutive series of these impressed points; *sulcated* or furrowed, when the impressed lines are deep and broad; *ribbed*, when between the furrows there are raised lines; *rugose*, when the raised lines are irregular, and divided in all directions; *reticulated*, when these lines are disposed with greater regularity, in a kind of network; *crenated*, when the lines are rather regularly undulated; *glabrous*, when the elytra are smooth, or destitute of raised points or other irregularities of surface; *tomentose* or *cottony*, when covered by a whitish down; *pilose*, when hairy, —also *villous*; *fasciculated*, when the hairs are collected here and there in little tufts; *muricated*, when the hairs are long, raised, and almost prickly; *spinous*, when the projecting parts are hard and sharp like spines; *squamous* or *scaly*, when covered by little scaly plates.

The elytra are said to be *marginated* when their edges are raised, or otherwise distinguished from the general and more central surface; *sinuated*, when there are sloping notches on their outline; *serrated*, when furnished with little sharp projections like the teeth of a saw; *dentated*, when these are sharp and more distant. They are likewise said to be *mucronated* when the apex is provided with a sharpish point; *bidentated*, when there are a couple of distinct projections; *obtuse*, when the summits are blunt or

External rounded; *truncated*, when they seem as if a portion had been severed.

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We have already mentioned, that in many of the hemipterous order the anterior wings are *semi-elytrous*, that is, comparatively solid in one part of their extent, and membranous in the other. In fact, the order derives its name from that character, as already mentioned in our introductory definitions. In the orthopterous order the anterior wings, though much more membranaceous than those of beetles, yet approach the nature of elytra, and serve as a protection to the under pair, which are more delicate. Among neuropterous insects both pairs of wings are alike in their general character of texture and reticulation, and the same may be said of the hymenopterous order. Those of the Lepidoptera are also similar to each other in their substance and covering. With a few exceptions, in which the wings are clear or diaphanous, in the last-named gorgeous group they are thickly coated with minute scales of various colours, which when removed exhibit the membranous structure of the parts. They present several other peculiarities, which we shall notice when we treat of the generalities of the greater divisions of which the order is composed.

The wings, regarded throughout the entire series of hexapod insects, are thus extremely varied in their form, consistence, development, and efficiency. The distinctions, both of form and texture, show themselves, as it were, by gradation, and present no striking disparity among species otherwise nearly allied. But the uses, and degrees of development, of these organs, vary greatly not only among species of the same genus, but even between the sexes of the same species; for while the males of several kinds are efficiently winged, the females are entirely apterous. When the anterior wings, as in the Coleoptera, are *elytrous* (if we may use the expression), they scarcely serve for the purposes of flight. In the neuropterous and hymenopterous orders both pairs are equally efficient, while in the dipterous or two-winged tribes the inferior wings have disappeared. In some cases, as among the female ants, the wings fall off immediately after the sexual union.

The development of the wings always bears a relation to that of the superior arc of the thorax by which they are supported. It has been already noted, that if an insect is more habituated to walking than flying, the breast or lower portion of the thorax is extended, and is furnished with more powerful muscles than the back; whereas if flight is the means of locomotion, an increase of power is observable in the dorsal muscles.

One of the laws laid down by M. Straus Durekheim as regulating organic structure is the following:—that when one organ governs another, or several others, these follow the march of the dominating organ; and that when the latter disappears, those which were subordinate to it immediately assume their primitive form. This law may be exemplified by the influence of the wings upon the thorax. In proportion as the two pairs of wings change in form and size, the two segments of the thorax which support them follow the same progression, and become more and more united to each other; but no sooner do the wings disappear in the Aphaniptera (*Pulex*), than the two segments of the thorax regain their primitive form, and separating from

one another, present the same appearance as in *Lepisma*. The wings being first introduced amongst the Coleoptera, and the thorax of these as yet differing but little from that of the Thysanura, it can easily return to the form it possessed previously to its undergoing any modification. It thence follows, that in such species as are deprived of wings, the thorax returns more or less to its primitive form. This is particularly remarkable in the females of many species of *Lampyrus*, which possess neither wings nor elytra; and this return is moreover occasioned in the Coleoptera without wings by another cause, which acts in this case on that part of the body; it is the diminution of the solidity of the integuments in those parts which are covered by the elytra.

In the other order of insects, according to the views of the last-named author, the two segments which bear the wings having already experienced a very considerable change of form, it would require a very powerful cause to bring them back to their primitive form; for this reason the return does not take place in *Cimex cellularius*, the *Formicae*, &c. amongst which the imperfection (if it may be so called) is only specific. In the Aphaniptera, on the contrary, which we may in some respects consider as wingless Diptera, the transformation of the thorax takes place in consequence of a complete absence of the wings, brought about by the degradation which these organs have experienced in passing through the whole of the class Insecta.

M. Straus Durekheim, in the introduction to his carefully elaborated work,¹ has also endeavoured to explain the laws which regulate the different changes of structure in passing from one group to another. The most general law in the organization of animals which he has recognised is, that all the systems of organs are subjected to a constant variation of form, and even of function, while passing from one family to another. The first more special or particular law which he evolves from the subdivision of the former is the following: That the organs at one extremity of the scale always exercise a very evident function; whilst at the other extremity they are constantly rudimentary and without function, and at last entirely disappear. He here distinguishes two kinds of cases. In the first, the organs present themselves at the head of the scale developed to the highest degree of which they are susceptible, and decrease insensibly, until they arrive at the other extremity of the scale. Thus, for example, the posterior wings of insects are “introduced suddenly” into the organization of that class at the highest point of perfection in the Coleoptera, where *they* alone serve for flight. In the Orthoptera and Hemiptera they already begin to divide their function with the elytra, and go on diminishing gradually until they exist merely as rudiments in the Diptera, where they are represented by the halteres.² Finally, they entirely disappear in the Aphaniptera. In the second instances, the organs do not appear at the head of the scale in their most perfect state of development, and only acquire it by degrees. Such is the case with the elytra, or first pair of wings, which follow a course exactly contrary to that of the inferior wings. They only appear at first as organs slightly accessory to flight, in which state they remain nearly throughout the whole Coleoptera. In the Orthoptera and Hemiptera they begin already to take a very active part in

¹ *Considérations Générales sur l'Anatomie Comparée des Animaux articulés, auxquelles on a joint l'Anatomie descriptive du Hanneçon*, 1 vol. 4to, avec planches, Paris, 1828. An abstract of the doctrines of this work will be found in the *Entomological Magazine*, vol. i.

² The name of *Halteres*, poisers or balancers, is bestowed on a pair of slender moveable appendages found on the hinder part of the thorax in dipterous or two-winged insects. They are usually regarded as the rudiments of the second or posterior pair of wings,—“*halteres rudimenta alarum posticarum*,” as Fabricius has expressed it in his *Entomologia Philosophica*. This opinion, however, is believed by others, and we think with reason, to be founded rather on the position which these organs bear in relation to the anterior wings, than on their connection with the metathorax and its different parts. Latreille, a great authority in such matters, maintains that the balancers do not correspond to or represent the second pair of wings, but are rather vesicular appendages connected with two posterior tracheæ of the thorax, and analogous in some measure to the processes which accompany the respiratory organs of the Aphro-

External Anatomy. flight, but still preserve their primitive use. In the Neuroptera, particularly the Libellulina, they attain the development of the inferior wings, from which they differ but very slightly. From this point they continue to surpass them, until in the Diptera they become the sole organs of flight, and of course have there attained their highest degree of perfection. Arrived at this culminating point, they suddenly diminish in Hippobosca, and entirely disappear in Pulex.

We shall next devote a few lines to those portions of the wings called *ailérons* by the French naturalists, known also under the name of winglets or *alulæ*.¹ They are chiefly characteristic of the dipterous tribes, and may be regarded as appendages of the anterior wings, the sole pair in that particular order. Their attachment to the scutellum and the postscutellum of the mesothorax is sufficient evidence that they are not the rudiments of a posterior pair; for these, if they existed, would derive their origin from the metathorax. They usually consist of two concavo-convex pieces, intermediate as it were between the wing and the poisers, and folded the one upon the other, like the parts of a bivalve shell when the insect is at rest, but stretched or extended during flight. Their special uses are not yet known.

The poisers or balancers (*halteres*) have been sufficiently described in the preceding note. Audouin regards them as the rudiments of the second pair of wings, of which the extreme tenuity in the Diptera accords in his opinion with the evanescence of the metathorax.² Their use, like that of the last-named organs, seems not to have been satisfactorily determined. Dr Derham and others have thought that, like the pole of a rope-dancer, they keep the body steady in flight; while some connect them with the noises produced by insects, and maintain that they act upon the membrane of the winglet, as a drumstick acts upon its proper organ, thus producing sound. Shelver's opinion is probably more correct, that they are connected with the function of respiration.³ But the various sentiments on the subject are as yet conjectural.

2. The Legs.

Having now endeavoured to explain the structure of the wings or organs of flight, we shall next request the reader's attention to those other organs of motion, the legs of insects. With the exception of the Myriapoda (*Centipedes*, &c.), which, with Latreille and Dr Leach, we shall form, as already noted, a separate class, the number of legs in insects is precisely six. They are composed of the following parts: 1st, The *coxa* or haunch, which is the first joint, or that which plays in the socket (see Plate CCXX. fig. 2, *a*); 2d, the *trochanter* or second joint, to the side of which the thigh is attached, and by means of which it inosculates with the coxa (Ibid. *b*); 3d, the *femur* or thigh, which is long, and usually compressed (*c*); 4th, the *tibia* or shank, generally the longest joint of the leg, and frequently notched on its edges, and terminated by spur-like appendages (*d*); 5th, the *tarsus*, composed of articulate portions, varying from three to five among the Coleoptera and the majority of insects (*e*). The last articula-

tion of the tarsus bears the *ungues* or claws (*f*). M. Audouin and some other French naturalists seem to use the term haunch (*hanche*) as a collective designation, including an internal portion formerly noticed, called *trochantin*, along with the *rotule* (our coxa), and the trochanter. In accordance with this view, the parts of the leg in insects may be said to amount to six pieces, instead of the five which we have just enumerated. These terms apply strictly to the intermediate and hind legs. The anterior pair are by some writers regarded as *brachia* or arms. The first joint of the brachium, answering to the coxa of the legs, is named *clavicula*, or the clavicle, by Mr Kirby; its second joint, answering to the trochanter of the other limbs, is called the *scapula*; the third and elongated joint, corresponding to the femur, is designated the *humerus*; while the articulations of the tarsus are known as the *manus* or hand. However, the majority of authors seem not to express any distinction between the parts of the fore legs and those of the intermediate and hind ones. The anterior pair, we may observe, are in some cases convertible into organs of prehension, and their tarsi are frequently dilated in the male sex. The number of articulations of the tarsi varies in the different tribes, and is not always the same in the different pairs of legs in the same insect. Their amount on each limb has been assumed as a basis for the formation of the great sectional divisions of the coleopterous order, as originally proposed by M. Geoffroy, and so generally adopted by the continental naturalists. The character, though arbitrarily chosen, and not seldom artificial in its results, has proved upon the whole more compatible with a natural arrangement than usually happens on the selection of a single and unimportant organ. We shall enter into further details in relation to this matter in our introduction to the coleopterous order, and shall merely observe in the mean time, that pentamerous species, or those of which all the tarsi are furnished with *five* articulations, are the most abundant,—more than one half of the coleopterous kinds being referable to that section.

These are the principal external parts of the structure of insects.⁴ Their internal conformation has been illustrated of late years by the successful efforts of several very skilful and ingenious observers. We shall here notice the dominating or more influential organs, and give a short view of the important vital functions which they exercise.

CHAPTER III.

THE INTERNAL STRUCTURE AND PHYSIOLOGY OF INSECTS.

SECT. I.—THE NERVOUS SYSTEM AND SENSES OF INSECTS.

The nervous system of animals in general, it has been remarked, is one of the most wonderful and mysterious works of the Creator. Its pulpy substance is the visible medium by which the governing principle (Τὸ Ὑγέμονικόν) transmits its commands to the various organs of the body, which instantaneously obey the impulsive mandate; yet this appears to be but the conductor of some higher principle, or

dites, or those of the aquatic larvæ of Ephemera and the genus Gyrinus. He founds his opinion chiefly on this, that the inferior wings always take their origin from the lateral and anterior summits of the third thoracic segment, at a very short distance from the superior wings, and always in advance of the two posterior stigmata of the thorax, whilst the balancers are inserted lower down at the internal extremity of these air-conduits, or close by them. (See Latreille's observations in the 7th and 8th volume of the *Mémoires du Muséum d'Histoire Naturelle*.)

¹ We have made use of the term *wing-scale* in the systematic exposition afterwards given of the order Diptera. Meigen uses the German word *schuppchen* (squama) in his *Zweiflügeligen Insecten*.

² *Dict. Class. d'Hist. Nat.* t. ii. p. 141.

³ Wiedeman's *Archiv.* ii. 210.

⁴ For some additional details, we beg to refer to a paper entitled "Osteology, or External Anatomy of Insects," by Mr Newman, in the *Entomological Magazine*, No. IV. We had not an opportunity of consulting it until our own abstract had been composed, chiefly from foreign sources.

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The nervous system of insects consists of a homogeneous pulp, usually disposed in twelve successive ganglions, connected by a double cord. We first observe a double or bilobed mass, which, as it is placed in the head, may be called the brain. It is surrounded by strong muscles, and from its anterior portion nerves are distributed to the eyes, antennæ, and mouth. Posteriorly two delicate recurrent nerves proceed towards the dorsal vessel, and inferiorly two larger nerves, after having formed by their branching a kind of ring, which embraces the œsophagus, unite in the form of a ganglion beneath the last-named organ. From the posterior part of this latter ganglion a pair of nervous cords proceed for a space, and then by their union produce a second inferior ganglion, from which the nervous cords again branch off posteriorly, and so uniting and ramifying from space to space, they extend through the different segments of the thorax and abdomen. The number of these ganglia varies; sometimes they correspond to the divisions of the body, while in many instances they are of smaller amount. In the larva of the rhinoceros-beetle, for example, the whole spinal cord (so called from its supposed analogy to the part known by that name among the vertebrate kinds) presents the appearance of a single ganglion, divided merely by transverse furrows,—while in that of a dragon-fly, six have been observed in the thorax, and seven in the abdomen. In the great water-beetle (*Hydrous piceus*) the head exhibits one ganglion, the thorax six, and the abdomen only two. In the honey-bee there are three ganglia in the thorax, and four in the abdomen. When we examine these knots attentively, we may perceive that, in addition to the double and longitudinal nervous cord by which they are connected, they throw off laterally on either side small nervous trunks, which divide into branches, and finally ramify over the museles, the intestinal canal, the tracheæ, and other parts. This nervous system differs considerably in the larva and perfect insect. In the latter the ganglia are usually less numerous, and the posterior appear formed by the close approximation of several others.

The principal ganglia of the nervous system of insects are frequently thus disposed. The position of the upper or cervical ganglion has been already mentioned. The others rest beneath the intestines, ranging along the inferior face of the body. There are three in what may be called the chest; that is, one in the prothorax, which sends nerves to the anterior legs; one in the mesothorax, which

supplies the elytra or the upper wings, and the middle legs; and one in the metathorax, which distributes its filaments to the second pair of wings and the last pair of legs. The other ganglia belong to the abdomen. Insects are characterized by the ganglionic distribution of the nervous system, in common with the Crustacea and Arachnides on the one hand, and with the Vermes or worms on the other. But in insects the ganglia are larger and less numerous than in the still lower tribes, which gives a more decided character of centricity to their nervous system. Indeed the highest manifestation of this character is usually presented only as the ultimate result of several metamorphoses; so that while the larva exhibits a closer agreement with the nervous system of worms, that of the imago or perfect insect assumes a higher development. It does not however appear that the brain or upper ganglion of insects acts in the capacity of a *sensorium commune*, as among warm-blooded animals, such as mammiferous quadrupeds and birds; for many insects will live for a considerable time, and even exercise their faculties of flight, after the loss of parts which among the other class we justly regard as of vital importance. The tenacity of life in horse-flies, for example (*Hippoboscæ*), is very remarkable. When deprived of their heads, and replaced upon a horse, they will be perceived to run backwards and forwards and sideways, with apparently the same ease as prior to their decapitation.¹

The ganglions themselves frequently exhibit a bilobed structure, which appears to result from the union of two smaller masses, originally distinct. Comparative anatomy tends to confirm this supposition. M. Marcel de Serres² maintains that the nervous system of insects, and of all invertebrate animals, corresponds to the eccentric portion of that system among the higher classes, that is, to the intervertebral ganglia and their radiations.³ In the primitive state of larva he deems the nervous system to consist of two distinct portions, a right and a left; and he maintains that the formation of the nervous system in all animals proceeds from the circumference to the centre, and not, as usually supposed, from the centre to the circumference. We know well, from the observations of Carus and Tiedeman, that the organs of the inferior animals repeat, as it were, the forms which present themselves only in the *embryo* condition of the higher tribes. M. de Serres endeavours to show that it is by the progress of successive developments that the portions of the nervous cord in insects approach each other,—that they first join around the œsophagus, then at the opposite extremity towards the inferior ganglions, and lastly in the central parts. He thus admits three distinct embryo states in the condition of the larvæ; first, that in which the two portions of the nervous system are entirely isolated and distinct; secondly, that in which the œsophagian ganglia are alone united; and, thirdly, that in which the opposite extremities are joined together. By means of this distinctive view, the French physiologist connects the nervous system of insects with that of the Mollusca, the latter presenting the embryo con-

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¹ *Entomological Magazine*, No. iii. 301.

² *Ann. des Sciences Nat.* t. iii. p. 377.

³ The relation which the nervous system of invertebrate animals bears to that of the vertebrate tribes has, however, given rise to many conflicting opinions. "Among the various suggestions on this point, are that of Ackermann and Reil, who viewed the nervous system of Articulata as corresponding to the sympathetic system of vertebral animals;—of Walther, who compared it in the Mollusca to the *par vagum*, and in the Articulata to the spinal marrow;—the most generally received opinion, however, is that supported by the authority of Meckel, Cuvier, Blumenbach, Gall, and Spurzheim, who compare it in the Articulata to the cerebro-spinal cord of vertebral animals. The latter gentlemen, in particular, have furnished a strong proof of the correctness of this idea, by demonstrating that the spinal cord of the superior animals actually consists of a series of ganglia with intermediate contractions,—a structure most fully developed in the Articulata. Rudolphi (*Physiologic*, b. ii. s. 8, 1823) adopts the same opinion, and notices the fact, that in Mollusca, Crustacea, Insects, &c. we find nerves of sense arising from the cerebral ganglia,—which by no means accords with the character of the sympathetic system." (See Note to Carus's *Comparative Anatomy*, by Gore, vol. i. p. 69.) E. W. Weber (*Anatomia Comparata Nervi Sympathetici*) appears to have been the first to suggest that the ganglia on the knotted spinal cord of articulated animals correspond to the intervertebral ganglia of the spinal nerves of the higher classes, rather than to the segments of which their spinal marrow is composed.

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dition of the former, that is, being permanently distinguished by a characteristic which is only temporary among the articulated tribes. This may probably be regarded as an additional argument in favour of what we shall afterwards endeavour to maintain,—the general superiority in the scale of organization of the annulose classes over the molluscous kinds. We shall conclude by observing, that besides the general protection afforded by the external envelope of insects to their nervous system, it is specially protected by the Y-shaped portion formerly described.

As the nerves constitute the principal media of sensation in all animals, we shall here give a short sketch of the different senses of the insect class.

Of the senses in general, as they exist in man and the higher beings, physiologists and metaphysicians alike enumerate the following *five*, viz. *touch, taste, smell, hearing, and sight*. All of these, we doubt not, exist in the class now under consideration, although we are not in every case acquainted with the special organ by which each particular function is exercised.

The sense of *touch* is usually regarded as affording animals, and man especially, a more intimate and assured communication with the external world than those of either sight or hearing, in as far as no intermediate substance comes between us and the subjects of perception. The perfection of the sense depends on the quality of the skin, the extent and nature of its surface, the number of its nerves, its freedom from insensible parts, and the delicacy of those appendages which are more particularly destined to the examination of bodies. As touch is the most important of all the senses, it may naturally be inferred to be finely developed in the human race; and we know that, of all the vertebrated animals, man in that respect is one of the most highly organized. But among the invertebrate kinds the sense of touch improves in proportion as the others degenerate; and those which have no other sense possess it so exquisitely that some of them seem even to *feel the light*.¹

Among insects the sense of touch varies remarkably according to the condition in which they happen to exist for the time,—their exterior surface, in which the function exists, or at least through which it must be manifested, being itself subject to great variation, even among individuals of the same species. When soft, as in the larva state, the skin is extremely delicate in its perceptions, and capable of transmitting the most lively sensations; while in the imago or perfect condition, more especially among the Coleoptera, its harder consistence renders it chiefly serviceable as a protecting covering. In this case the feet, palpi, and, as many suppose, the antennæ, seem the principal organs of the sense of touch.

The sense of *taste*, which some regard as an exalted modification of the perception of touch, is very obvious among insects. We see many species, while searching after food, reject or only partially consume whatever is disagreeable or unexpected, while they gloat over a more favourite morsel. The organ in which the sense is placed is not, however, so easily determined. Some regard the palpi, and others the pharynx, as its principal seat. That portion of the labium which the French naturalists name the languette or ligula, has also been regarded as exercising the sense of taste. It is certain that distinct nerves are distributed to that quarter, as represented by Lyonnet in his great work on the caterpillar of the cossus.

The sense of *smell* is exquisitely developed in the insect tribes. No sooner has an animal fallen, from age or sickness, even on the loneliest and most barren moor, where

perhaps no vestige of insect life was previously perceptible, than troops of flies and carcass-eating beetles assemble from every quarter, led by the emanation of the tainted air.

It was in truth the influence of the sense of smell that in ancient times no doubt gave rise to so many erroneous ideas regarding the origin of insect life. Every animal body in a state of decay being seen to present a crowd of small larvæ or worms, these were regarded as the *produce* of corruption, whereas they resulted naturally, and according to the usual course, from eggs previously deposited by parent flies or beetles, which had been attracted by the putrid effluvia. It is not two hundred years since Redi proved for the first time, by conclusive experiments, that this was true. It is also known that bees will discover and hover around a box containing honey, though their prized treasure is screened from sight; and both flies and beetles are so affected by the perceptions of this sense, that even their peculiar and all but unerring instincts are occasionally deceived by its influence. They will deposit their eggs on plants which are characterized by a fœtid smell (for example, on the *Phallus impudicus*), misled by the resemblance of their flesh-like odour, which the experience of the sense of sight cannot rectify.

The scent of many flowers is cadaverous, and is thus the means of assembling around their deceptive petals numerous insects which feed on putrid matter. It is thus that the spathes of the *Arum dracunculoides*, and the corolla of the *Stapelia variegata*, are frequently found covered by Silphæ, flesh-flies, and other species, which not only attempt to feed upon them, but also deposit their eggs in what they conceive to be a fitting station. But the seat of this indispensable faculty is likewise still involved in obscurity. On a subject so difficult of solution, and which can only be solved by a consummate knowledge of anatomical structure, viewed in relation to the uses of physiology, it would not become us to offer an opinion, or do more than report the sentiments of those who are necessarily more experienced than ourselves. Many agree with Dumeril in maintaining that in insects the sense of smell is effected, as among the higher animals, through media in very intimate connection with the process of respiration; in other words, that either the *tracheæ* or stigmatic openings are the seat of its exercise. Others again suppose, that for the exercise of so important a function, a more special and concentrated organ is required; and proceeding upon the analogical relation of mere position, they regard the antennæ as its seat. These receive the first pair of nerves, and so far correspond to the olfactory organs of the higher animals, which are likewise connected with the brain by means of the first pair. The question is one which is extremely difficult of determination, especially in reference to the singular experiments of Huber on bees, which go far to prove that the sense of smell, at least in these hymenopterous species, is placed in the cavity of the mouth.

Christian maintained that insects exercised the sense of smell in relation to distant objects through their antennæ, and in regard to near ones by means of their palpi; while Comparetti imagines that in the different tribes of insects different instruments are subservient to that end. Cuvier, at least in his earlier works (and we are not aware of any recorded change in his sentiments) favoured the opinion already alluded to regarding the respiratory organs. "As the organ of smell," he observes, "in all animals which respire air, is situated at the entrance of the organs of respiration, the most probable conjecture that has been pro-

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¹ *Leçons d'Anatomie Comparée*, sect. 14.

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Huber's experiments, undertaken with a view to ascertain the seat of smell in bees, consisted in presenting successively to all parts of their bodies a hair pencil dipped in oil of turpentine, an article which they particularly abominate. When made to approximate the head, trunk, or abdomen, it produced no particular effect, and the odour appeared to be equally disregarded by the antennæ and proboscis. But when he brought the point of a fine hair pencil saturated in the oil almost into contact with the cavity of the mouth, above the insertion of the proboscis, the bee started back in an instant, quitted its food, clapped its wings, and would have taken immediate flight had not the pencil been removed. A repetition of the experiment produced the same signs of discomposure; and similar results, but more prompt and sure, followed the use of oil of marjoram. The indefatigable Genevese observer then stopt up the mouths of several bees with paste, which soon became comparatively hard and dry. In this state they were quite insensible to those odours which had previously produced such painful effects.²

Mr Kirby maintains an opinion different from any we have yet alluded to, though more allied to the last than to the others. As the nose of an insect evidently corresponds with the part so named in the Mammalia, not only in its situation, but frequently in its form, and as a constant connection may be observed to obtain between the senses of smell and taste, he felt convinced in the first place that the argument from analogy was wholly in favour of the nose, or anterior portion of the head formerly mentioned under that name. The common burying beetle (*Necrophorus vespillo*) is an insect remarkable for its extreme accuracy and acuteness of smell. While examining the nose of this insect, Mr Kirby observed in the middle of its anterior part a subtrapezoidal space, as it were cut out and filled with a paler piece of a softer and more membranous texture. On dividing the head horizontally, he perceived beneath the nose, and partly under the space just mentioned, which he calls the *rhinarium* or nostril piece, a pair of circular pulpy cushions, covered by a membrane transversely striated with beautifully fine lines. These are what our learned author regards as the organs of smell, and he noted that they remained distinctly visible in a specimen which he had had by him for more than fifteen years.³

Hearing is perceptibly acute in some insects, and of more doubtful existence in others. The frequent and various sounds to which many species give utterance have been adduced in proof of their being endowed with this perception; for we cannot but suppose that the shrill voice of the grasshopper, and the evening song of the cricket,

are subservient to some essential end, which they cannot well be if unheard by their blythe companions. The small wood-devouring beetle called the death-tick (*Anobium*), answers its neighbour's call as regularly as a cock crows a response to its pugnacious rival; and Derham, when he kept these insects in captivity, by imitating their tiny call, could make them click when he pleased. What is called the voice in insects is usually produced by the friction of certain hard and horny parts of the limbs upon some other portion of the body of a like consistence. In others it is effected by a rapid vibration of the wings; and a few beetles seem to give utterance to a shrill and sometimes plaintive cry by rubbing the terminal segments of the abdomen against the curved points of the elytra. This power of voice, as we call it for want of a better name, is often possessed by the males alone; and as it is used as a call of love in spring and summer (most obviously so among the Cicadæ), we infer the sense of hearing in the females of that family, and consequently in the class of insects.

Brunelli kept some large green grasshoppers (*Acrida viridissima*) in confinement. They used to sing all day in a closet, but ceased when any one gave a rap upon the door. He learned by degrees to imitate their chirping call. At first a few of the boldest would answer him, and then gradually the whole band would strike in and sing with all their might. On one occasion he inclosed a male in his garden, and gave the female her liberty; but no sooner did the husband begin to solace his captivity with a song than his quondam partner recognised the accustomed voice, and flew towards him without delay.⁴ In relation to this subject Dr Wollaston makes the following curious observation. "Since there is nothing in the constitution of the atmosphere to prevent vibrations much more frequent than any of which we are conscious, we may imagine that animals like the *Grylli*, whose powers appear to commence nearly where ours terminate, may have the faculty of hearing still sharper sounds, which at present we do not know to exist; and that there may be other insects, hearing nothing in common with us, but endued with a power of exciting, and a sense that perceives, vibrations indeed of the same nature as those which constitute our ordinary sounds, but so remote that the animals who perceive them may be said to possess another sense, agreeing with ours solely in the medium by which it is excited, and possibly wholly unaffected by those slower vibrations of which we are sensible."⁵

The precise position, however, of the organ of hearing in insects has not been determined with precision. In the Crustacea it is found at the base of the large antennæ; and Latreille has satisfied himself of its existence in a similar situation in an orthopterous insect called *Gryllus lineola*. Mr Kirby is of opinion that the *primary* use of the antennæ is to exercise a function analogous to that of hearing, and Mr Rennie entertains a similar sentiment.

The sense of *sight* is too obvious in this class to require demonstration. The eyes of insects are, however, of a very different nature and construction from the exquisitely formed visual organs of the higher tribes. They consist of two kinds, the *composite* and the *simple*. The latter, known under a certain form likewise by the name of ocelli or stemmatic eyes (*stemmata*), are sometimes wanting, sometimes co-existent with the others.⁶

¹ *Comparative Anatomy*, vol. ii. p. 687.

² *Introduction to Entomology*, vol. iv. p. 254.

³ Lehmann, *De Sensibus Externis Animalium Exsanguinum*, 22.

⁴ What Messrs Kirby and Spence name *conglomerate* eyes do not essentially differ from simple eyes, collected together in a compact bundle. They occur in *Lepisma*, and many *Myriapoda*.

⁵ *Nouvelles Observations sur les Abeilles*, t. ii. p. 375.

⁶ *Phil. Trans.* 1820, p. 314.

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The composite eyes generally form, as it were, the lateral portions of the head. They are either entire, notched, or even occasionally so completely divided by a little corneous stalk, as to exhibit (for example in the genus *Gyrinus*) the appearance of a pair on either side. In other respects their forms are extremely variable—their surfaces more or less convex. These compound eyes are composed externally of a hard and transparent membrane (softer in the dipterous tribes), which presents an infinity of small hexagonal surfaces, disposed with the most exquisite regularity. This peculiar structure prevails equally on the concave or internal, as on the convex or external surface. The structure and composition of the eyes of insects have been carefully studied and explained by Leeuwenhoeck, Swammerdam, Cuvier, and more lately and laboriously by Marcel de Serres. We shall here avail ourselves of the *résumé* given by M. Victor Audouin.¹ In the eye of an insect we observe, *1st*, a cornea (convex in proportion to the carnivorous habits of the species), transparent, hard, thickish, generally encased in a groove of the head, and exhibiting many thousand regularly disposed, hexagonal facettes, each of which is in itself a perfect eye. These are sometimes so numerous that not fewer than 34,650 lenses have been counted in the head of a butterfly, and the coleopterous genus *Dynastes* of Macleay is supposed to be still more wonderfully and exuberantly supplied. *2d*, An opaque, slightly liquid matter, variously coloured, frequently deep violet or black, but sometimes red or green, tenaciously adherent to the inner face of the cornea, and distinct from the deep-black varnish of the choroid. It is by no means rare to observe various colours united in the same eye, which then appears beautifully mottled, as in many species of the orthopterous, neuropterous, and dipterous orders. These tints, however brilliant in the living state, speedily vanish after death. They are always owing to this peculiar coating of the cornea. *3d*, A true choroid, covered by a dark varnish, which may be regarded as a *pigmentum nigrum*. The lynx-eyed Swammerdam failed to distinguish this coating from that of the cornea; but, in the opinion of Marcel de Serres, it is really different. The choroid and its pigment do not always exist in insects. They are wanting in the *Blattæ*, and in all the lucifugous or light shunning species, such as those of the genera *Blaps*, *Tenebrio*, and *Pedinus*. In these cases, it has been remarked that the covering of the cornea is much deeper than usual. The choroid membrane is fixed by its circumference to all the margin of the cornea, of which it follows the contour, and is intimately connected with the tracheæ, which are there so numerous. *4th*, Air vessels which play an important part. They take their rise from larger trunks which are situated in the head, and form around the eye a circular trachea, which sends forth an infinity of branches, producing by bifurcation a number of isosceles triangles. These triangles, of which the base is outwards, are placed around the optic cone, and receive, in each angular interval which separates their summits, a nervous filament, which traverses the choroid, and reaches the external surface of the covering of the cornea. The assemblage of tracheæ and nervous threads forms at the circumference of the eye a peculiar kind of network, of which the aspect is beautiful to look upon. The tracheæ themselves are so abundant on the choroid, that that membrane appears to be composed of them; and it may also be noted, that in those genera in which the choroid is wanting, the circular trachea is likewise absent.² *5th*, Nerves arise from a principal

branch which, after proceeding immediately from the brain (or upper ganglion), is either encompassed by a little circular trachea, or traverses the fibres of the abductor muscle of the mandibles. This branch soon augments in volume, and forms a kind of cone more or less extended, of which the base is towards the transparent cornea. Numerous nerves proceed from that base, mingle with the tracheæ of the choroid, traverse both that membrane and its pigment, penetrate the lining of the cornea, and finally terminate each on a facette of the transparent cornea, so that the nervous filaments are thus immediately in contact with the light, which reaches them after having traversed only the last-named organ. This disposition of the nervous threads, which thus constitute as many small retinæ as there are facettes in the cornea of the eye, is very distinguishable in *Libellula*, *Truxalis*, and *Gryllus*. The eyes of insects, then, contain no humours properly so called,—neither vitreous nor crystalline,—and vision is consequently much more simple with them than with the vertebrated tribes, in which the nerves are placed deeper in the eye, and do not receive the rays of light till these have passed through media of different densities.

The simple or *stemmatic eyes* of insects are usually three in number, and are placed on the crown of the head, between the genuine organs of sight, from which their structure differs. In spite of their extreme minuteness, Marcel de Serres has succeeded in detecting the following component parts. *1st*, A transparent cornea, formed by an external membrane, hard, convex externally, and smooth, that is, exhibiting no appearance of facettes. *2d*, Of a variously-coloured matter, which lines the internal face of the cornea, but which is perhaps not essentially distinct from the varnish of the choroid. It varies in colour, being almost always black in Hymenoptera, usually whitish in Orthoptera, and, in many caterpillars, yellow, red, or green. *3d*, A kind of choroid, rather thick, more extended on the surface than the cornea itself, sometimes of a black colour, more frequently red, and occasionally of a peculiar whitish hue. *4th*, Tracheæ, which do not derive their origin from a circular air vessel, and do not, as it were, constitute the choroid, but appear to be distributed over its surface. *5th*, Nerves proceeding either directly from the brain or upper ganglion, or from another more considerable nerve or common trunk, according as these simple eyes are separate from each other, as in perfect insects, or closely approached, as among larvæ. In their passage towards the eyes they are attached to the neighbouring parts by tracheæ or air vesicles, and do not appear to present any swelling; they pass between the motive muscles of the different parts of the head, traverse the choroid and its varnish, and expand upon the internal face of the cornea, where they are surrounded by the layer of pigment belonging to that membrane. Thus, on examining the simple or stemmatic eyes of insects, and proceeding from the circumference to the centre, we meet with a transparent cornea,—a pigment, which lines its inner face,—the termination of the optic nerves,—the pigment of the choroid, when distinct from that of the cornea,—and the choroid itself, which frequently rests upon a large trachea. The principal character of these simple eyes consists in this, that each is a single organ, whereas the composite eyes, as the name implies, are formed by the union of many. The one kind is most characteristic of the larva state, the other of the perfect insect; but several orders, even in the last-mentioned condition, possess both organs.

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¹ Dict. Class. d'Hist. Nat. t. viii. p. 554.

² Muller and others appear to entertain a different view from that given above. The subject is one of considerable complexity, and our present limits prevent our entering into its various and sometimes contradictory details. We refer the curious reader to a series of papers on the visual organs of insects and Crustacea in the fourth volume of the *Naturalist's Magazine*.

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Thus, with few exceptions, the Orthoptera, Hemiptera, Hymenoptera, Neuroptera, and Diptera, possess both simple and compound eyes. Dr Carus however states that the stemmata do not exist either in beetles or butterflies; a most erroneous opinion in regard to the latter, in which they exist universally, although not always detected; and incorrect as to the former, in several of which they have been distinctly seen. They are visible in Gravenhorst's genus *Omalium*, or at least in some of the species;¹ and Mr Kirby found them very conspicuous in *A. Caraboides*, and other Anthophagi. They are wanting in Strepsiptera, Dermaptera, and Aptera.

Although neither Linnæus nor Fabricius, those great masters in the science, gave any explanation of the uses of the stemmata, there can be no doubt that Swammerdam and Réaumur were correct in regarding them as genuine eyes.² The French writer supposes that the compound organs have the power of magnifying, and are used for surveying more distant objects, while the simple ones possess little of that power, and are employed on objects close at hand. Blumenbach is also of opinion that the polyhedral eyes are for viewing distant objects, and the simple ones for such as are near.³ This is in some measure confirmed by the fact, that while most insects in the perfect state have large compound eyes, caterpillars and other larvæ have usually small myopic ones. On the other hand, the Mole cricket (*Gryllotalpa*), a truly subterranean species, is furnished with both kinds. Réaumur's experiments on the visual organs of bees are extremely important in relation to our present subject. He smeared the compound eyes with paint, when the insects, instead of directing their flight towards the hive, ascended in the air till they were lost to sight. He then treated the stemmatic eyes in the same manner, and placing his patients near their hive, they winged their way on all sides among the surrounding flowers, but neither ascended into the air, nor flew far from home. From these experiments it has been supposed that the compound eyes are for horizontal sight, and the stemmatic for vertical.⁴ Spix imagines that what we call simple eyes in insects are in fact olfactory organs.⁵ Nothing can be adduced in support of a theory so fantastical.

We shall conclude this branch of our subject by observing that some insects are supposed to be entirely destitute of eyes. This is the case, according to Rudolphi,⁶ with the coleopterous genus *Claviger*, in which there are certainly no apparent eyes; and Marcel de Serres observes, "un assez grand nombre de larves à métamorphose complète n'ont point d'yeux du tout."⁷

SECT. II.—THE RESPIRATORY SYSTEM IN INSECTS.

Though insects respire air, they do not receive it, like the majority of vertebrated animals, through nostrils or other orifices in the head, but by means of numerous small openings along the sides of the body, and which lead not to lungs, but to a system of air vessels ramified *ad infinitum* through every part of the body. The respiratory organs of this class are composed of *stigmata*, *tracheæ*, and *bronchiæ*. The first, called also spiracles or breathing pores, consist of small perforations of various forms, placed along the lateral portions of the body, and generally incased externally in a small corneous ring, though sometimes pierced in the membrane which separates the dorsal from the ventral surface. These stigmatic openings occur both on the thorax and abdomen, and lead inwards to the tracheæ. Their num-

ber varies according to the species, and even in the same species according to the temporary condition of the individual. They are wanting on the second and third segments of the body of the larva; and as it is from these segments that the wings are developed, M. de Blainville has been induced, probably by that circumstance, to regard the organs of flight as reversed and expanded tracheæ. The existence, however, of stigmatic openings on the thorax of the perfect insect simultaneously with the wings, militates against this theory; for if these parts were convertible, would they not be likewise each exclusive of the other?

Parallel with the sides of the body of most insects, and extending its whole length, run two cylindrical tubes, which communicate with the spiracles, and give issue, at points opposite to those organs, to other tubes, the ramifications of which are distributed over all the membranes, penetrate the muscles, and pervade even the legs and wings. They also envelope the dorsal vessel and digestive organs, and demonstrate that the ultimate aim of respiration is assimilation, or the increase and reproduction of organic molecules, by the decomposition of food. The first of these tubes are called the tracheæ, the latter the bronchiæ. This structure, however, cannot be regarded as universal, as in many of the lamellicorn beetles the bronchiæ spring directly from the spiracles, the interior mouth of which is lined by a membrane from which they proceed.⁸ But a volume would scarcely suffice to describe the beautifully varied features of the respiratory system in insects. Among those tribes especially which pass their early stages under water, the changes in form and position in these organs cannot be sufficiently admired. Several common species of gnat, the larvæ of which abound during the summer season in all our ponds and marshes, will afford a familiar illustration. When one of these is examined, a singular tunnel-shaped organ, terminating in a radiated point like a star, will be perceived, forming an angle with the penultimate segment of the body. In the interior of this organ is a tube, which conveys the air to the tracheæ, and communicates with the atmosphere by means of several perforations in the centre of the star. The diverging rays of the star suspend the animal at the surface of the water, with its head downwards, till it wishes to descend. It has no sooner assumed the pupa state, than the respiratory tail disappears, and the insect (still an inhabitant of the water) then breathes through two projecting horns, each resembling a little cornucopia, which proceed from the upper part of the trunk. Ere long the skin of the pupa bursts asunder, and the perfect gnat, or winged insect, makes its appearance, with neither caudal nor thoracic appendages, but breathing by means of numerous lateral pores (the stigmata above mentioned), after the usual manner. The *rat-tailed worm* in this respect is still more extraordinary. In the larva state it breathes through a tail formed of retractile tubes, like a telescope, and capable of being extended many times the length of the body. This also terminates in a star-like process, which, when viewed in a strong light, forms a perceptible dimple on the surface of the water; and as the body of the insect lies in the mud below, the tail is contracted or extended according to the varying depth of its stagnant habitation. On assuming the pupa state, in which it is no longer an aquatic animal, the respiratory tail is cast off, and its function performed by four horns, which spring from the upper part of the thorax. It afterwards becomes one of those bee-like flies so remarkable for the rapid vibratory movement of their

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¹ *Magazin der Entomologie*, iv. 410.

² See *Biblia Naturæ*, i. 214; and *Memoires*, iv. 245.

³ *Vergl. Anatomie*, p. 425.

⁴ *Introduction to Entomology*, iii. 505.

⁵ *Cephalogenesis*, p. 57.

⁶ *Physiologie*, ii. 154.

⁷ *Mém. sur les Yeux composés et les Yeux liés*, cs.

⁸ *Introd. to Ent.* vol. iv. p. 61.

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SECT. III.—THE DORSAL VESSEL, OR SUPPOSED CIRCULATING SYSTEM, OF INSECTS.

We shall next endeavour to explain the construction and physiological uses of the organ known by the name of *dorsal vessel*.

The *primary* use of the heart of animals is the elaboration of the nutritive fluid by which the general system is strengthened and sustained; its *secondary* use is to effect the circulation of that fluid, a process by which important changes are produced in its nature or attributes. The dorsal vessel, which corresponds to the heart in insects, certainly effects the primary purpose; its performance of the secondary one is, as we shall see, a matter of greater dubiety.

When an insect is dissected with due precaution from its inferior surface, and we remove the nervous system, which first presents itself, and then the intestines and other viscera, we shall observe running along the back, a peculiar vessel, of which the most obvious powers are those of contraction and dilatation. It is of a cylindrical form, narrowed at either end, and extends from the head to the anal extremity. This constitutes the *heart*, frequently so called, of the class of insects. A closer examination shows that it is composed of two membranes, one internal and muscular, the other external and cellular, and pervaded by a close interlacement of tracheæ or air-vessels. When opened, its interior presents a transparent coagulable liquid, which dries rapidly, and then exhibits the aspect of gum, of a colour seldom deeply defined, but sometimes greenish, orange yellow, or sombre brown. Masses of fat frequently surround this vessel, and partake of the tint by which it is pervaded. If, as Marcel de Serres has noted, the *dorsal vessel* (for so this organ is often named) were a genuine heart, or centre of a circulating system, it would be necessarily open at one or other of its extremities, and would present vascular ramifications in certain points of its extent. But, according to the minute and laborious investigations of the last-named author, no such openings are observable. The same view was taken by Swammerdam; and Lyonnet, so unrivalled in his examination of the structure of insects, was foiled in his attempts to demonstrate the ramifications of the dorsal vessel. Comparetti no doubt took another view of the subject; and if the assurance of his readers was equal to his own, less suspicion would exist of the possibility of his having mistaken biliary for sanguineous vessels.

Anatomists, however, are greatly divided in opinion regarding the essential nature of this organ. It has been dissected and injected by Marcel de Serres in a variety of species; but in none could he discover its divisions or ramifications. Even when he removed it entirely from the insect, no drop of the liquid which it contained was observed to escape, which he thinks it must have done on the cutting away of open vessels during dissection, had these existed. The *beating* of this dorsal vessel was not explicable, otherwise than by the contraction of its tissue, or the movement of the fluid which it contained; and such movement was not itself conceivable except in the case of circulation, which the alleged closure and non-division of the organ forbade us to suppose. Its contractions also appeared irregular, and scarcely ever isochronic; that is, the same number of pulsations, if they may be so called, did not take place in an equal time. They varied singularly in different species. Thirty-six per minute were

counted in the caterpillar of the *Pavonia Major*, eighty-two at least in grasshoppers, and a hundred and forty in one of the ground bees. While endeavouring to discover the cause of these contractions, Marcel de Serres came to the conclusion that they bore a relation, *1st*, to the quantity of adipose tissue by which they were surrounded; *2dly*, to the energy of the muscular fibres which were inserted on the vessel, and were the means of fixing it to the rings of the abdomen; *3dly*, to the number of tracheæ or air conduits by which it was supplied. He was not of opinion that the nerves exercised any strongly marked influence on these contractions, although we know that special nerves are directed to the dorsal vessel. The fact, however, which he deemed the most clearly established, was the influential action of the muscles. When any of these were removed, the pulsations became less frequent,—on a farther removal they still diminished; and when the muscles were almost all withdrawn, the pulsations ceased. The appropriate function of this disputed organ, according to the last-named author, is the secretion of fat. Baron Cuvier also denies to it the character of a genuine heart.

Meckel and Herold, on the other hand, regard the dorsal vessel as a heart, and they conceive that the use of its movement is to agitate the fluid contained in the cavity of the insect's body; but they do not admit the existence of posterior or anterior openings for the reception or rejection of that fluid. It is long since Lyonnet informed us that it contained a gummy matter of an orange colour; and some recent observations have led Latreille to admit the existence of certain very minute accessory vessels. In addition, however, to the fact that this circulation must be extremely partial, insects would still greatly differ in that respect from the Crustacea, inasmuch as the blood does not return to the heart. Herold is of opinion that the triangular muscles of the dorsal vessel serve for its dilatation, while the systole movements are effected by the muscular fibres, which form the proper tunie. Straus is also of opinion that the dorsal vessel is the true heart in the class of insects, and that it serves, as in the higher animals, as the motive organ of the blood, which, however, instead of being contained in vessels, permeates in the general cavity of the body. According to his views, it terminates anteriorly by a single unramified artery, which conveys the blood to the head, where it pours it out, and from whence it returns again to the abdomen, to re-enter the dorsal vessel. He thus limits the circulating system of insects to a single artery without branches (there are not any veins); and he combats the sentiments of Herold regarding the muscular nature of the wings of the heart, which, he maintains, are only simple fibrous ligaments, by which it is maintained in its proper place. The heart itself, that is, the abdominal portion of the vessel, he describes as divided interiorly into eight successive chambers (as in the common cockchafer, *Melolontha vulgaris*), separated from each other by two convergent valvules, which permit the transmission of the blood or circulating fluid from behind forwards, and from one chamber to another, up to the artery which conducts it to the head, but prevent its retrograde motion. Towards the lateral and anterior portion of each chamber are two transverse fissures, which communicate with the abdominal cavity, and through which the blood contained in the latter enters the heart. Each of these apertures is provided internally with a little semicircular valve, which presses on it during the systole of the organ. When the posterior chamber dilates, the fluid contained in the abdominal cavity penetrates into it by the transverse fissures, called *auriculo-ventriculaires* by M. Straus. When the chamber contracts, the blood, unable to return into the abdominal cavity, forces the *inter-ventricular* valve, and passes into the second chamber, which dilates to receive it,

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Mr Bowerbank has recently published some observations on the circulation of the blood in insects.¹ The instance detailed was that of the larva of an Ephemera (*E. marginata*). In fixing the insect for examination (under water), especial care must be taken not to compress the body, which impedes or interrupts the circulation of the lateral vessels, and that of the tail, legs, and antennæ. When the larva is fixed, with its dorsal aspect towards the observer, a truly beautiful sight is said to present itself. The blood, abounding in flattened oat-shaped particles, will be seen circulating in every part of the body, not in a continuous stream, but at regular points, in accordance with the pulsations of the great dorsal vessel. The latter, which is of great comparative magnitude, extends nearly the whole length of the body, and is furnished at regular intervals with double valves, nearly equal in amount to the segments of the body. Both above and below each of these sets of valves there is a pair of irregular-looking appendages, which are probably nervous ganglions, auxiliary to the motions of the vessel, but so extremely translucent as to be scarcely definable in their form, even through the medium of the highest power which we can apply. The action of the valves is singularly interesting. While in their greatest state of collapse, the point of the lower valve is seen closely compressed within the upper one. At the commencement of the expansion of the artery, the blood is seen flowing in from the lateral aperture, and at the same time the stream in the artery commences its ascent. When it has nearly attained its greatest state of expansion, the sides of the lower valve are forced upwards by the increased flow of the blood from the section below the valve, the lateral openings are closed, and the main current of the blood is projected through the two valves. The structure of the upper valve appears to consist of a duplication inwards and upwards of the inner coat of the artery; that of the under, of a contraction and projection of the like parts of a portion of the artery beneath, so as to come within the grasp of the lower part of the valve above it. The exterior portion or continuation of the artery is perceptible in the form of an exceedingly fine and transparent membrane. The so-called blood does not appear to be confined within any specific vessels prior to its entering the lateral openings just mentioned, because, as soon as they expand, the particles are seen converging towards them. The whole of the fluid received throughout the course of the dorsal vessel is conveyed to the extremity of the anterior part of the body, where the vessel makes a curve inwards, and is lost to view. To all appearance the main current of the blood is now discharged into the cavity of the body, as it is seen pursuing its course downwards in a wide-spreading stream on each side, and beneath the dorsal vessel. As it descends, portions are again absorbed by the valves of the large vessel, while at the same time smaller vessels pass down each side of the body, and convey another portion of blood to the lower extremity. These lesser vessels have perceptible boundaries, and are certainly not portions of the great abdominal cavity. They communicate at each junction of the segments of the body with that cavity, as a

part of the fluid they convey is discharged at those points, to supply the place of what is absorbed by the valves of the dorsal vessel, into the lower end of which they empty their contents. In the caudal extremity the ascending and descending vessels are seen, like vein and artery, to accompany each other, and at the same moment that the fluid passes up the one with the usual pulsatory motion, it descends the other. There is, however, no perceptible pulsation of these minuter vessels themselves, and the motion of their fluids therefore results from the action of the great dorsal heart.

"Next to the larvæ of the Ephemera marginata," Mr Bowerbank observes, "the larvæ of Agrion afford the best view of the blood and its circulation. In all the species of these larvæ I have yet examined, I have found it as nearly similar as possible in appearance to that which we observe in the Ephemera, and in some instances it has afforded even more satisfactory results. The head of this larva is much more transparent than that of the larva of the Ephemera; we therefore have a better view of the circulation of the blood in the head of this insect than can possibly be obtained in the other. In this object the blood is seen rushing like a beautiful intermittent fountain towards the mouth, and dividing right and left into two jets, a portion of each of which flows within a given boundary past the back of the eye, whilst the remainder winds its way through other channels, deep in the side of the head, and returns again into the body. The antennæ of this insect also afford another beautiful instance of the circulation being carried forward within well-defined vessels. They are each composed of six joints, up four of which the blood is seen to take its course; and turning round the extremity of the fourth joint, it returns by a distinct vessel into the head. In the leg, likewise, the circulating fluid and its vessels are clearly and distinctly to be traced, even to the very extremity of the tarsus, where, as in the antennæ, the particles of the blood are seen to descend on the one side of the leg, and, turning the extreme point, to return up the contrary side to the one by which they come down. I regret much that I have not yet had an opportunity of examining the Ephemera in its perfect state; but in two species of Culex, one of which was first observed and brought to me by my friend Mr Tulley, I have seen the great dorsal vessel performing its functions in a manner similar in every respect to its appearance in the larvæ of Ephemera, Agrion, &c. &c.; but, from the body of the fly being more opaque than that of the larvæ, and nearly covered with its striated scales, neither the valves nor the particles of the blood could be detected. On another occasion, after having carefully cleared the wings of Phlogophora meticulosa of their coloured scales, both Mr Samouelle and myself clearly saw a fluid pass down the side of one of the principal ribs of the wing. We may therefore, I think, fairly conclude, that the circulation is carried forward in the perfect insect as well as in the larva, although, perhaps, not with so much vigour as when young and growing."²

The writer whose observations we have just quoted, inclines to the opinion that a much greater portion of the circulation than we can clearly define is carried on within special vessels, as the blood may be frequently seen flowing in curved and other lines, as if confined within very narrow limits. These streams, however, are generally so deeply seated amidst the muscles and intestines as totally to prevent their boundaries from being clearly seen. The blood itself is in fact a perfectly colourless and transparent fluid, rendered visible only by its containing a number of oat-shaped particles; and even the great dorsal vessel can-

¹ Entomological Magazine, No. III. p. 239.

² Ibid. p. 242.

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The reader will be able to judge, from the preceding notices, of the diversified opinions still entertained regarding the circulation of the blood in insects. We shall conclude with a short account of Dr Carus's observations, which many consider as the first of a satisfactory and conclusive nature on the subject. Mr Spence, the accomplished coadjutor of Mr Kirby, having had the advantage, at a pretty recent period, of witnessing some of the most striking facts on which the Dresden physician rests his views, transmitted an account of them to an English periodical. "The first insect," he observes, "to which Dr Carus directed my attention was the larva of *Ephemera vulgata* (or an allied species), in which, near to the branchiæ, and parallel with each side of the body, was very distinctly visible a constant current, towards the tail, of oblong globules, swimming in a transparent fluid, propelled with a regular pulsating motion; and in cutting the body of the larva across, near the tail, these globules were most plainly seen pushed out of the divided vessels in a distinct mass, which increased at each pulsation. I cannot express the pleasure which it gave me to see thus clearly this ocular demonstration of one of the most important physiological discoveries of modern times; and my gratification was heightened by the next object which Dr Carus placed before his microscope, viz. a specimen of *Sembris viridis*, in which precisely the same phenomena, but if possible more clearly, were seen in the nervures of the wings, and in the antennæ, in both which the constant current of globules was most apparent; and in the former, the sudden turning of these globules at the apex of the wing, out of the exterior nervure, into a central one, with which it joins and forms an acute angle, was equally curious and striking. On cutting off the end of the antennæ, precisely the same emission of globules (which soon assume a greenish tint) took place as in the former case, forming a mass which was increased with a sudden gush at each pulsation."² The chief point to be attended to in the manipulation of these microscopic experiments, is to place the specimens on the slip of glass, in a drop of pretty thick gum water, which confines their too agile movements, without affecting the transparency of the medium.

SECT. IV.—OF THE ADIPOSE TISSUE OF INSECTS.

Insects are abundantly supplied with an adipose substance or fatty matter, which may be mentioned in this place with the more propriety, as many consider it a secretion from the dorsal vessel. It is spread over the viscera and in the splanchnic cavities; and although its aspect varies, it seems to consist essentially of membranous woofs, in some cases divided in shreds, in others spread over the intestines and against the sides of the abdomen, and containing pouches filled with a homogeneous pulpy matter, sometimes in an oily condition, and offering all the characters of grease. Much more of it is observable among larvæ than in perfect insects, and this observation leads us to a know-

ledge of its use. It is particularly plentiful just before an insect is about to undergo its metamorphosis; and as it almost entirely disappears on the completion of those signal changes, we naturally conclude that it has served in the production or development of the newly acquired organs. This is rendered the more probable when we consider that, during the intermediate or nympha state, the insect abstains from food, and is therefore necessarily dependent on some internal reservoir. It is analogous, in fact, to the store of fat which is known to pervade the system of hibernating animals before they consign themselves to their winter sleep.

In regard to the nutrition of insects, our opinions must be in a measure regulated by the sentiments which we may adopt as to the functional uses of the dorsal vessel. We need scarcely observe, that in all the higher animals, and in most of the invertebrated tribes, nutrition is effected through the medium of the blood, which, propelled by the heart, circulates through the entire system, and reaches every organ, after having been submitted to the action of the air in lungs or gills. Cuvier thinks it is carried on among insects by imbibition. The alimentary canal elaborates a fluid which transudes through its coats, and flows into the cavity of the body. There the various organs, such as the muscles, the nerves, and many secreting vessels, absorb from that fluid nutriment, whatever molecules are best adapted to their purposes. Those who look upon the dorsal vessel as a true heart, which dispenses a circulating fluid to the remotest ramifications of the wings and tarsi, will place less confidence in this particular view. However, it is certain that the secreting vessels are characterized by a structure entirely appropriate to the functions which we have just assigned them, their surface being obviously furnished with numerous pores or small absorbent mouths.

SECT. V.—THE DIGESTIVE SYSTEM OF INSECTS.

The digestive system in insects naturally forms the next subject of consideration. The earliest, most general, and perhaps the only indispensable function of animal life, is that of nutrition. But its materials are so different, and their modes of reception so various, that the exercise of this function by no means necessitates the existence of a mouth, a stomach, or an alimentary canal; for an increase of parts may be effected even through the medium of imponderable or elastic fluids, and by imperceptible and superficial pores.³ The digestive organs of insects are however in general rather complicated, and a great variety of parts are brought into action. The more external portions, or those of the mouth, have been already described. We shall therefore at present confine our observations to the different portions of the *intestinal canal*, and the *biliary* and *salivary vessels*.

It is natural to suppose that, in a class so extensive and varied as that with which we are now engaged, a corresponding diversity must exist in the form, development, and number of the parts which constitute the intestinal canal. It is always, however, so far tubular, and open at either end; but in some it is straight and of the length of the body; in others it is bent and longer than the body; while in many it is tortuous, or twisted on itself in numerous convolutions, and consequently of great extent. In general, its length corresponds in a certain measure with the nature

¹ *Entomological Magazine*, p. 244.

² *Magazine of Natural History*, vol. iii. p. 46. See also the German memoir by Dr Carus on the circulation of the larvæ of neuropterous insects (Leipsig, 1827). The English reader may consult Mr Gore's translation of Carus's *Introduction to Comparative Anatomy*, appendix to vol. ii. p. 392.

³ Vol. iii. of this work, p. 183.

Internal structure. of the aliments; such insects as feed on vegetable matters having a longer, and such as feed on animal substances a shorter canal. In some it is of equal diameter throughout; in others the breadth of special portions varies; and there are many dilatations and restrictions, known by various names. It even differs greatly in the same species, according as the individual exists in the larva or imago state.

The texture of the intestinal canal in insects is not the same in all parts of its extent; but on a careful examination it is found to exhibit throughout three tunics, more or less distinctly marked. Of these, the first is external, with a membranous aspect; the second is of course intermediate and muscular, with its fibres diversely directed; the third is internal and mucous. In its more complicated state it exhibits the following parts: 1st, a *pharynx*; 2d, an *œsophagus*; 3d, a *crop*; 4th, a *gizzard*; 5th, a *chylific ventricle*; 6th, *intestines*, which may be considered in subdivision as the small intestines, the great intestine or cæcum, and the rectum. The following may be regarded as the usual process of transmission. The mouth, having seized and chewed the food, transmits it to the pharynx, into which salivary vessels sometimes open. It then passes into the œsophagus (of which the muscular nature occasionally produces by its action a peculiar impression), and is next transmitted to the crop, which converts it into a homogeneous pulp. This is introduced into the gizzard, of which the sides, being armed with teeth, complete its trituration. In the form of a kind of paste it is now received by the chylific ventricle, where it undergoes the action of the bile, is converted into chyle, and thus supplies the nutritive fluid, which, passing through the coats of the ventricle, spreads over the splanchnic cavity, and pervades the whole of the organs. The residue is received by the small intestine, then by the great intestine, in which it remains for some time, and finally by the rectum.

The *pharynx*, which is sometimes rather difficult to distinguish as a distinct feature, is placed at the bottom of the mouth, and may be regarded as an anterior dilatation of the œsophagus. Two pieces, very apparent in certain Hymenoptera, called the *epipharynx* and the *hypopharynx*, seem to restrict and protect its entrance.

The *œsophagus* is a conduit varying in length, which traverses the prothorax, and sometimes extends beyond it; but it is occasionally so short as scarcely to pass beyond the region of the head. Its structure is musculo-membranous, and it opens into the crop, or, if that part is wanting, into the gizzard, or, if the latter is also absent, into the chylific ventricle. It is around the origin of the œsophagus that the nervous system, as formerly described, constitutes a ring, by sending forth two branches which unite on the inferior face of the body.

The *crop*, which is by some called the stomach, is essentially nothing more than a dilatation of the œsophagus. It is often difficult to detect, is sometimes entirely wanting, and may be observed to vary greatly even in two individuals of the same species. Exteriously it does not differ much from the gizzard, but its interior never presents those corneous pieces which in the latter serve the purposes of trituration. Its position bears some analogy to that of the crop of birds, from which circumstance it has probably derived its name. Its texture is simply membranous, or slightly muscular when its development is considerable, and in that case it is not rare to observe certain folds or fleshy columns and deeper lines, which give it something of a ribbed appearance. These folds, prolonged in the interior, frequently constitute a kind of valve. It is in this crop that bees contain their honey prior to their disgorging it, and it likewise serves as the reservoir of that black and often fetid fluid which many insects allow to flow from their mouths when they are seized. The form of the crop

Internal Structure. differs in the various species; and even in individuals of the same species, according to its state of repletion or vacuity, it assumes an ovoid, rounded, or pear-shaped appearance. In some orders of insects it is greatly developed, and very muscular; and in certain cases, instead of lying in the same direction with the intestinal canal, it forms with it an angle more or less acute, thus constituting a lateral pouch varying in extent and form.

The *gizzard* follows the crop. Its existence is not constant, and its essential character consists in its singular internal structure, which is furnished with moveable portions of a horny texture, provided with ridges or bristles pointed in all directions, in the form of combs or brushes. The principal portions are more or less numerous, and form by their union a kind of valvule at the orifice of the chylific ventricle, into which they permit nothing to enter but what has been previously reduced to a state of tenuity. This very singular triturating machine, as we may call it, exists among both the herbivorous and carnivorous kinds. It recalls to mind the aspect of the stomach among the crustaceous tribes. Externally it greatly resembles the crop, and indeed can scarcely be distinguished from it otherwise than by its internal structure.

The *chylific ventricle*, which corresponds to the part named *duodenum* by Marcel de Serres, and *stomach* by Ramdhor, is a very constant organ among insects, although its form and character are extremely various. It is here that the pulpy food, mixed with specially elaborated fluids, is converted into chyle. One of its most constant characters is the insertion on a kind of circular pad more or less developed, of at least one extremity of the biliary vessels. Its texture is soft and delicate, and capable of varying its capacity by extension. Its form is generally cylindrical, although it sometimes undergoes dilatations and restrictions in its course. In some rare instances, detailed by M. Dufour, it is bilobed or bifurcated at its commencement, the preceding part of the alimentary canal being inserted in the angle of the furcation. It presents several other occasional and very curious characters, but it is in general straight, and but rarely exhibits a limited number of convolutions. It is not garnished interiorly with triturating organs, either muscular or corneous; but it is furnished with a valvule at the point of union with the intestine. One of its most curious characters consists in its being sometimes villous on the surface, that is, covered by a quantity of little tubes, named *villosities* by Cuvier, and *papillæ* by Dufour. These are a species of tubes or purses, somewhat resembling the fingers of a glove, and opening into the ventricle. Their functional uses are differently construed by physiologists. Cuvier inclines to think that they draw from the abdominal cavity a gastric fluid, which they pour into the ventricle to aid digestion. Marcel de Serres partakes of the same opinion, and regards these papillæ as the superior hepatic vessels. Dufour, however, does not consider them as analogous to the biliary vessels, but as culs-de-sac, which receive the alimentary fluid, and, after its conversion into chyle, transmit it to the abdominal cavity. That able anatomist has recognised in their interior a brownish matter, quite analogous to what is contained in the ventricle itself. They do not differ greatly as to form, but a great variation occurs in regard to number and disposition. Sometimes they exist in great numbers throughout the whole extent of the ventricle, sometimes they are fewer in number, and confined to a limited portion. Insects belonging to the orthopterous order have but few of these papillæ, but they are greatly developed, and inserted on the anterior part. In other instances the papillæ are entirely absent; and the ventricle is then smooth, or occasionally exhibits depressed lines, which divide it transversely into so many little bands. The presence of

Internal Structure. these papillæ cannot be regarded as a constant character in any group, for we find them absent or present in different insects of the same family, without any known or assignable cause. They occur indiscriminately among carnivorous and herbivorous species; but it is among the coleopterous tribes that they show themselves most frequently, and under the most characteristic forms.

The *intestines* constitute an extended portion of the canal. They receive the alimentary matters after they have been digested in the chylific ventricle, and extract by their action whatever nutriment remains. Their absorbent powers, however, as alimentary organs, are probably confined chiefly to their upper portion. They consist of a *small intestine*, a *great intestine*, and a *rectum*. The small intestine of course proceeds from the ventricle, and is in general narrow, with an equal diameter throughout, although it is sometimes swollen or pursed in the course of its extent. It is of various length, and makes numerous circumvolutions in the interior of the abdomen, after which it borders with the great intestine. The latter, called also the *cæcum*, consists of a swelling or enlargement, usually ovoid and smooth, but not unfrequently also covered by plaits and little muscular rib-like bands, more or less projecting. It is dilatable, and in some cases is swollen beyond measure, especially among certain aquatic tribes, such as the *Dytisci*. In these, as detected by the skilful eye of M. Dufour, the *cæcum* is no longer placed in the direction of the intestinal canal, but is thrown to one side, and furnished with a vermicular appendix, spirally twisted. It becomes inflated with air at the will of the insect, and thus seems to act the part of a swimming bladder. Other modifications of this organ have likewise been observed, into the detail of which we shall not here enter. The rectum is a muscular tube, in general of no great extent.

We shall next devote a few lines to the *biliary vessels*. That peculiar fluid called bile seems equally indispensable to the digestion of insects as to that of the higher animals, but the organ which secretes it is very different. In the former class it has no longer the appearance of a gland, but consists of more or less numerous vessels, of variable length, fixed for the most part by a single extremity, but not unfrequently by both ends, to the intestinal canal, and floating as it were in the abdominal cavity. These vessels are often rolled on themselves, and interlaced by numerous tracheæ and slender nervous filaments. They are never wanting in insects, and they exist equally in the larva state as in the perfect condition. They are delicate tubes, composed of a thin and pellucid membrane, on which certain transverse foldings produce a somewhat varicose appearance. They contain a liquid, sometimes limpid and colourless, but usually varying from yellow to brown. It is bitter, and exhibits all the characteristics of bile. The vessels themselves vary in amount from two, four, six, to an almost countless number. Their mode of insertion exhibits some remarkable variations, which however may be reduced to two great divisions: 1st, where the insertion takes place upon the ventricle alone; 2d, where it takes place upon the *cæcum* likewise. The first of these divisions offers two classes; sometimes the vessels are inserted only by one extremity, while the other is free or floating; sometimes they are fixed by both ends, and form so many arches. In the latter case they are few in number, and each arch may be regarded either as a vessel strongly curved towards the two points of insertion, or may be looked upon

as composed of two vessels exactly anastomosed at their extremities. A coleopterous insect belonging to the genus *Donacia*, described by M. Dufour, was observed to possess a ventricle provided at once with arched vessels and with such as were free at their extremity. Such a combination connects, as it were, the characters which principally distinguish the first great division. The second great division above alluded to never presents us with any vessels that are free or unattached at one extremity. They form a complete arch from the ventricle to the *cæcum*, and scarcely present any particular character, except that their number is always restricted. The insertions on the ventricle are always more distinct than those on the *cæcum*; the latter being rarely isolated, but usually uniting into a smaller number of common branches, and sometimes into one.

The *salivary vessels* consist of floating tubes, which open about the pharynx, and furnish a liquid to assist in deglutition. They are sometimes wanting or imperceptible, and are more general, as well as more highly developed, among the suctorial than the masticating tribes. The receptacles which supply the silk used by spinning caterpillars, are by many regarded as analogous to salivary glands, as are likewise the organs which furnish the venomous fluid in the mouths of *Scolopendræ*.¹

CHAPTER IV.

THE METAMORPHOSES OF INSECTS.

As frequent reference is made, in the course of this treatise, to the metamorphoses of insects, we shall here endeavour to explain in what these essentially consist. "Were a naturalist," observe Messrs Kirby and Spence, "to announce to the world the discovery of an animal, which for the first five years of its life existed in the form of a serpent; which then penetrating into the earth, and weaving a shroud of pure silk of the finest texture, contracted itself within this covering into a body without external mouth or limbs, and resembling more than any thing else an Egyptian mummy; and which, lastly, after remaining in this state without food and without motion for three years longer, should at the end of that period burst its silken casements, struggle through its earthy covering, and start into day a winged bird,—what think you would be the sensation excited by this strange piece of intelligence?" Yet the difference which exists between the sometimes repulsive aspect of a creeping caterpillar, and the consummate beauty of the gorgeous butterfly to which it gives existence, is as remarkable as any supposable change from one form of animal life to another.

Although the ancients appear to have been aware that many insects, such as butterflies, bees, and beetles, proceeded from eggs, and underwent those changes which we name metamorphosis; yet, very shortly before the time of Redi, Swammerdam, Malpighi, and Leeuwenhoeck, to whom we owe so much of our present knowledge, Mouffet, who has been called the father of entomology, mistook the aquatic larvæ of *Libellulæ* for creatures entirely distinct from the perfect insects, and named them *Water Locusts*! The error was excusable, and has no doubt often been repeated in corresponding cases; for how many are ignorant, even at the present day, that the slender red-coloured wriggling worm, which is so often seen in collections of rain water,

¹ Whoever inclines to enter fully into these subjects, will find in Messrs Kirby and Spence's *Introduction to Entomology*, not only a very ample and able account of the structure and functions of the various organs of insects, but also such references to the best informed writers, as will unfold a wide field for further study and reflection. See also *Entomologia Edinensis* (Introduction); the article *Insectes* in the *Dict. Classique d'Histoire Naturelle*, t. viii.; and M. Dufour's papers on Insect Anatomy, in the *Annales des Sciences Nat.*

Metamor- is the larva state of a clear-winged and elegantly formed phoses. fly, furnished with feathered antennæ and long slender limbs, the *Chironomus plumosus*? How entirely dissimilar is the hairy caterpillar, which we frequently observe crossing our foot-path in country lanes, from the richly attired tiger-moth which it eventually becomes? Many examples of a similar nature will probably occur even to the least instructed reader.

The word metamorphosis seems to have passed originally from a mythological meaning to a term in natural science. We had deemed it an ancient phrase, till we were informed by Mr Kirby that μεταμορφωσις, and its derivative μεταμορφωσις, are not extant in any Greek writer before the date of the New Testament. They are used to express any external change of form or colour, and metaphorically any inward change and progressive improvement of the mind. The word metamorphosis, as applied to insects, is in fact synonymous with the more familiar term transformation, although, speaking strictly in relation to physiology, the changes indicated by these expressions should rather be regarded as a series of developments.

All insects proceed from eggs either previously deposited by the female parent, or, as in the case of the so-called viviparous (strictly ovo-viviparous) kinds, hatched within the body of the mother. Their first active condition is that of larva, which, according to the views of Swammerdam, contains within itself the germ of the future perfect insect, and those various envelopes, each of which, successively developed, becomes external and apparent by the casting off of that by which it was preceded.

Thus a caterpillar may be viewed, not as a simple, but a compound creature, containing within it the germ of the future butterfly, inclosed in what will become the case of the pupa, which is itself included in several more envelopes or skins, each of which becomes external in its turn. As the larva (so called from the very circumstance of its containing the imago, or perfect insect, shut up as it were in a mask) increases in dimensions, the various parts expand, and are thrown off, until at length the completed and more beautiful form is displayed in all its lustre. Swammerdam, in fact, discovered, by careful dissection, not only the skins of the larva and pupa incased within each other, but within these again the very butterfly itself, with its organs all complete, though nearly in a fluid state.¹

Of the same fact, Mr Kirby states, any one may convince himself, without the skill of the great Dutch observer, merely by plunging into vinegar or spirit of wine a caterpillar about to assume the pupa state, and allowing it to remain there for a few days till it gains consistency of parts; or by boiling it for a few minutes in water. A very rough dissection will then enable the student to detect the future butterfly,—the wings being rolled up into a sort of cord, and lodged between the first and second segments, the antennæ and trunk coiled up in front of the head, and the legs, though very dissimilar in form, actually sheathed in those of the caterpillar. Malpighi, moreover, discovered the eggs of the future moth in the chrysalis of a silkworm only a few days old;² and Réaumur those of *Bombyx dispar*, even in the caterpillar, seven or eight days prior to its change into the pupa state.³

According, however, to the more recent doctrines promulgated by Dr Herold, the successive skins of the caterpillar, the case of the pupa, and the members of the perfect insect (except the sexual distinctions, which he perceived even in the newly excluded larvæ), do not pre-exist as germs, but are formed successively from the rete

mucosum, which itself is formed anew upon every change of skin, from what he denominates the blood, or the chyle after it has passed through the pores of the intestinal canal into the general cavity of the body, where being oxygenated by the air-vessels, it performs the nutritive functions of blood.⁴ These proceedings, as usual, are attributed to a *vis formatrix*, a term of most convenient application where the mysterious workings of nature are but dimly seen or vaguely understood. But whatever may be the mode or principle of development, we know that insects exist in the four following states,—the egg, the larva, the pupa, and the imago or perfect condition.

The first stage of life, properly so called, is that of larva, in which existence is usually more prolonged than in any other, and in which the insect does nothing but eat voraciously, and increase rapidly, with intervals of repose occasioned by repletion. In this state it is entirely sterile. In the course, and towards the termination, of the larva state, that peculiar internal secretion the caul, epiploon, or fatty matter, formerly mentioned, is observed to increase, and the insect then assumes the pupa state, which is usually one of inaction and apparent torpidity. Ere long the skin of the pupa bursts asunder, or the wings and members become sufficiently developed for active exercise, and the insect assumes the perfect state, as exemplified in bees, beetles, and butterflies, all of which proceed from a worm-like larva. In this condition they are usually less voracious, their principal object and occupation being the preservation or continuance of their kind.

All insects, however, do not pass through these transformations. Most of the apterous kinds issue from the egg in a form very similar to that which they maintain throughout their after lives; from which circumstance Linnæus and others have bestowed the name of *complete pupæ* on their intermediate state, when such is recognisable. Even those that are subjected to the signal changes above described, differ considerably in the nature and degree of metamorphosis to which they are subjected. Many of the winged kinds experience no other change than the accession of the organs of flight. Their larvæ resemble the perfect insect, with the exception of the want of wings. Their pupæ, known as *semi-complete*, merely differ from the larvæ by exhibiting the rudiments of those organs the eventual development of which produces the completion of the perfect insect. Such are the grasshopper and locust tribes, in which the pupæ continue to exercise their locomotive powers and ordinary vital functions. Those insects which undergo a more entire metamorphosis are changed from larvæ into motionless and inert pupæ, and this mode of transformation presents different gradations. The pupæ, or nymphs as they are often called, of the Coleoptera and several other orders, exhibit their external members in close approximation to the body, but free or uncovered by any general envelope; we name them *incomplete*. But among the Lepidoptera, such as butterflies and moths, an elastic but firm and sufficiently solid skin or integument is moulded over the entire body and its various members, and only shows the form and outline of the latter visibly impressed upon its surface. These were called *pupæ oblectæ* by Linnæus. Dipterous flies, again, are covered in the pupa state by small simple cases, or egg-like shells, usually regarded as the skin of the larva, through which the form and proportions of the parts are in no way discernible. These were termed *pupæ coarctatæ* by the great Swedish naturalist.

When, however, we make use of the term *metamor-*

Metamor- phoses.

¹ Hill's *Swammerdam*, ii. 24.

² *De Bombyce*, 29.

³ *Memoires*, i. 359.

⁴ *Entwicklungsgeschichte der Schmetterlinge*.

Metamor-
phoses.

phosis, in relation to the different states of insects, another meaning is apt to result from the application of the words complete, semi-complete, and other adjective phrases,—for the less complete the pupa, the more complete the metamorphosis. Some confusion, we think, has arisen from this circumstance,—at least we have ourselves been occasionally puzzled by the contrariety of opinion expressed upon the subject even by the “master spirits” of entomology. Thus, Latreille observes, “*Les Coléoptères subissent une métamorphose complète*,”¹ while Mr Kirby has it “*Metamorphosis incomplete*,”² and the same form of expression is used by Mr Macleay.³

However this may be, our entire range of natural knowledge presents us with nothing comparable in singularity or beauty with the phenomena of metamorphosis. No wonder that the mystical sages of Egypt, and the refined philosophers of Greece, were so entranced or delighted with what they saw and fancied, as to found upon these changes many of the fondest fables which now pervade our classical literature. “*Psyche*,” says Dr Nares, “means in Greek the human soul; and it means also a butterfly, of which apparently strange double sense the undoubted reason is, that a butterfly was a very ancient symbol of the soul. From the prevalence of this symbol, and the consequent coincidence of the names, it happened that the Greek sculptors frequently represented *Psyche* as subject to Cupid in the shape of a butterfly; and that even when she appears in their works under the human form, we find her decorated with the light and filmy wings of that gay insect.”⁴ Swammerdam himself, although his observations tended to prove that the analogy between the metamorphosis of a butterfly and the resurrection of the body, or second life of the human soul, was not so close as had been imagined, is yet of opinion that the process is so remarkable as to paint and exemplify that resurrection before our eyes.⁵ “To see, indeed, a caterpillar crawling upon the earth, sustained by the most ordinary kinds of food, which, when it has existed a few weeks or months under this humble form, its appointed work being finished, passes into an intermediate state of seeming death, when it is wound up in a kind of shroud and incased in a coffin, and is most commonly buried under the earth (though sometimes its sepulchre is in the water, and at others in various substances in the air); and, after this creature and others of its tribe have remained their destined time in this death-like state, to behold earth, air, and water, give up their several prisoners; to survey them, when, called by the warmth of the solar beam, they burst from their sepulchres, cast off their cerements, from this state of torpid inactivity come forth as a bride out of her chamber,—to survey them, I say, arrayed in their nuptial glory, prepared to enjoy a new and more exalted condition of life, in which all their powers are developed, and they are arrived at the perfection of their nature; when, no longer confined to the earth, they can traverse the fields of air, their food is the nectar of flowers, and love begins his blissful reign;—who that witnesses this interesting scene can help seeing in it

a lively representation of man in his threefold state of existence, and more especially of that happy day, when, at the call of the great sun of righteousness, all that are in their graves shall come forth, the sea shall give up her dead, and death being swallowed up of life, the nations of the blessed shall live and love to the ages of eternity?”

“But although the analogy between the different states of insects and those of the body of man is only general, yet it is much more complete with respect to his soul. He first appears in this frail body—a child of earth, a crawling worm, his soul being in a course of training and preparation for a more perfect and glorious existence. When it has finished this course it casts off this vile body, and goes into a hidden state of being in Hades, where it rests from its works, and is prepared for its final consummation. The time for this being arrived, it comes forth clothed with a glorious body, not like its former though germinating from it, for though ‘it was sown an animal body, it shall be raised a spiritual body,’ endowed with augmented powers, faculties, and privileges, commensurate to its new and happy state. And here the parallel holds perfectly between the insect and the man. The butterfly, the representative of the soul, is prepared in the *larva* for its future state of glory; and if it be not destroyed by the ichneumons and other enemies to which it is exposed, symbolical of the vices that destroy the spiritual life of the soul, it will come to its state of repose in the *pupa*, which is its Hades; and at length, when it assumes the *imago*, break forth with new powers and beauty to its final glory and the reign of love.”⁶

Swammerdam, to whom we owe the earliest philosophical examination of the subject, divides the phenomena of metamorphosis into four classes. In the first, in which the changes are the least varied or remarkable, he includes apterous insects commonly so called, most of which we now name Myriapoda, and the metamorphosis of which consists in gaining additional segments and pairs of feet; also Arachnides and Crustacea, which are for the most part characterized by simple renewals of their envelope. In the second class he places such insects as are born with six feet, but have their wings concealed or inclosed in a sheath during a rudimentary period, such as Orthoptera, Hemiptera, and many Neuroptera. In the third class are included those insects which exhibit three distinct conditions; they compose two subdivisions. The first comprises those insects of which the second state, called nymph or semi-nymph, exhibits either the appearance of feet and wings, or the reality of these organs. They are not reduced to that state of utter lethargy or apparent death which some present, and they include the remainder of the Neuroptera, the Hymenoptera, and the Coleoptera. The other subdivision contains the Lepidoptera, of which the larvæ, commonly called caterpillars, are subject to several preparatory changes of their coat, and are finally converted into chrysalids, through the coriaceous skin of which the interior parts are perceptible, but which externally exhibit neither wings nor legs, nor any other members.

¹ *Règne Animal*, t. iv. p. 354.

² *Horæ Ent.* p. 440. The confusion above referred to may perhaps have arisen from certain adjective phrases having been at times applied indifferently, either to the state of pupa or the phenomena of transformation, which in most cases causes a contradiction in terms. In Orthoptera, of which the pupa is semi-complete, the metamorphosis may bear the same designation; but in the other orders the double application of any of the adjective terms leads to inaccurate ideas. Thus, in Coleoptera, the pupæ are *semi-complete*; but there is surely a total transformation, that is, a *complete* metamorphosis, when we compare together the larva and the perfect insect. So also in Lepidoptera, the pupa is objected; in Diptera, coarctate; and consequently the metamorphosis must be *complete* in both. Now Mr Kirby makes use of the phrase “*metamorphosis objected*” in regard to the former, and “*metamorphosis coarctate*” in relation to the latter,—terms which we have been in the practice of applying to the pupa state of these orders, but not to the general transformations. The same admirable author, in defining apterous insects, states the metamorphosis to be *complete*. We would rather say that they undergo *no* metamorphosis at all,—for which very reason, each particular state, or rather period, of the insect, is itself complete from youth to age. The less complete the pupa, the more complete the metamorphosis, and *vice versa*.

⁴ *Essays*, i. 101.

⁵ Hill's Translation of the *Biblia Naturæ*, i. 187.

⁶ *Introduc. to Ent.* vol. i. p. 75.

Metamor-
phoses.

Metamor- Finally, in the fourth class are included all those insects phoses. which on their exclusion from the egg exist as vermiform apodal larvæ, are provided at most with six feet, and are converted into nymphs without a change of envelope, so that their skin merely hardens over the intermediate state of the insect, which ere long issues winged. Such are the dip- terous tribes.

These views and combinations have been somewhat modified in later years, by Réaumur, Linnæus, Fabricius, Huber, Dutrochet, Savigny, Marcel de Serres, Latreille, and others who have devoted themselves to the investigation of metamorphoses. Those phenomena have consequently been classed as incomplete or partial by which the aspect of the insect is merely modified, and as complete or total by which it is entirely changed. In all, the interior changes may be said to command the exterior, that is, the latter are consequent on the former. In numerous species, not less than three of the principal organic systems, viz. the *nervous*, the *nutritive*, and the *respiratory*, undergo important modifications, and we may easily conceive how strongly the instinctive habits of the individual must be thereby affected. The alterations in the nervous system especially, are singular in their nature and effects. The number of ganglia of the spinal cord is usually greater in the larva than the perfect insect, although the great single ganglion of the rhinoceros-beetle (*Oryctes nasicornis*), in its early state, compared with the four ganglia of its subsequent condition, offers an exception to the general rule. But in the larva of the stag-beetle (*Lucanus cervus*) we observe eight ganglia, besides a recurrent nerve, while the perfect insect possesses only four; and among caterpillars in general the same restriction takes place in the number of their ganglionic knots as they attain the perfect state.

Among beings in which the parts representing the brain and other organs of sensation of the higher tribes undergo so many variations even in the same individual, we may well suppose that whatever ideas they are capable of conceiving at one period of their existence, may differ essentially from those with which they are impressed at another. We shall not here involve ourselves in the discussion of the difficult and dissimilar theories of instinct, nor enter into any exposition of the mechanical, the intellectual, or the supernatural character of that surprising manifestation, which, under whatever aspect it may be viewed, whether as differing in kind or only in degree from reason, cannot be otherwise regarded than as a most beautiful illustration of divine benevolence. But we may ask, by what peculiar memory or mode of recollection does the brilliant butterfly, which seeks its sustenance in the nectarous juices of flowers, rifling their sweets with its tubular *proboscis*,—by what means does it remember that its progeny, while in the larva state, must be sustained by a far different diet, and that they exercise their *jaws* on cabbage-leaves, and other vegetation of the coarser kind? M. Virey, who denies all intellect to insects, and views their various actions as resulting mechanically from the peculiar disposition or character of their nervous system, has endeavoured to illustrate the subject by the following parallel. He compares an insect to one of those portable organs, of which the cylinder has different airs noted on its surface, and which performs one or another tune in proportion as the cylinder is made to recede or advance. So likewise the nervous system, or series of ganglia along the double medullary cord, of the creatures now under consideration, being differently constituted in the larva and the perfect insect, ought to produce different actions in the two cases,

though respectively appropriate to the nature of each. Art Metamor- phoses. in the one instance, and nature in the other, has impressed certain dispositions, or notes of action, fixed in a determinate series, equally in the musical organ, and the ganglionic system of caterpillars. Hence the one gives utterance to a certain air, while the other acts according to a certain sequence of operations. Pull out a note of the barrel organ, and you have another tune; await the transformation of the caterpillar to a butterfly, and you have (with a change in the *notching* of its nervous system) another series of instinctive operations. In both, the relations of cause and effect are the same, and each is merely the mechanical playing of an instrument! Now, to prove this position, as has been elsewhere remarked, M. Virey ought at least to have shown, that whenever a change takes place in the instincts of insects in their different states of larva and imago, a corresponding change also takes place in the structure of the nervous cord.¹ But this is by no means the case. In three entire orders, namely, Orthoptera, Hemiptera, and Neuroptera, the structure of that cord remains unchanged, and yet we know that thousands of the species which compose these orders acquire instinctive habits in their perfect state, altogether dissimilar to those by which they were characterized in their earlier condition. Even were it otherwise, our query would still require to be answered, by what mechanical impulsion is the completed butterfly, a gay and gorgeous honey-sucker, induced to play a tune (we speak in harmony with M. Virey's views) so completely in accordance, not with its own refined tastes, but with the future welfare of the crawling caterpillars of which it is the parent? Why does it deposit its eggs, not on the odorous blossoms and bright consummate flowers in which it takes so much delight, and amid the varied petals of which it rejoices to expand to the sunshine its own still more brilliant wings, but on the rank leaves of the cabbage and cauliflower, or the dingy foliage of the nettle? These questions, and many others of a similar nature, are perhaps more easily proposed than answered. When we consider, indeed, how frequently inaccurate is our knowledge even of our own individual feelings, and how much more incompetent we are to judge of what passes in the minds of others of our own species, need we wonder that the sentient principles of the lower animals should, in relation to human intelligence, be still shrouded in dim eclipse, if not in total darkness. It is far more probable, however, that the alterations in the nervous cord have no necessary connection with the changes of instinct, but are more closely concerned with those other not less remarkable mutations in the organs of sense and motion, which occur between the larva and imago states of several orders. "In a common caterpillar, the form of the body, the legs, the eyes, and other organs of the senses, all strikingly differ from those of the imago; whereas, with the exception of the acquisition of new wings, a perfect locust differs little from its larva; so that we may reasonably expect a corresponding change, such as we find it in the structure of the nervous cord of the lepidopterous insect, not called for in that of the neuropterous (orthopterous?) species, in which accordingly it does not take place."²

Metamorphosis frequently induces no less remarkable changes in the *system of nutrition* of insects, followed of course by corresponding alterations in their instinctive appetites and modes of life. In such as undergo an incomplete metamorphosis, the parts of the mouth, and the form of the alimentary canal, experience no essential alteration; but among those tribes in which the change of external aspect is complete in each successive stage, these import-

¹ *Nouv. Dict. d'Hist. Nat.* xvi. 313.
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² *Introd. to Ent.* iv. 27.

³ *Ibid.* vol. iv. p. 28.
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ant parts assume another character, and admirably illustrate the multitude of means employed by nature to vary her innumerable products, even although the general laws by which these are regulated, and from which, under the great and never-slumbering eye of Omnipotence, they more immediately result, are themselves so few in number. The shorter the alimentary canal becomes, the more carnivorous are the tendencies of the individual. This finally exemplifies the great physiological truth previously deduced from the difference between the structure of the alimentary system in herbivorous and carnivorous animals of the higher classes,—between the short canal of the blood-thirsty tiger, and the lengthened convolutions of the gentler ruminating tribes. Here, however, the disparity exists, not as among animals of entirely different attributes, but in the same individual at different periods of its existence. The young of many aquatic beetles of the family of *Helophoridae* are carnivorous in their larva state, and become herbivorous on assuming their final transformation. A like singularity is manifested by many dipterous flies, which, born and bred amid the putrid moisture of animal remains, no sooner become winged insects, than they seek a purer diet in the nectarous juices of fruits and flowers.¹ Analogous changes take place even in those species which do not entirely alter the nature of their diet. A voracious caterpillar, which, by means of its robust maxillæ, rapidly gnaws and consumes a quantity of the most coriaceous leaves, to the amount sometimes of triple its own weight in a single day, and presents the beau-ideal of an eating machine, has its intestine greatly dilated, and pursed like a colon. The larvæ both of wasps and bees have a stomach so vast, that it occupies almost the entire of their interior, although in the perfect state of each it becomes greatly restricted. Thus in the bee that great laboratory consists of little more than two unequal honey pouches; and among butterflies, of which the trunk or sucker corresponds to the previous jaws, the stomach is much less than in caterpillars. This, we may observe, reverses the rule which applies to the great ruminating animals among the vertebrated tribes, where we find a single stomach in the fœtus state, and which in the adult is multiplied to four. It is the opinion of some naturalists that larvæ in general, having larger intestines, tend more towards a herbivorous diet than perfect insects, in which these organs are shorter, and which are consequently supposed to assume a more carnivorous habit;—"so rare is it," observes M. Bory St Vincent, "to perceive the manners of living creatures not tending to mutual destruction as their powers are developed." An enlightened mind, however, naturally delights in the perception and extrication of general rules; and these, we fear, are not seldom fancied without being either perceived or deduced. In opposition to the presumed law, we have already mentioned the *Helophoridae*, which reverse the rule; and to these we could add many more. The glow-worm in its larva state is greedy of animal juices, and feeds chiefly on minute testacea, while, in its completed state, it is entirely herbivorous. A large aquatic beetle, the *Hydrous piceus*, is so ferocious and blood-thirsty in the form of larva, as to bear in France the name of *ver-assassin*; but in its after condition, through the medium of metamorphosis, the intestine becomes elongated, and the disposition of the insect is softened and subdued, so that it then prefers a vegetable to an animal diet. In fact the great aim and object of an insect in the perfect condition is rather the continuance of its kind than the sustenance of itself; although, as the one process cannot be well accomplished without the other, it no doubt, even in its most

high and palmy state, casts, like its betters, an occasional eye on the "flesh-pots of Egypt."

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The changes in the *respiratory system* of insects produced by metamorphosis, are not less extraordinary than those to which we have just alluded. But as we have already mentioned some of the more remarkable of these in our observations on the *organs of respiration*, we shall not further dilate upon that portion of the subject.

Metamorphosis in insects has been described as the maximum state of a general law of nature, by which the whole organization of the animal being is gradually developed and made fit for reproduction. Without the study of this phenomenon, we cannot acquire a knowledge of the most important circumstances in the lives of such animals as are guided entirely by instinct; and just as an acquaintance with the whole life of an insect necessarily induces a truer knowledge of its actual nature, than a mere description of one of its forms,—so, in the same proportion, it has been said, ought metamorphosis to outweigh every other principle of arrangement. When we trace the natural history of a dragon-fly (*Libellula*) from the time that the egg is first dropped into the bosom of the uncertain waters, till, on some bright sunny morning in "the leafy month of June," the gauzy-winged insect in the perfect state is seen to rise from its moist abode, and, hawking for flies, to hover like a bird of prey along the placid shores of some familiar pool, we can scarcely conceive a clear idea of the truth, except by supposing one animal to have been so inclosed within another, that the imago is in a great measure distinct from the repulsive larva, and is only opened to our view by its desiccation or death. Hence, as Mr Macleay observes, a system unconnected with metamorphosis may be regarded as taking no more notice of half the number of true insects than if they did not exist. "It is the defect both of the artificial system in Entomology, and of the sexual system in Botany, that they become useless, except when the objects of the respective sciences are before us in one particular state, which is often the most transitory of their life. Unless this condition be fulfilled, such systems lose their sole and peculiar merit of being dictionaries by which natural objects may be named. There are thousands of organized beings, to the history and knowledge of which the disciple of Linnæus and Fabricius has no clue whatever, although perhaps they are in that state of their existence which most directly affects the interests of man. Plants not in flower, and insects not in their declared state, constitute an ocean of difficulties, in which the most skilled in the Linnæan nomenclature will founder, unless he have other beacons than such momentary considerations as are afforded by the number of stamina, or the form of the antennæ."²

We shall conclude our observations on the singular subject of metamorphosis, by another quotation from the last-named author, which, with what has been already stated, will, it is hoped, suffice to instruct the reader regarding what we consider the most extraordinary phenomena observable within the range of the animal kingdom. "It was perfectly in unison with the innate propensity of the human mind towards the marvellous, that the change of a caterpillar into a butterfly, when first noticed, should have been considered by the ancients as a true transformation, irreconcilable with the ordinary course of nature. Even on the mystery being in a great degree cleared up by the discoveries of Libavius, Redi, Malpigli, and Swammerdam, the phenomenon continued to be termed metamorphosis; and perhaps it is even still a little owing to such circumstances that a natural process, neglected in other

¹ *Entomologia Edinensis*, p. 207.

² *Hor. Ent.* p. 449.

Metamorphoses. branches of zoology, has always excited so much curiosity among entomologists. Metamorphosis, however, has been taken of late in a very general point of view, and rendered synonymous with that species of organic decomposition which, by means of continual shedding of the external envelopes, or even of the various integuments which may compose those envelopes, occasions that extraordinary characteristic of a living body, namely, that it never remains in a constant state, or identically the same, but is continually assimilating new particles of matter, as it throws off the old. And since no metamorphosis can take place except in consequence of these integuments being shed, perhaps it may not be altogether improper to survey the subject in this light. What I mean is, that we ought to regard the metamorphosis or change of form which certain animals undergo at various periods of their life, as an attendant upon, if not a variety of, the *ecdysis*, or moulting, to which all organized beings are subject. There is, however, a great distinction to be made between the *ecdysis* of the *Vertebrata* and *Annulosa*, for in the former we observe little more than that the animal has quitted a sheath in which it was inclosed; whereas in the latter the change is nothing else than if the skeleton were shed; for this name is surely deserved by those hard and solid parts which in so many cases afford support to the muscles. It is clear that such a process must occasion a crisis in the life of an annulose animal, incomparably more decisive in its effects than what can be produced among the *Vertebrata*, by merely being set free from an integument. All the marvellous, however, of *ecdysis*, was with the earlier naturalists comprehended in the change of form; and consequently the shedding of the envelope only excited attention where it regarded a few of the *Annulosa*. Hence it was a great discovery of Linnæus, that every annulose animal ought to be considered as subject to metamorphosis. It may indeed have led to his more artificial notion of every externally articulated being having a nympha state; but even this helped Fabricius to give, although with a faulty nomenclature, a much more convenient division of metamorphosis than he could otherwise have devised.

"Ecdysis, by which term is signified generally every change in the identity of the envelope of a living body, may either be complete or incomplete. If it be incomplete, or, which is the same, if the integuments scale off piece by piece, we have that mode of change which is peculiar to the most perfect of the *Vertebrata*, and to the least perfect of the *Annulosa*.

"Complete ecdysis is the shedding of the whole external envelope at once, of which we have examples among the vertebrated as well as annulose animals. It is of three sorts; first, where the external envelope is shed without producing any essential change of form, except in as much as may relate to the increased size. In those larvæ of insects which become inactive in their pupa state, such a process may always be distinguished from the true metamorphosis; but in apterous Hexapods having active nymphæ, they are necessarily confounded. It is also visible in reptiles and spiders, where such appendages of the trunk as have been lost may be reproduced by continued moulting. When the various envelopes are all cast as it were in one mould, it is to be expected that the proper form of the animal should re-appear as these continue to be thrown off. The return therefore of a spider or crab, after having lost a limb, to its original form, may be in some measure understood as depending on the manner in which such animals shed their envelope; but that the limbs thus shot forth should be furnished with muscles and nerves, is, I conceive, what cannot be accounted for, except by referring to that polype nature of the cellular substance, which is perhaps, in the opinion of some persons, the foundation

of all ecdysis. If perfect hexapod insects cannot reproduce their members, this inability may probably proceed from a cause which appears to have produced the same effect among *Mammalia* and birds, to wit, that these animals in their perfect and final form are all subject, if to any, at least to a very imperfect ecdysis.

"The second sort of complete ecdysis is that where the under envelope has been cast in a somewhat different mould from the upper, so that in the course of the moulting certain new parts become gradually developed without the general form being in any material degree altered. This is observable in every annulose class, as well as in Humboldt's Axotl among the *Vertebrata*, and is the first species of change which merits the name of metamorphosis. It includes the *Metamorphosis inchoata* and *Metamorphosis dimidiata* of Latreille, and is the same with the *Metamorphose partielle* of Lamarck.

"The third sort of complete ecdysis is that wherein, by some two or three moultings, generally the last which the animal has to undergo, the form is entirely changed, as well as the number of appendages more or less increased. This is clearly a true metamorphosis, and includes the other two sorts of complete ecdysis; for we have here combined a total casting of the integuments, a development of additional appendages, such as feet or wings, and finally an entire change of form. Such a combination may be witnessed, among the *Vertebrata*, in frogs, and, among the *Annulosa*, in certain hexapod insects. Hence, in confining ourselves to plain and open ecdysis, there will be no great error in stating that the most imperfect takes place in the highest *Vertebrata* and the lowest *Annulosa*; while the most complete ecdysis is that which is seen to prevail in the highest *Annulosa* and some of the lowest *Vertebrata*.

"In strict accuracy, however, it appears that we ought to acknowledge the existence of complete ecdysis throughout the circle of *Vertebrata*. Nay, some physiologists have attributed insect metamorphosis itself to a shedding of an envelope analogous to that which contains the fœtus of the more perfect *Vertebrata*. As every embryo, whether animal or vegetable, is enclosed in a tunic more or less solid, which is its chorion, so, proceeding with the analogy, they conceive that there must be some condition for every animal, similar to the state of the fœtus of the more perfect animals when surrounded by the amnios; and this state in batrachian reptiles and hexapod insects they hold to be the larva. The only danger of this reasoning is, that while we find the birth of an animal to be attended with complete ecdysis, we may be apt to imagine that every complete ecdysis betokens a true birth. It would, however, be truly absurd to consider the casting of their shell by *Crustacea*, or the periodical moulting of the serpent, in this light; yet no one can doubt the fact of both these being cases of complete ecdysis, only differing from that of *Lepidoptera*, because in the former animals the external envelope is always of the same form as that of which it is to take the place. The truth perhaps is, that we ought only to allow two states to every animal, a perfect and an imperfect state. Then, by the reflection that no animal out of the circle of *Acrata* can ever arrive at its perfect state except by means of metamorphosis, and that when perfect it can never again be subject to this change of form, though it may still moult or shed its external envelope, we may be able, if not to comprehend the cause, at least to know the effect, of some of the most puzzling phenomena in nature. The true criterion of animal as well as vegetable perfection is the ability to continue the species; hence some of the *Vertebrata*, as well as *Annulosa*, gaining this faculty before they have arrived at their proper type of form, metamorphosis ceases, and they preserve the shape of larvæ.

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"But if a complete ecdysis may sometimes create a total change in the external appearance of the animal, the fact, however astonishing, is nothing in comparison of the internal metamorphosis which accompanies it, and of which as yet no philosopher has been able to give any satisfactory explanation. The generalization indeed by which we have reduced the moulting of a bird's feathers and the metamorphosis of a butterfly to one principle, may appear to be strained beyond its proper limits; yet if we contemplate the regular gradation from one to the other, how truly, for instance, the inactive pupa of a beetle corresponds with the agile nymph of a *Gryllus*, how this ecdysis in an apterous *Gryllus* corresponds with the sloughing of a spider, and this again with the annual renovation of the serpent, we must be sensible that, however dissimilar the extremes may be, all these changes are modifications of one principle. But what particularly deserves remark is, that these extremes should often be visible in neighbouring groups; nay, in the same order; that, in short, metamorphosis should differ so much in degree even where the animals are near in affinity." An orthopterous insect may preserve the same form and habits from the instant it quits the egg up to the period of its death, the only qualities obtained by ecdysis being an augmentation of size and an aptitude to continue the species. But if we turn to the order of *Coleoptera*, which is contiguous in affinity, it is truly wonderful that, by metamorphosis, not only the form, but the nervous and digestive systems, may be altered, and the organs connected with these primary functions may all be of a construction different from that which they originally possessed."¹

The reader has now been made acquainted in a general way (and as precisely as the limits of our present article may admit) with the most characteristic features in the structure of the insect tribes, from which he may form some opinion of their real nature. Their relative position in the magnificent range of created things is a subject deserving of a deeper and more extended examination than we can here bestow upon it; but as we are unwilling to leave such an interesting matter of philosophical consideration entirely unregarded, we shall here enter into it in the only way compatible with our prescribed limits.

CHAPTER V.

OF THE RELATIVE POSITION OF THE CLASS OF INSECTS IN THE ANIMAL KINGDOM.

A great diversity of opinion has existed from the earliest ages regarding the natural affinities of the different kinds and classes of animated beings to each other, and a consequent contrariety has prevailed in our systems of classification, which are of course indications of the relation of groups, unless where, for mere convenience, a professedly artificial basis of arrangement, deduced from one or two obvious though unimportant characters, may have been adopted. The majority of naturalists, both ancient and modern, have proceeded upon the idea that all natural objects were *concatenated*, or formed a continuous *chain* or linear series, and that whatever hiatus might seem to exist arose either from some great convulsion which had swallowed or swept away the desired links, or from these links being still to be discovered in one or other of those regions of the

earth's surface which still remain to be explored. Hence the dictum of Linnæus—*natura saltus non facit*. "When the ALMIGHTY CREATOR," says Mr Kirby, "willed to bring into existence this mundane system, he formed it according to a preconcerted plan, with all its parts beautifully linked together and mutually corresponding. All things were ordered in *measure*, and *number*, and *weight*.² There was nothing deficient, nothing superfluous; but the whole, in the strictest sense, 'was very good,'³ and calculated in the highest degree to answer the purpose of its GREAT AUTHOR."⁴ Observation and analogy alike combine to prove that there is a regular approximation to each other in the works of God, and that they are related to each other in a variety of ways both naturally and analogically; but it need not be supposed that, in the magnificent plan of the creation, there is no disparity in the relative position of the most nearly related kinds, and no greater interval in one place than another. There is in truth a great variation in the combinations of living beings, though no violent break or sudden interval; in other words, "some continuous species or groups have more characters in common than others." But in considering the various groups of living creatures, we must ever bear in mind our own ignorance of their actual amount, and the thousands of unknown forms which in all the pride of life may be daily unfolding their exquisite forms and gorgeous colours amid those far deserts where man has never trod, and which for that very reason he regards as *solitudes*, though assuredly teeming with all the inexplicable wonders of creation. Let not therefore a *hiatus* be confounded with a *saltus*, the former being merely one of the many blanks in the superficial map of knowledge drawn by man, the latter an absent link in that resplendent chain, to us too often "dark with excessive light," which in one way or other connects together in divinest harmony the beautiful works of the Creator. That the series of beings, however, was not only continuous, but *undeviating*, and ascended in a direct line from the lowest to the highest, was maintained, among many others, by the excellent and ingenious Bonnet, and has generally prevailed till very recent times.

Now the principle which mainly characterizes the views so mildly advocated by Mr Macleay, and entertained, we believe, about the same period, although without communication, by Agardh, Fries, and other continental naturalists, is this,—that although the natural arrangement of objects is indeed in a continuous series, that series in its progression forms various convolutions, each of which may be represented by a *circle* or series returning into itself. He maintains that absolute divisions do not exist in nature, and that a single plan pervades the universe, a plan founded on the principle of series of affinities returning into themselves, and forming circles; hence there is no such thing among natural objects as a simple progression of species.⁵

If it were true that the descending scale, as so long supposed, in the perfection of organization, was regular from man to the infusorial tribes, then the lowest of one form of life would naturally lead to the highest of the next ensuing, and the most simply organized of the vertebrated classes would connect most nearly with the most complex of the invertebrated kinds. But this, as we shall afterwards see, is not the case.

Although naturalists, if we may judge from their sys-

¹ *Hor. Ent.* p. 441.

² *Wisdom*, xi. 20.

³ *Genes.* i. 31.

⁴ *Introduc. to Ent.* iv. 356.

⁵ The latter sentiment appears to have been also entertained by Latreille in his later years. Writing of certain coleopterous insects, he observes, "Les Dryptes ont aussi des rapports avec les Cychrus, et paraissent lier les Cicindelètes avec la section des Carabiques grandipalpes. Plusieurs sections de cette famille semblent se rattacher, comme autant de rameaux, aux Cicindelètes. La plupart des autres familles d'insectes sont dans le même cas, ou forment des troncs ramifiés. En un mot, des séries continues n'existent pas dans la nature. (Note to *Règne Animal*, t. iv. p. 373.)

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tems of classification, are accustomed to consider the insect tribes as inferior in the great range of organization to the molluscous animals which inhabit shells, there can be no doubt that they are superior in many of their vital functions. Their powers of locomotion, whether as winged, aquatic, or terrestrial creatures, are finely developed, and their perceptive faculties are much more acute. The symmetrical perfection of their forms, and the articulation of the limbs, in the insect class, seem also in some measure to connect them with the vertebrated tribes. Indeed, even of the latter, many seem far inferior to insects, not only, as Mr Macleay has observed, in the possession of those faculties by which we are accustomed to estimate the rank of the *Vertebrata* among themselves, but also in the complication of their general structure. These and other considerations afford powerful arguments in favour of the *circular* system; for it appears necessary, first, that certain affinities of the *Mollusca* to the *Vertebrata*, and which are obvious in the *Cephalopoda* or cuttle-fish, should not be disturbed by any intervening division; and, secondly, that the annulose animals themselves, such as insects, Crustacea, and Arachnides, should not be far separated from *Gastrobranchus* and other genera of cyclostomous fishes; above all, that they should not be made subordinate in rank to such simply organized creatures as compose the greatest part of the Mollusca. "Now these conditions will all be fulfilled if the chain of nature be viewed as returning into itself; whereas they will be completely violated if we account it to be a regular line or ladder, commencing with the *Infusoria*, and terminating in man; or indeed if we adopt any opinion that has hitherto been advanced on the subject by naturalists."¹ It seems to have been chiefly owing to the perfection of the circulating system in molluscous animals that they have obtained their present rank; for, in regard to the nervous system, which would have been a truer test, although such tribes as possess a distinct head, and are furnished with tentacula and other organs of sense, have undoubtedly a true brain, yet oysters and many more *acephalous* kinds can lay no other claim to the possession of that organ than what is derived from the analogy which its position in these Testacea is supposed to bear to that of the brain in the gasteropoda. It is a strong fact, however, that so skilful an interpreter of nature as Baron Cuvier should have been determined by that analogy, and should have acceded to the *acephalous* Mollusca the possession of a brain, and a general construction, which, upon the whole, he regards as making a nearer approach to that of the *Vertebrata* than is effected by any annulose animal. Yet in spite of this it would be difficult to contend that an *Ascidia* is in any respect superior to a bee, as no one who has ever seen the two, and observed their respective functions, would venture to bring the sluggish mollusc into competition, either as respects intelligence or complication of mechanism, with the delightful emblem of industry.

When we call in the aid of anatomy to determine the relative importance which different material beings bear in the scale of the creation, we must consider the beauty of the general mechanism and (speaking humanly) the difficulty of the workmanship, and not any "fancied and often forced resemblance to the human structure."² It is in truth a great error to regard the works of the creation as referable to the human structure, as a standard of perfection; for although the frame of man, when taken as a whole, ought

doubtless to be regarded with wonder and admiration as a most complicated yet complete machine, there is at the same time as little doubt that we scarcely possess a single sense or bodily power in which we are not excelled by some irrational beings. Different animals have in fact been constructed on different plans, and man may without impropriety be regarded as upon the whole the most admirably constructed creature of all those which have been organized upon the same general plan with himself, but with the others he cannot be compared.

In the article ANIMAL KINGDOM of this work we have already shown the importance of the nervous system in the formation of the greater divisions of living creatures, and we there exhibited the relative positions occupied by the different classes of animals in the works of the most distinguished systematic writers. Lamarck divides the animal kingdom into two great branches,—the one containing all those living beings of which the skeleton is *internal*, and constructed upon a bony and articulated column, hence called *Vertebrata*,—the other consisting of those innumerable kinds of which the skeleton is either wanting, or its supposed analogue is for the most part *external*, and includes the muscles; these are the *Invertebrata*. This grand distinction is strongly marked throughout the great mass of each division, but it begins to disappear wherever the provinces approach each other. Thus among the turtles or chelonian reptiles, the vertebral column is converted to a row of square osseous plates, which run along the back, and unite with eight pair of expanded ribs, which are anchylosed together by real sutures, and combine to form in fact the *external* carapace or shell. In like manner the vertebral column almost disappears among the cyclostomous fishes, while, on the other hand, the Cephalopoda, or cuttle-fish, though belonging to the invertebrate division, exhibit the commencement of an internal skeleton. M. Virey, as we have shown in the article above referred to, divided the animal kingdom into *three* great branches, according to the different character of their nervous system. Baron Cuvier, proceeding upon the consideration of the same important basis, includes all animals within *four* primary divisions; while Mr Macleay, according to his peculiar views, perceiving *five* great sub-kingdoms in the magnificent *circle* of living things, has assumed that number of divisions. We shall here present a sketch of his system, so far as relates to the primary forms, the majority of which agree with those of his predecessors, although their relative position, and circular sequence, if we may so call it, differ.³

1st, There is a great tribe of beings which possess one principal centre to their nervous system, the great trunk of which, with the said centre, is contained in a bony articulated case, which forms the axis of the whole body, and constitutes the vertebræ and skull of these creatures, which are therefore named VERTEBRATA.

2d, In another form of animals the skeleton is as it were external, so as to envelope the whole body, and is divided by transverse folds into a certain number of rings, to the internal surface of which the muscles are always attached. Their nervous system consists of two long strings of medullary matter, passing through the whole of the body, and united to each other, at small distances, into several knots or ganglia. These ganglia may be said to perform for the parts which surround them the function of so many brains, and for a certain period are even sufficient for ner-

¹ *Horæ Entomologicæ*, vol. i. p. 206.

² *Ibid.* p. 405.

³ As the book entitled *Horæ Entomologicæ* has been long out of print (the author has never brought out a second edition, and the first was almost totally consumed by fire), our occasional exposition of its peculiar and prevailing doctrines cannot prove otherwise than interesting to the considerate reader.

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vous sensibility after the animal has been cut in pieces. All the beings so constructed are named ANNULOSA.

3d, In a third prevailing form there is no articulated skeleton either external or internal, the muscles being attached solely to the skin, which is itself in general soft, though often protected by a calcareous or stony crust, termed the shell. These animals, remarkable, like plants, for the variety of modes in which the sexes are combined, have their nervous system composed of several masses or ganglions united together by nervous threads. The constituents of this group are almost all aquatic, and are named MOLLUSCA.

4th, A fourth form of animal life exhibits to our view the organs of locomotion and sensation arranged in a circular disposition round a centre, so as to give a sort of radiated aspect to the whole body. They are composed of a more or less gelatinous substance, of which the fibres are indistinct. The nervous system of these imperfect beings is but little known. M. Tiedemann, in a work crowned by the French Institute (*Mémoire sur l'Anatomie des Astéries*), conceives that the whitish threads which proceed in a radiant direction from around the mouth, and which extend themselves through the entire length of the arms of these animals, form a kind of nervous system, which, from the pulpy nature of the medullary matter, seems to correspond with the gelatinous composition of the animals themselves. They are all aquatic, and are named RADIATA.

5th, Thus far these groups agree in number and constitution with the four primary divisions established by Baron Cuvier,—the *Annulose* division corresponding with the *Animalia Articulata* of the French naturalist, except that it excludes the *Annelides*, or red-blooded worms, and includes certain radiated species (commonly so called), such as the intestinal group denominated *Intestinaux Caritaires* by the French, or *Entozoa Nematodea* of Rudolphi. But, according to Mr Macleay's views, there still remains a *fifth* form of animal life to be considered,—a group of beings which cannot in the present state of knowledge be better described than as masses of a transparent, homogeneous, mobile, and sensible pulp. There may, however, be observed in this translucent mass innumerable minute granulations, which may be regarded as the nervous molecules dispersed over, or as it were confounded with, the substance of these animals, so as to endow the whole with sensibility, or something which the author calls such, probably for want of a better name. This final division is named ACRITA.¹ Its constituents form a portion of the *Animalia Radiata*, or fourth primary division of the Cuvierian system, and include the infusory animals, many of the intestinal worms, and the *polypi*. Their distinctive character is principally negative in reference to animals, and positive in regard to plants. The simple texture of their cellular tissue is common to them and to the *Algæ*. Their gemmiparous generation is allied only to the very simplest mode of the reproductive system among other animal tribes, but is by no means unfrequent among plants. The method by which they are more or less sustained by the absorption of their external pores, and the attractive influence exercised on them by light, are likewise features only elsewhere to be observed among the vegetable tribes. When a polype is cut in pieces, each of these continues to live, and in time assumes the original form, so that every point of such an animal body may be regarded as possessing an independent life, like that of the lower plants. Lamarck accounts

for this peculiarity by regarding their alimentary canal as constituting a second absorbing surface, in no way different from the absorbent external surface of the *Apas-tria*, or infusorial tribes, so that any portion separated from their bodies may live for a time, like the Infusoria, until they have obtained the second or internal absorbent surface.

"On considering," says Mr Macleay, "the gelatinous composition of these animals, the dispersion of the nervous molecules through their substance, and the absolute certainty that they are devoid of every sense, except perhaps those of taste and touch, we are led to connect them with the *Mollusca*, whose substance is always mucous, and often even gelatinous,—whose nervous system, though collected into several *ganglions*, or *centres of sensibility*, has nevertheless these ganglions dispersed, with little if any arrangement, throughout the whole mass of their body,—and whose senses, so far at least as we are certain of their existence, seem to be confined to those of taste and touch, with the exception of a few animals of the division which possess the organs of sight, and still fewer which possess those of hearing.

"Nevertheless, on comparing the *Acrita* with the *Mollusca*, we find that the organization of these last has become much more complicated, and that a distinct system of circulation, and peculiar organs for respiration, digestion, and secretion, are even visible in these animals, which connect them in a remarkable manner with a still more perfectly organized family—the *Vertebrata*.

"These, however, by their red blood, their muscular heart, their jaws acting vertically, their distinct organs for sight, hearing, smell, and taste, their sexes constantly distinct, their vertebral column, and extreme concentration of the nervous system, are sufficiently insulated from the *Mollusca*, as well as from all other material beings. The group is therefore perfectly distinct and natural; yet if we attempt to define it by any of the above-mentioned various properties, little examination is requisite to convince us that the characteristic thus chosen either disappears in the least perfect of the *Vertebrata*, or passes imperceptibly into the neighbouring groups.

"Thus in the fishes which compose the genera *Amiocatus*, Dum. and *Gastrobranchus*, Bl. all those parts which ought to have constituted their skeleton as vertebrated animals become so soft and membranaceous that they may be considered as having no bones. The organs of respiration and of manducation, the absolute want of the sense of sight, the general habits and external form of these singular fishes, all prove to us that they are connected with the *Annelides*, and that by their nature passes to the structure of the *Annulosa*. On the other hand, on examining some of the *Echinodermata* of Cuvier, such as those composing the genus *Comatula*, we may trace the articulated texture of the *Annulosa* into the division of *Radiata*, many of whose external forms are also exactly imitated by the sessile *Cirrhipedes*. Of the *Radiata*, again, the stellate form and the gelatinous semi-transparent substance are observable among the *Acrita*. So that the chain whose links we have endeavoured to unfold returns into itself, and we find that all animals form a circle composed of the following great divisions, viz.

ACRITA.
MOLLUSCA.
VERTEBRATA.
ANNULOSA,
RADIATA.

¹ "Animalia gelatinosa polymorpha, interaneis nullis medullæque indistincta. Os interdum indistinctum, sed nutritio absorptione externâ vel internâ semper sistit. Anus nullus. Reproductio fissipara vel gemmipara, gemmis modo externis modo internis, interdum acervatis. Pleraque ex individuâ pluribus semper coherentibus animalia composita sistunt." (*Hor. Ent. p. 224*)

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"This arrangement of animals is, it is true, quite distinct from that generally adopted; but it will be seen that it is not only conformable to nature, but that it removes many of the discrepancies which shock the naturalist in the common systems. For instance, there is an acephalous animal of the division *Mollusca* (*Ascidia mammillaris*, Linn.) which exists without any visible organs of sense except that of taste, whose substance is little better than a homogeneous gelatinous pulp, whose inert nature seems to deprive it of any power like that of voluntary motion; a being which is consequently reduced to fix itself to solid bodies, or to be the sport of winds and waves, whose principal sign of life consists in the absorption and spouting forth of water, and whose animal properties, in short, are all comprised in its irritability, its circulation, and respiration. Yet because these two last qualities appear in this animal, whose existence is little better than vegetative, to bear some resemblance to the circulation and respiration in some of the *Vertebrata*, we find it placed in the common systems before the bee, which astonishes us by its industry and social qualities; before the ant, which excites our admiration by its frugality and courage; and before the other numberless insects, which by their manners and stratagems have often made the naturalist hesitate as to the point where he would draw the line, and separate instinct from reason."¹

Mr Kirby seems equally inclined to accord a step of precedence to the insect and other annulose or articulated tribes over the *Mollusca*, or at least to maintain that the latter should not be interposed between the former and the vertebrated tribes. "If you inquire," says he, "into the rank of each of these sub-kingdoms, of course you will assign the principal station to the *Vertebrates*, which are the most perfectly organized, to which man belongs, and over which he immediately presides. If we form the scale according to the nervous system of each province, that in which the organ of sensation and intellect is most concentrated will stand first; and in proportion as this organ is multiplied and dispersed, will be the station of the rest, which will place them in the order in which I have mentioned them; and the *Annulosa*, to which insects belong, will precede the *Mollusca*, which Cuvier and Lamarck had placed before them on account of their system of circulation. But when we reflect that a *heart* and *circulation* occur in some of the conglomerate *Polypi*,² animals that approach the *vegetable* kingdom; that some of the acephalous *Mollusca* have no visible organs of sense except that of taste, whose substance is little better than a homogeneous gelatinous pulp, and who seem from their inert nature to have very slight powers of voluntary motion;³ we shall be convinced that a heart and circulation alone, unaccompanied by a more concentrated nervous system and more perfect structure, cannot place an animal above those which in every other respect so obviously excel them. With regard to *insects* particularly, we may further ask—who that considers how man employs his powers and organs even in his most degraded state, or that contemplates the wonderful works that he is enabled to accomplish when his faculties receive their due cultivation and direction, can avoid regarding him as superior to the rest of the animal creation? And what unsophisticated mind, not entangled in the trammels of system, when it surveys the industry, the various proceedings, and almost miraculous works that have been laid before you,—the waxen palaces of the bee,—the paper cottages of the wasp and hornet,

—the crowded metropolis of the white ants,—the arts, the manufactures, and stratagems of other insects,—the associations and labours for the common good of those that are gregarious;—will not at once conclude that they must be a superior race to the slug, the snail, and others, which live only to eat and propagate their kind? Or who, that considers the wonderful structure of the animals whose cause I advocate,—the analogy that exists between their organs of manducation, of motion, and of sensation, and between various other parts of it, with those of the higher animals,—the acuteness of their senses, their wonderful strength of muscle, and powers of locomotion,—but will think them superior to the headless and almost inanimate oyster or muscle, or the conglomerate *Alecyonia*, though they have a heart and circulation. Who, again, that observes, that in proportion as pedate animals approach to the human type, their motions are accomplished by fewer organs,—that man walks, *ore sublimi*, upon *two legs*; the majority of quadrupeds upon *four*; insects upon *six*; the *Arachnida* apparently upon *eight*; most *Crustacea* upon *ten*; and the *Myriapods* and others upon *many*,—but will thence conclude that insects must precede the *Arachnida* and *Crustacea*? Who, once more, that reflects, that if any of the superior animals are deprived of a limb, it can never be reproduced, and that in insects the same circumstance occurs; while spiders and *Crustacea*, if they lose a leg, have the power of reproducing it: and the *Mollusca*, if they are decapitated, can gain a new head,—will consent to their being placed after any of these animals?⁴ Lastly, who that recollects that the *Mollusca* are hermaphrodites, like most plants, bearing both male and female organs in the same body, but will allow that insects, in which the sexes are separate, as in the *Vertebrates*, must be more perfect, and of a higher grade?⁵

Whoever regards the different classes of the animal kingdom with an observant and discriminating eye, will not fail to perceive that the knowledge of any organ in one particular division of nature is insufficient to enable us to judge of its importance; for such are the changes in the organization of animals, that a system of organs which performs the most important functions in the first division, may either not exist in the next, or be found in a secondary condition, and subordinate to some other system which has acquired the preponderance. In truth, the anatomy of the higher classes having been first profoundly, or at least laboriously studied, before the requisite attention had been bestowed on the structure of Invertebrates, all those organs and functional actions which were invariably more or less sustained and apparent in these first divisions, have been regarded as fundamental, and for this reason alone an equal importance in our systems of classification has been attributed to them throughout the whole animal kingdom. From this course of proceeding, as noticed by M. Straus, approximations have resulted which break the natural relationship of many divisions. For example, in the first great division of animals, respiration and circulation being in fact two functions to which all the rest are more or less subordinate, it has been imagined that we ought to regard them as essential in the whole series of animals, and employ them as the sole basis of classification. Among the *Vertebrata* these functions indeed afford the firmest foundation for a natural distribution; but amongst other classes, on the contrary, in which they are only secondary, their adoption has led to the

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¹ *Hor. Ent.* p. 202.

² Savigny, *Mem. sur les Anim. sans Vertèbr.* ii. 1, 3.

³ *Hor. Ent.* 204.

⁴ In this respect insects excel many reptiles, which can reproduce some of their parts.

⁵ See Macleay, *Hor. Entomolog.* 203, 206, 208.

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gravest errors and most palpable contradictions; for it not unfrequently happens that one family of Invertebrata which respire by branchiæ, cannot be separated (keeping numerous natural affinities in view) from another family in which the respiration is pulmonary or tracheal.¹ One great principle of creation being to combine variety in the means with uniformity in the effect, we find that among molluscous animals the circulation of the blood varies in its manner *ad infinitum*, and has thus led to the most artificial arrangements. Yet few animals in existence have the organs of circulation more complicated than some of the Cephalopoda. Among the annulose animals, also, in which the nature of the nervous system is so uniformly accordant, circulation varies from an extremely perfect to an evanescent state. A mode of nutrition and respiration takes place so entirely different from that exhibited by the vertebrated and molluscous tribes, that they never can be regarded as modifications of the same system. As, then, the general plan of construction of these animals is so different, Mr Macleay regards it as necessary to suppose that the new and dissimilar system of respiration is that which more peculiarly characterizes the annulose group, or, in the author's words, "is that to which the structure of the animals forming the group tends." And what makes this supposition the more probable is, that the Annelides, or red-blooded worms, which, of all the articulated tribes, are placed by Cuvier the nearest to the vertebrated classes, are nevertheless imperfectly organized, and of as dull perceptions as any of the annulose division. This could hardly be the case were the Annulosa to be considered with propriety as modifications of the vertebrated structure, while, on the other hand, those annulose classes which respire by tracheæ, and coincide in nothing with a vertebrated animal, are, nevertheless, the most active and industrious of their group, although their activity and industry are of a nature entirely different from what is observable among the vertebrated tribes. Now it is difficult, if not impossible, to account for all this, unless we regard every vertebrated creature to have been constructed by the great Creator with reference to one type, and every annulose with reference to another; and as the former is more imperfect in proportion as it approaches the annulose structure, so the latter also becomes more imperfect in proportion as it obtains a distinct system of circulation and other characteristics of the vertebrated tribes. It thus follows that the animals which connect them ought to be extremely imperfect in their organization; and this conclusion is well supported by the sluggish Annelides, in which organs of sense are barely perceptible, and organs of motion by no means so perfect as among the larvæ of insects.² M. Straus also maintains the opinion that it is the less perfect species of any one great group which approach most closely to the group which precedes or follows them, and that it hence results, that in any division, the species which offer the most elevated organization may be more perfect than such as are placed at the lower confines of a higher division. He admits that a more natural passage exists from the Vertebrata to the Annulosa, than from the former to the Mollusca; but this connection he considers is by the lowest in the scale of organization of each of these groups. As soon as the Vertebrata reach the most simple form compatible with their mode of organic life, the great Author of nature commences from that point a new group, that named *Annulosa*, by successively introducing a new series of organs altogether

different from those he has abandoned, and by considerably modifying those he has retained. The genus *Ammonoites* (and perhaps also that of *Myxine*) form this point among the Vertebrata, while *Gordius* and *Hirudo* compose the corresponding link among the annulose tribes. On either side these animals find their place at the lowest point of the descending scale, formed by each of these two series; and, compared with each other, the two genera of fishes just named, and the abbranchial *Annelides*, present some remarkable resemblances in the few organs which they possess.

The opinion that insects and other annulose animals are more nearly connected with the Vertebrata than are the Mollusca, is regarded as true by M. Straus Durckheim, both in regard to the modes of organization according to which these three divisions are formed, and in relation to the degree in which their faculties are developed. The Vertebrata, he observes, are characterized by an articulated body, of which the two lateral halves are symmetrical, and are sustained by an internal skeleton, the central portion of which is composed of a series of parts, to which the other osseous parts are attached. In the Annulosa the symmetry of the two sides of the body is still greater than in the Vertebrata; the body is likewise articulated, and formed by a series of central parts, to which the others are attached, although they have no internal skeleton. The nervous system in both consists principally of a spinal marrow, from which arise most of the nerves of the body; but there is this difference in the Vertebrata,—the spinal marrow is dorsal, whereas it is ventral among the annulose tribes. The muscular system is also as fully developed in the one as in the other, and offers nearly the same distinct forms. The Mollusca, on the contrary, exhibit characters totally at variance with those now mentioned; for, on the one hand, their body no longer exhibits a perfect parity of parts, nor is it in any degree articulated; on the other, the nervous system is not longitudinal, nor its situation constant, while its mass is greatly decreased. The muscular system is also in general much less perfect, and, considered in detail, the muscles are less distinct, and only form, throughout the greater part of the body, a mass of fibres so interlaced as to be incapable of separation, thus conducting us to *Entozoa*, of which the body is only a continuous *parenchyma* without distinct muscles. According to the author last named, the character which eminently distinguishes the Mollusca from the two other divisions is, that in these the organs of *animal*, in the Mollusca those of *vegetable* life, are the most predominant; from whence it follows that the latter are totally devoid of industry, and of that higher mode of perception approaching to *intelligence*, which insects possess in a degree surpassing all other invertebrated tribes.

Having entered into the preceding investigation with the view of illustrating the true position of the annulose division in relation to the other sub-kingdoms of animal life, we shall now, in more direct reference to the proper subjects of our present dissertation, that is, the hexapod or six-footed insects, exhibit, by means of the following diagram, the views entertained by Mr Macleay regarding the natural affinities observable among the annulose tribes themselves. The reader will perceive that the circles of *Mandibulata* and *Haustellata*, with those portions of *Ametabola* named *Thysanura* and *Anaplura*, constitute the true INSECTA, such as we have defined them at the commencement of this article.

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¹ See *Considerations générales sur l'Anatomie comparée des Animaux Articulés*, &c. par M. Straus Durckheim.

² *Hor. Ent.* p. 295.

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Geographical Distribution.

Our next subject of consideration is one which has not previously formed a part of any of our encyclopædias of knowledge.

CHAPTER VI.

THE GEOGRAPHICAL DISTRIBUTION OF INSECTS.

This topic has indeed been much less attended to as a matter of philosophical investigation than it deserves. When we take an extended view of the general distribution of animals and plants, we find that they are usually disposed over the earth's surface in bands or parallel zones, corresponding in a great measure with the peculiarities of temperature and climate which are appropriate to the nature of each. When the temperature of a particular latitude becomes colder, as on mountains or highly elevated plains,—or warmer, as on plains by the sea shore, or in low lying sheltered valleys,—we find, in the former case, that the species approximate in their nature and characters to those of a more northern, in the latter to those of a more southern parallel. Of course the zones of vegetable and of animal life do not correspond at all strictly with the *latitudinal* lines of our geographical system. Humboldt has indeed shown, that within 15° or 20° from the equator, the mean annual temperature is nearly the same in all longitudes of equal elevation, or is at least but slightly varied by local circumstances. In other words, the isothermal lines are more regularly parallel with those of the equator. But in temperate and northern countries the same uniformity of temperature in each portion of the same parallel is not observable; all western coasts, and districts of continents and of considerable islands, being of a higher temperature than those of the same latitudes along the eastern shores. The mean temperature of the North Cape, under the seventy-first degree of north latitude, does not exceed, indeed corresponds with, that of Labrador, which is 14° further south; and that of the west of Ireland, in the fifty-fourth degree, agrees with the forty-third parallel in the United States.

In relation to zoological geography, indeed, there are several other minor circumstances which tend to change or counterbalance the more usual results, and consequently to derange such calculations as might very reasonably be formed upon a knowledge of latitudinal and longitudinal position, and of the height of a country above the level of the sea. The nature of the soil and surface, the different degrees of dryness and humidity, and the consequent character of the climate and vegetation, the comparative extent of land and water, the extent and continuity of forests, marshes, and sandy deserts, the direction of mountain ranges, and the form and position of lakes;—these and several other circumstances must be taken into consideration, and will be found materially to affect the distribution of animal life over the surface of the earth.

It does not appear that the climates of insects, or those peculiarities of temperature and other physical attributes under which certain groups or species appear to predominate, have been as yet studied in connection with our imperfect knowledge of isothermal lines. Humboldt, indeed, has remarked, that the geographical stations of the gnats and some other insects of South America did not appear to depend solely on the *heat* of the climate, the excess of humidity, or the thickness of the forests, but on local and unappreciable circumstances.¹ It is evident, however, that the characteristic stations of insects are mainly dependent on the degree of temperature, so influential on the development and distribution of all the other varied forms of animal life. An increase of caloric seldom fails to produce a corresponding increase and alteration in the number and character of entomological forms; and when we travel from the hyperborean regions towards the sunny south, we find that the tiny multitudes accumulate in all the warmer portions of the temperate zone, till they swarm between the tropics. Otho Fabricius resided six years in Greenland, and during that period he collected only sixty-three species of the insect class, properly so called. In the still higher latitude of Winter Harbour, where Sir Edward Parry sojourned, only six species were collected from the beginning of September till the August following. Mr Kirby has stated that in Greenland every order of insect has its representatives, except Orthoptera and Hemiptera; but in Melville Island, besides these deficiencies, neither coleopterous nor neuropterous species exist, or at least were observable; and even the mosquito, that shrill tyrant of the Lapland plains, appeared to have ceased from troubling along those hyperborean shores. The most northern locality of any insect yet ascertained is that of the *Aphis borealis*, taken in latitude $82^{\circ} 26' 44''$, about one hundred miles from the nearest known land.² It is probable, however, that the distribution of many northern species is still unknown. It was formerly supposed that in Iceland there were none, and that even in Norway there were very few, their absence from those countries being attributed to excess of cold. This opinion, however, was contradicted by Horrebow, so far as Iceland was concerned; and Olafsen and Povalsen, during their sojourn there, collected 200 different species in one small valley. It must indeed be borne in mind, that insects can escape the extreme of cold, not only, as Mr Macleay observes, by passing certain periods in the *pupa* or torpid state, but also by being while in that condition usually buried in the earth, where they are greatly protected from the rigours of the winter season. "What they chiefly re-

¹ Personal Narrative, vol. v. p. 88.

² This species was found in the boat during the last day of Sir E. Parry's attempt to reach the north pole over the ice. There was no vestige of vegetation around the adventurous party; and we think it more probable that the forlorn insect had been carried, *volens volens*, from a somewhat more southern quarter.

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quire is the presence of heat during some period of their existence; and the greater, within certain limits, is the heat, the more active will be their vital principle. On the American continent the extremes of heat and cold in the course of the year are, as is well known, incomparably greater than in places of the same latitude in Europe. We may therefore readily conceive how particular families of insects will inhabit a wider range of latitude in the former country than in the latter. We see also how insects may swarm in the very coldest climates, such as Lapland and Spitzbergen, where the short summer can boast of extraordinary rises in the thermometer; because the energy of the vital principle in such animals is, within certain limits, proportionate to the degree of warmth to which they may be subjected, and escapes in a manner the severe action of cold.¹ It is on these principles that Mr Macleay accounts for what certainly at first seems an extraordinary circumstance in the geography of insects; namely, that their tropical structure extends much farther north in America than in Europe; that is, in a manner directly the reverse of that which has been noted by botanists to occur in the vegetable kingdom. For example, the *Chamærops humilis*, a species of palm, occurs along the southern shore of France, in latitude 44°; while on the eastern coasts of North America the hardiest of the family, *C. palmetto*, does not advance beyond the 34°. But if we examine *Copris carnifex*, *Cetonia nitida*, *Rutelæ punctata*, and other coleopterous insects from the neighbourhood of New York, and compare them with species of the same families from Brazil, we shall find their difference of structure infinitely less than that which would result from a comparison of the entomological productions of the environs of Madrid with those of the banks of the Congo.²

A slight consideration of the subject suffices to show that certain differences in the relative intensities of summer and of winter must exercise a strongly modifying power on the influence of mean annual temperature, even in countries where that temperature is one and the same. "Several fruits, as the olive and grape, as well as the different kinds of corn and other annuals, depend more on the heat of summer than of the whole year; while others, impatient of cold, and not requiring great heat, have their range more influenced by the temperature of winter. Now, it is almost an universal rule, that of two places whose mean temperature is the same, that nearest the sea, and more particularly a western sea, has a temperate summer and a milder winter. Hence the inland situation is better adapted to the growth of corn and fruits, the maritime one to the preservation of tender plants. In Europe, the northern boundary of the vine and olive rises as we go eastward, though in so doing we encounter a lower mean annual temperature. The *Arbutus Unedo*, *Sibthorpia Europæa*, *Erica ciliaris*, &c. rise in a westerly direction."³ Whatever vegetation requires the absence of extreme cold rather than the presence of extreme heat, will probably extend itself in a tropical form more towards the poles on a dry continent than on a moist or marshy one. Tropical plants, therefore, will thrive better in Thibet and other inland parts of northern Asia, than they would do if transported to positions of the same latitude in America; for in the latter country the extremes of heat and cold are too distant from each other. Thus the vegetation of Canada does not correspond either in its general character or its amount of species, with that of the corresponding latitudes of France.⁴

Mr Macleay admits, that although in his opinion the insect tribes suffer less in cold climates than plants, for the reasons which we have already stated, it does not therefore follow that the prevalence of cold has no effect in relation to the destruction, or rather we should say the prevention, of insect life. In truth the diminution of the number of species becomes very conspicuous as we advance towards the poles. But this the learned author of the *Horæ Entomologicæ* supposes to be owing rather to the short continuance of the summer warmth than to the lowness of its existing degree. In accordance with this view we certainly find that many insects, such as gnats, mosquitoes, &c. which pass their larva state in water,—thus avoiding the external cold, and whose existence in the perfect state being naturally ephemeral, must therefore suffer little from the shortness of summer,—are nowhere more troublesome than among the moors and marshes of the north. On the other hand, the number of coleopterous species, which, being naturally longer lived, require a greater continuance of warmth, is sensibly diminished amid those dreary wastes.

It is natural to suppose that if certain plants are peculiar to certain climates, so also insects, the greater proportion of which not only feed on plants, but are each according to its kind almost restricted to particular species, must in like manner be characteristic of special localities. Whether this restriction in diet holds good in relation to the carnivorous kinds, that is, whether one kind of carcass is not as good as another, is a point which has not yet attracted the consideration of the naturalist. Such as feed on living animals (the *thalerophagous* Carnivora) are probably more restricted in their parasitical attachments. But the coprophagous or dung beetles, and such as prey on dead animals (the *saprophagous* Carnivora), may be supposed to be less regular in the limits of their localities, occurring wherever their favourite food happens (not seldom accidentally) to have been deposited. In such cases, of course, less advantage results to the entomologist from local references, as the appearance of an insect in the place cited may have been entirely accidental, and incapable of affording any great probability of its recurrence; yet even the saprophagous beetles are no doubt regulated by temperature and elevation, and it is likely that a dead body by the sea shore will exhibit different species from a similar nidus exposed on a mountain summit.

The geographical distribution of insects in general is, in truth, a subject of too difficult and complex a nature to admit of being worthily treated within our present limits. We shall, however, notice a few facts which, though presented in a somewhat desultory manner, we trust will not be found entirely devoid of interest.

We may observe, in the first place, that there are two aspects under which the subject of zoological geography may be viewed. We may either proceed upon the consideration of the divisions laid down by politico-geographical writers,—divisions which are no doubt sufficiently arbitrary in relation to the physical qualities of countries,—and describe or indicate the species and genera which we have ascertained to characterize such divisions,—or we may take into view the systematic arrangements of naturalists, and by tracing and pointing out the different localities of the various tribes, genera, and species which we find there arranged, thus arrive by another route at the conclusions sought for. We shall here, even

¹ *Hor. Ent.* p. 45.

² Watson's *Outlines of the Geographical Distribution of British Plants.* (Printed for private circulation.) Edinburgh, 1832.

³ *Hor. Ent.* p. 44.

⁴ *Ibid.*

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We formerly remarked that no coleopterous insect was noticed in Melville Island. *Dytiscus marginalis*, however, an aquatic beetle well known throughout Great Britain, inhabits the waters of Greenland, and extends over the whole of Europe. Another species of the same genus, *D. griseus*, is not only spread over the south of Europe, and most of the countries adjacent to the Mediterranean, but is also found in Bengal. The genus *Calasoma* is very widely spread. Captain Frankland took *C. calidum* during his arctic journey. *C. laterale* and *curvipes* inhabit tropical America; while *C. Chinense*, as its name imports, is found in China. Mr Macleay possesses a specimen from New Holland; and *C. retusum* was captured in Terra del Fuego. The *Coccinellæ* occur in almost all countries from pole to pole.¹ The *Silphidæ* and *Dermestidæ* prey on carcasses wherever the solar influence is of sufficient power to produce putrescence; but the brachelytrous beetles (genus *Staphylinus*, &c.) have undoubtedly their metropolis or centre of dominion in the temperate zone, and more especially within the British islands; for while Dejean, in the last edition of his *Catalogue* (1833), gives only 789 species as his total amount both of European and exotic kinds, Mr Stephens enumerates above 750 as indigenous to Britain. This apparent excess may, however, partly arise from the great attention which has been paid in this country to the collection of the minuter sorts, which are frequently neglected in foreign lands for the sake of the more showy and imposing species. The genus *Onthophagus* is native both to the old world and the new, to the temperate as well as the torrid zone; while *Copris*, its near ally, is more abhorrent of cold,—*C. lunaris*, which extends northward into Sweden, being the only recorded species found in Europe out of Spain.² Latreille, however, laboured under a misconception when he supposed that all the large species of the latter genus were of equinoctial origin; for *C. Tmolus* of Fischer occurs in the vicinity of Orenburg in Asia, under the 50th degree of north latitude.³ Of the magnificent *Dynastidæ*, termed by Mr Kirby the “giants and princes of the insect race,” the metropolis is strictly tropical, although a kind of advanced piquet is observable in *Oryctes nasicornis*, common in the south of Sweden. The reason why the last-named insect, and several others which occur in Scandinavia, are unknown in Britain, may be inferred from some of our preceding observations: in a torpid state, or under the form of larvæ, they are capable of enduring the utmost rigour of a Swedish winter; but when revived by the returning spring, the cool and variable summers of our “sea-girt isle” would prove insufficient for the full development of their vital functions.

The genus *Meloe* seems almost peculiar to Europe; and Britain, which possesses nine species, has been regarded as one of its most characteristic countries. The entomological characters of the southern shores of Europe strongly exhibit their geographical approach to the African continent. The *Ateuchus sacer* (the renowned species sculptured of old by the Egyptians on their sacred monuments), and various species of *Scaurus* and *Ahis*, may be regarded in the southern countries of Europe, as the *avant couriers* among the coleopterous tribes of those more exclusively African forms which have their centre of dominion in the burning deserts. Along the Mediterranean shores the

entomological traveller may study the habits of many curious insects of the genera *Onitis*, *Cebrio*, *Pimelia*, *Brachycerus*, *Brentus*, and *Scarites*, and may also enrich his collection by the capture of many beautiful butterflies, and other lepidopterous insects, which are more truly characteristic of Northern Africa. Spain especially exhibits many features of African zoology. We shall not here talk of the cameleons, the scorpions, and other species belonging to the separate classes of reptiles and Arachnides; but the European entomologist will there discover for the first time several species of the genera *Erodius*, *Sepidum*, *Brachinus*, and *Pimelia*. It is however only after crossing the Mediterranean, and traversing the African shores, whether north of the Atlas, or eastward towards the coasts of the Red Sea, that our eyes are delighted with the hitherto unknown forms of *Anthia*, *Graphipterus*, *Siagona*, and numerous other species unknown to the colder and moister shores of Europe.

But no sooner do we leave the Mediterranean coasts of Africa, and enter upon the more weary and disastrous pilgrimage of the great deserts, the apparently limitless expanse of which so soon greets the eye of the yet undaunted traveller, than almost all vestiges of European life, whether human or brute, disappear; and Nubia, Ethiopia, Senegal, and a great part of Guinea, exhibit entomological forms, cognate in character when compared among themselves, but separated in every sense of the words “*longo intervallo*” from those of Europe. As we proceed farther southwards, where the chariot of the “Great Apollo” rolls on with a still fiercer and more fiery lustre, and the beams of a vertical sun induce even the tawny Moor and the woolly-headed negro to avoid his scorching and sometimes fatal rays, we discover many extraordinary forms of insect life, called into existence through the instrumentality of that bright effulgence which the pale-faced European has so often sought to withstand in vain. From the burning regions of Guinea, and the parched shores of the Congo, we derive the finest of those magnificent coleopterous insects named generically *Goliathus* by Lamarck. The western and equinoctial parts of Africa also yield us the species of *Petalochirus* and *Enceladus*, while the Cape of Good Hope is remarkable for the genera *Anthia* and *Brachycerus*. The last-named district is almost the exclusive domain of *Manticora* and *Pneumora*; and the southern parts of Africa present us with the *Sagra*, *Diopsis*, and *Paussus*, although it may be observed that some of these also occur in the East Indies.⁴

Both Madagascar and St Helena present a few insects which, to a certain extent, demonstrate the African complexion of those islands; but the latter especially is also allied, by its entomological features, to some of the southwestern countries of Asia. According to Latreille, Africa furnishes no species of the genus *Passalus*, although it is elsewhere widely distributed over America and the East Indies. The genera *Graphipterus*, *Eurichora*, and *Pneumora*, are probably peculiar to Africa. Among the hemipterous insects of Africa may be mentioned the *Mantis precaria*, an object of superstitious veneration among the Hottentots, who hold in the highest respect the person on whom the insect happens to alight. Locusts are of common occurrence in many parts of Africa, where, as “a great people and a strong,” they still produce their days of “darkness and of gloominess,” their days “of clouds and of thick darkness,” so magnificently described by the Prophet Joel. One of the most formidable of the insect tribes of this continent is the *Termes bellicosus*, or

¹ *Introd. to Ent.* vol. iv. p. 488.

² *Ibid.* p. 490.

³ *Entomographia Russica*, tab. 13, fig. 1.

⁴ *Edinburgh Cabinet Library*, vol. ii. p. 93.

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white ant. It dwells in congregated troops, consisting of labourers, soldiers, and sovereigns. The habitations are of a conical form, built of mud and clay, from ten to twelve feet high, and divided in the interior by thin partitions into a variety of cells. Indeed, Jobson, in his *History of Guinea*, alleges that they are often twenty feet high; and he adds, that he frequently found them extremely serviceable in screening himself and his companions while engaged in the pursuit of antelopes and other game. The queen-mother of this species becomes of so enormous a size in the pregnant state, that her abdomen exceeds, by two thousand times, the bulk of the rest of her body; and when the ova are fully formed, she obtrudes them at the rate of sixty in a minute, or 72,000 in twenty-four hours. Madeira and the Canary Islands are decidedly African in their productions,—the insects, especially, exhibiting a strong relationship to those of Barbary and the adjacent districts.

Latreille, while considering the geographical distribution of insects, has well observed, that where the empire of Flora terminates, there the domain of zoology likewise comes to an end. Animals which feed on vegetables cannot support themselves in a region entirely sterile, and such as are carnivorous are thus themselves indirectly deprived of sustenance in consequence of the want of vegetation. Those countries of which the vegetable productions are the most gorgeous and abundant, are likewise the most productive of insect life. Both effects spring from a temperature high and continuously sustained, from moderate moisture, and a varied soil. The more closely, on the contrary, we approach the other extreme, where clouds and darkness obscure the sky, and the ground is so often covered with a pure but unproductive garment of snow, and the lifeless solitude of the mountain valleys is defended by the icy battlements of the enduring glaciers,—the more we shall perceive a diminution in the amount of organic, and more especially of insect life. If, instead of travelling northwards to the polar plains, we ascend some majestic mountain even of a tropical range, the same phenomena are observable. Although its base should be laved by the glittering waters of an equatorial sea, and its sloping sides should bear the arborescent ferns and plummy palm trees of the warmest climes,—still, should the mountain belong to the highest class, like those of Cayambé or Chimborazo, long before the traveller has approached its barren summit, he will perceive the most striking symptoms of that sterility which we are apt to associate only with the polar regions. The “bright consummate flowers” of the lower plains have disappeared,—the parrots in their gay attire no longer adorn the stunted trees,—and the insect tribes, so fantastic in their forms, and of such surpassing lustre, have gradually decreased in size and number, and at last present, in common with the vegetable kingdom, an aspect and character much more allied to those of northern climes. Finally, unless it may be that some giant condor, or other bird of loftiest flight, is seen floating in the thin air of those extremest heights, there is nothing to remind the adventurous traveller that he is actually within the *burning* tropics; for all his perceptions and sensations might be identical were he suddenly transported to the summit of Mount Hecla,

An earthquake-rifted mountain of bright snow.

It is thus that, on the Central Alps of Europe, we meet with many species characteristic of, though not peculiar to, the plains of northern countries. The *Prionus depsarius*, long

regarded as exclusively confined to Sweden, has in later times been taken on the mountains of Switzerland; and M. Latreille has captured at Cantal the *Lycus minutus*, formerly received only from the most northern provinces of Europe. The beautiful Apollo butterfly (*Parnassius Apollo*), so common in the plains and flower-gardens in the vicinity of Upsal, never occurs in France, except on mountains of considerable elevation, and re-appears again in the snow-surrounded valleys of Switzerland. Many other butterflies which, in the northern provinces of France, occur not far from warm and low-lying sheltered stations, are found in the southern departments and in Italy on alpine or sub-alpine situations. The same may be said of *Carabus auratus* and *Acridium grossum*. Even in Great Britain, the limited extent of which might be supposed to preclude any great disparity in the entomological productions of its geographical divisions, there is an obvious difference between its southern and northern quarters. The colder and more cloudy clime of Scotland is poor in Lepidoptera of the finer kinds. Here no purple emperor, “proud of cerulean dyes,” floats over the far-stretching branches of our oaks and beeches,—no swallow-tailed butterfly (*Papilio Machaon*), with its elegantly lengthened wings, reminds us of the exquisite Brazilian tribes,—no “Camberwell beauty” (*Vanessa Antiopa*) expands to the sun its richly margined wings; but these and many more, denied to bleak Caledonia, are found in the southern counties of England.¹ It is interesting, however, to observe the analogy which exists between the insects, more especially the Coleoptera of Scotland and of Sweden. Several of the rarest species lately discovered in the northern quarters of the island, such as *Clivina Arctica*, *Harpalus micropterus*, *Elaphrus Laponicus*, *Byrrhus aeneus*, *Salpingus foveolatus*, and others, are better known in the Scandinavian peninsula than elsewhere, and are indeed characteristic of the north-western division of the continent of Europe.

From these and similar observations, those who have viewed the science of entomology with a philosophic eye have endeavoured, in common with geographers, to divide the surface of the earth into different climatic regions. But while the latter have assumed as a basis the progressive differences in the longest continuance of the natural day, the former proceed upon a knowledge of the mean temperature of countries. Fabricius, in his *Philosophia Entomologica*, divides climate in general into eight sub-climates, or restricted stations, viz. the *Indian*, the *Southern*, the *Mediterranean*, the *Northern*, the *Eastern*, the *Western*, and the *Alpine*. But it is easy, as M. Latreille has remarked, to perceive, by the enumeration of the particular countries which are referred to each of these divisions, that the divisions themselves are by no means established on a fixed foundation; and that the suppression of several would be necessary were the principle on which they are established followed out with rigour. The sub-climate which he names *Mediterranean* comprises the countries adjacent to the Mediterranean Sea, with Media and Armenia. The *Northern* extends from Paris to Lapland. The *Eastern* consists of the north of Asia, of Siberia, and of the cold or mountainous portion of Syria. The *Western* contains Canada, the United States, Japan, and China. From these it will be seen that this arrangement is in many respects extremely arbitrary; for several of the above-named districts, although placed under separate climates, have a mean temperature identically the same. Moreover, many countries in which the mean temperature is the same, are characterized and distinguished

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¹ On the other hand, *Hipparchia Blandina* and *Lycæna Artaxerxes*, two extremely rare English butterflies, occur very plentifully in many parts of Scotland,—the former in July and August, the latter in June and July.

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M. Latreille has taken another view of this interesting subject, more in conformity with the dictum of Linnæus, regarding the characters of genera, the spirit of which may be also here applied. "Let the insects point out the climate, and not the climate the insects." He takes into consideration all those genera which seem to be appropriated exclusively to certain determinate spaces on the surface of our earth. It is true that the groundwork of this method is much more restricted than that from which Humboldt and other writers on botanical geography have deduced their observations on the distribution of plants; for our knowledge of the precise localities of foreign insects is by no means ample.¹ The great French entomologist rather upbraids the majority of scientific travellers with their negligence in these particulars; for it is not the locality alone, but the physical character of the climate, the mineralogical qualities of the soil, the vicinity of wood and water, and the height above the level of the sea, which ought to be noted in connection with the occurrence of particular species. We have already noticed the fondness of *Papilio Cleopatra* and other insects for a calcareous soil. The *Pimelia bicaudata*, so common in the neighbourhood of Marseilles, scarcely ever occurs at a distance from the sea. If the interior parts of Barbary, Syria, and Egypt, present us with species of the same genus, this entomological relation no doubt results from the soil of these countries being impregnated with saline particles, and abounding in plants of the genus *Salsola*. The insects which occur in the countries which border the Mediterranean, the Black, and the Caspian Seas, exhibit many analogies.

The following propositions result from M. Latreille's researches in Entomology.

1st, The totality or a great proportion of the insects which occur in countries of which the qualities of the soil and temperature are analogous, are nevertheless of different species, if these countries, though placed under the same parallel, are widely distant from each other. All the insects brought from the most eastern parts of Asia, for example China, are distinct from those of Europe and of Africa, whatever may be the latitude, elevation, or mean temperature of these Asiatic countries.

2d, The generality of insects still differ specifically in countries agreeing in the characters of their soil and temperature, but separated, independently of mere latitudinal difference, by great natural barriers, such as chains of lofty mountains, vast sandy deserts, or the waters of an intervening ocean. Thus the species of New Holland or of America are easily recognised among those of the various countries of the ancient world; and even the insects of Grenada and Peru, though at no great distance from those of Guiana, are in a great measure different, owing no doubt to the interposition of the vast chain of the Cordilleras. When we pass from Piedmont into France by the Col de Tende, we perceive a marked difference of species, even in that short journey. These rules, however, like most others, however general, are subject to several individual exceptions. Several species of insect are distributed over such a vast extent of territory as entitles them to be regarded as genuine cosmopolites. Thus the

Geographical Distribution. painted lady-butterfly (*Vanessa Cardui*) is found over great portions of Europe, Asia, Africa, and America, and is as familiarly known in the central islands of the vast Pacific Ocean, as in the flower-gardens of England.² That beautiful sphinx-moth (*S. nerio*), well known near Genoa, and so remarkable for the richness of its green, a rare colour among lepidopterous species, although it seldom occurs farther north than France, is found in the Mauritius, and probably in many intermediate countries. The death's head moth (*Sphinx Atropos*), which occurs occasionally in most parts of Scotland, is well known in India and the Isle of France. We have already mentioned the great extent of territory occupied by several aquatic beetles; and these and other examples which might be adduced remind us of M. Latreille's next proposition.

3d, Many genera of insects, and particularly such as feed on vegetables, are spread over numerous points of the principal divisions of our globe.

4th, Other genera are exclusively proper to a certain extent of country, whether of the ancient continents or the new. According to Latreille, no species of the genera *Anthia*, *Graphipterus*, *Erodius*, *Pimelia*, *Scaurus*, *Cossyphus*, *Myliabris*, *Brachycerus*, *Nemoptera*, *Apis*, or *Anthophora*, occur in America; and many genera of the family *Scarabeidæ* are likewise there unknown. But the western world, on the other hand, produces several genera which we do not meet with elsewhere,—such as *Agra*, *Galerita*, *Nilio*, *Tetraonyx*, *Rutela*, *Doryphora*, *Alurnus*, *Erotylus*, *Cupes*, *Corydalis*, *Labidus*, *Pelcinus*, *Centris*, *Euglossa*, *Heliconia*, *Erycina*, *Castnia*, &c. Our bees are there replaced by *Melipona* and *Trigona*. We have already mentioned several genera peculiar to Africa. *Colliuris* is characteristic of the East Indies; *Lamprina*, *Helæus*, *Paropsis* (*Notoclea* of Marsham), and *Panops*, are confined to New Holland.

5th, Many species in their natal countries effect particular localities. Several alpine butterflies are never observed at any considerable distance from the region of perpetual snow, while other species prefer the warmer air of low-lying sheltered meads at no great height above the level of the sea.

6th, Both the ancient continent and the new may be divided into zones, successively extending in the direction of the meridians, and the breadth of which is measurable by a portion of a circle parallel to the equator. The species proper to one of these zones disappear gradually, and give place in the same manner to those of the zone following; so that from space to space the dominating species, or even the totality, have undergone a change.³ Latreille compares these changes to that series of horizons which the traveller discovers in proportion as he removes from his first point of departure.

Sweden presents us with many insects peculiar to that country, some of which are confined to its more northern provinces, such as Lapland. But its southern portions, for example Scania, produce, though still in limited numbers, many German insects. France, as far as the 45th or 44th degree, supplies the entomologist with many of the species which occur in the last-named countries; but the Rhine and its eastern mountains form a kind of frontier line, which many others do not appear to pass. The first of the species characteristic of the warmer regions of

¹ The second edition of Comte Dejean's *Catalogue de Coléoptères* now exhibits a very interesting picture of the distribution of that order. We shall refer to it more particularly when we come to treat of the coleopterous tribes.

² *Edinburgh Review*, vol. liii. p. 339.

³ *Introduction à la Géographie Générale des Arachnides et des Insectes, ou des Climats propres à ces Animaux*. This memoir was read to the Academy of Sciences in 1815, and forms part of the 3d volume of the *Mémoires du Muséum d'Hist. Nat.* It was afterwards republished, with corrections and additions, along with some other essays, in a separate volume, entitled *Mémoires sur divers Sujets de l'Histoire Naturelle des Insectes*, &c. Paris, 1819.

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Western Europe show themselves towards the inferior course of the Seine, in pretty close accordance with the point where the vine is vigorous in the open air, independent of any succour derived from merely local circumstances. *Ateuchus flagellatus*, *Mylabris chicorii*, *Mantis religiosa*, *Cicada hæmatodes*, *Ascalaphus italicus*, and others, announce this change,—which becomes still more obvious at Fontainebleau and the environs of Orleans, where, in addition to the above-named species, we may perceive *Phasma Rossii*, *Mantis pagana*, and *Sphinx celerio*. But these are but the forerunners of such as are native to southern countries properly so called. The culture of the olive, the spontaneous growth of the Arbutus, the pomegranate, and of lavender, are botanical symptoms which cherish in the mind of an instructed entomologist the hopes of a rich increase. This change is very obvious in France, when, journeying from Paris to Marseilles, we reach the territory of Montélimart. The eastern provinces of Spain, those sunny regions where the orange and the palm-tree are luxuriant without the aid of man, produce more abundantly the rarer southern insects of France, intermingled with species hitherto unperceived in Europe.

Our knowledge of the insects of the south-east of Europe is by no means ample. Latreille informs us that the *Papilio chrysippus* of Linnæus, common in Egypt and the East Indies, makes its first appearance as a European species in the kingdom of Naples. The greater proportion, however, of the Egyptian species are entirely unknown in Europe, although they pertain, in numerous instances, to the same natural families as our own. The southern parts of that land of pyramids produce many magnificent species of *Copris*, such as *C. Midas*, *Bucephalus*, *Antenor*, *Gigas*, and other insects peculiar to warm countries, and seldom found at any great distance from the equinoctial line of the old continent.

Similar successions of species take place from east to west, and reciprocally. Most of the insects which occur in Normandy and Brittany likewise inhabit the southern parts of England. The northerly departments of France, situated on the banks of the Rhine, have in many respects a community of species with the neighbouring provinces of Germany; while, again, several species of the Levant, such as *Cantharis orientalis*, *Mylabris crassicornis*, a beautiful variety of *Melolontha occidentalis* brought home by Olivier, and certain diurnal Lepidoptera, appear to have journeyed far westward from their ancestral homes, and fixed their abode in the Austrian territory. The collections formed by Olivier in Asia Minor, Syria, and Persia, prove that the insects of those countries, though nearly related to those of the south of Europe, are not specifically the same; and a like judgment, with some exceptions, may be entertained of the species of Southern Russia and the Crimea. The entomological productions of the coast of Coromandel, of Bengal, of the south of China, and even of Thibet, possess many characters in common; but they are entirely distinct from those of Europe. In the regions just named we discover no species of the genera *Graphipterus*, *Akis*, *Scaurus*, *Pimelia*, *Sepidium*, or *Erodia*, for of these nature appears to have granted the exclusive possession to the south-western regions of the ancient continent. Although Fabricius assigns the East Indies as the native country of certain species of *Brachycerus*, Latreille has been unable to identify any from such locality. The genus *Anthia* is said to occur in Bengal, but not farther eastward.

The great Asiatic division of our globe, when considered in its entomological and other zoological relations, may

indeed be partitioned into several different departments.¹ The Siberian or most northern portion, in consequence of the severity of its winter season, possesses, even in its southern districts, many attributes of the arctic regions; while its inland valleys, and the upper basins of its numerous and far-flowing rivers, are enriched, during a brilliant though short-lived summer, with many of the more gorgeous forms of insect life. Another vast and imperfectly known region of Asia is bounded to the north by Siberia, and to the south by those highly elevated table-lands which terminate among the Himalaya Mountains. This division still presents several features which prove its assimilation in some respects to the characters which distinguish animal life in Europe; for although it is undoubtedly characterized by numerous peculiar forms of existence, yet many of its genera and species are either the genuine types of groups which occur in countries with which we are familiar, or pertain to groups which are themselves well exemplified by European insects. But we now speak rather in relation to the higher animals than the insect tribes; for, in truth, of the Entomology of Central Asia we have as yet a most inadequate idea. Among the Himalaya Mountains, and other southern portions of this division, we begin to discover many genera of birds which occur in the lower lands of Hindustan and the peninsular projection of Malacca; and if the entomological kingdom is at all regulated by corresponding rules, we may infer that some of the southern insects also make their way up those stupendous valleys. The same circumstance indeed occurs, we mean the like transition of species, in all the great geographical sections of the groups of animal life. "Each extensive division is characterized by several peculiar forms, and yet at the same time nourishes many species which are common alike to it and to other regions; and it is only under some peculiar circumstances of local situation, that either the zoological or botanical products undergo a sudden change in character and condition. As the adventurous and observant traveller advances on his journey, a few species are continually perceived to decrease in number, and then to disappear, while their places are supplied by others, which, at first but thinly scattered, gradually acquire an accession of numbers, till they too have reached their full amount or centre of dominion; but the change being only partial from place to place, the difference is no more suddenly perceptible than that in the horizon by which the traveller is surrounded, and a portion of which in his onward progress becomes insensibly, from the circumference, the very centre of the field of vision."² But no sooner do we enter upon the zoology of India Proper, than the European forms of animal life almost entirely disappear, and are succeeded by others of a richer and more varied character of form and aspect, some of which, however, extend to the parallel latitudes of the African continent. The Asiatic Islands again present us with another picture, and this latter change may be said to commence at the southern extremity of the Isthmus of Malacca. Java and Sumatra, in Mr Swainson's opinion, will probably be found to be the metropolis or central region of this range, which still produces several of the forms of Northern India; while in New Guinea and New Ireland, the Asiatic forms properly so called begin to disappear, and are replaced by many singular and interesting species, which exhibit the commencement of what may be termed the Australian kingdom. *Papilio bolina* occurs both in Java and New Holland.

Madagascar, as might be supposed, exhibits in its natu-

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¹ Edinburgh Cabinet Library, vol. viii. p. 1.

² Ibid. p. 2.

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ral families a resemblance to Africa. Nevertheless the species are distinct, and many of them present no analogy whatever to those of the continent. The Isles of France and Bourbon likewise manifest traces of the same family resemblance; but, on a general view, they show a closer connection with the East Indian species. Their ascertained number is, however, extremely limited.¹

Although the Entomology of New Holland may be said, like that of all other vast tracts of country, to exhibit a special type, it is yet composed, in some of its principal portions, of species analogous to those of the Moluccas and the south-east of India. This great fifth continent, as it has been called, is, however, less rich in insects than many other foreign countries, its soil being drier, and not so well wooded. The genus *Mylabris*, so abundant in the south of Europe, in Africa, and Asia, does not appear to pass beyond Timor. In that respect, then, New Holland agrees with America, as well as in the possession of *Passalus*, a genus of which the species have been more particularly noted as inhabitants of the new world. Several generic groups of the latter region present a closer resemblance to those of the east of Asia, than to such as are characteristic of the ancient world. The insects of New Zealand, of New Caledonia, and the circumjacent isles, show an obvious relation to those of New Holland; and the same may be said of such as occur in the archipelagos of the Great Southern Ocean. These islands, composed in great measure of aggregations of polypiferous rocks, form a chain which unites them in a westerly direction to the preceding regions, and from which many of their natural productions may have been received in the long course of ages. This natural communication could not have taken place with the new world, and thus many of these islands, although rather American than otherwise, according to their geographical position, may be regarded as Asiatic in regard to their animal and vegetable products.

The new world has also been observed to present progressive changes in the succession of its species, in connection with every considerable difference in the latitude and longitude. M. Bosc collected in Carolina many species which were unknown in Pennsylvania, and were still more foreign to New York; and the researches of Abbot in illustration of the Lepidoptera of Georgia demonstrate the existence in that province of certain species which have their central station in the Antilles. The banks of the far-stretching Missouri, about twenty degrees to the west of Philadelphia, produce many peculiar species. The Entomology of the Antilles presents a strong contrast to that of the United States. Trinidad, under the tenth degree of north latitude, presents us with truly equatorial species, such as the splendid butterflies called *Teucer* and *Mene-laüs*, which do not occur in St Domingo. Brazil, so gorgeous in its insect tribes, possesses species in common with Cayenne, but it also produces many others peculiar to itself. Latreille differs from Mr Macleay in his opinion regarding the comparative extension, in a northerly direction, of the southern species in the new and old world. He states that the southern species of the western hemisphere do not attain to so high a latitude as they do on the ancient continents. Here, he thinks, they begin to appear between the forty-eighth and forty-ninth degrees of north latitude; there, not until we gain the forty-third degree.² In relation to this subject Mr Kirby has remarked, that although the winters in Canada, within the same

parallel as France, are longer and more severe than those even of Great Britain or of Germany, yet the summers are intensely hot; so that though tropical species do not range so high, those of a tropical structure, in conformity with Mr Macleay's views, may be found in a higher latitude in the new world than in Europe.³ When we take into consideration certain peculiarities in the physical constitution of America,—its well watered surface, its lofty mountains, its majestic forests, and humid atmosphere,—we shall easily understand how many genera of the ancient continent, dwelling by preference in dry, warm, and sandy situations, for example *Anthia*, *Pimelia*, *Erodium*, and *Brachycerus*, should not occur in the comparatively rich, moist, and shaded soils of the new world. Thus also the carnivorous Coleoptera in America are proportionally of smaller amount than in the old continent, although no quarter of the globe is more productive of large and splendid species among the phytophagous or vegetable-eating tribes of insects. However, the south of China and the Moluccas still maintain a certain superiority in the production of such splendid examples of the lepidopterous order as *Papilio Priamus* and *Bombyx Atlas*, of which the dimensions surpass those of the American species. A fact noted by Latreille is worthy of remembrance, viz. that Europe, Africa, and Western Asia, are extremely unproductive of the genus *Phasma*, or the spectre insect, and that such of the species as do occur are extremely small, while the Moluccas and South America produce many of remarkable size. The atmospheric humidity of the new world, its narrow and elongated form, the nature of its soil, and the vast extent of ocean by which it is environed, are sufficient reasons for the disagreement observable between its productions and those of corresponding latitudes in our own hemisphere. The new world, in fact, bears in many respects the same relation to the old that Britain does to a great portion of Europe.⁴

We have already alluded to the classification of climate given by Fabricius, and to certain circumstances which have been supposed to render the adoption of that classification inadvisable. Latreille has viewed the same subject under a better aspect. He considers the northern extremities of Greenland and of Spitzbergen, under the eighty-first degree of northern latitude, as the points where vegetation terminates. But to obviate all difficulty, and with a view to establish a duodecimal division, which is not only convenient in itself, but also in frequent accordance with the actual observation of geographical groups, he raises this supposed limit of vegetation three degrees higher, that is, to the eighty-fourth degree. If we then divide into successive spaces of twelve degrees, a meridian commencing from the western parts of Spitzbergen, or those nearest to Greenland, we shall have a suite of latitudes corresponding successively to the limits of the countries already alluded to in relation to their zoological productions. He continues these sections duodecimally or by twelve degrees, beyond the equator, and towards the antarctic pole, and stops about the sixtieth degree of southern latitude, under the parallel of Sandwich Land, regarded in that direction as the *ne plus ultra* of geographical discovery.

It appears that a difference in latitude of twelve degrees always produces a very sensible change in the mass of insect species; and that if that space is doubled, the alteration is almost total; as, for example, between the

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¹ See an interesting memoir (which we did not receive till the present pages were in types, and which we consequently have not had time to analyse) entitled "Sur les Lépidoptères de Madagascar, Bourbon, et Maurice," by Dr Boisduval, in the *Nouvelles Annales du Muséum*, t. ii. p. 149.

² *Mémoires*, p. 132.

³ *Introd. to Entomology*, vol. iv. p. 492.

⁴ *Mémoires*, p. 184.

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north of Sweden and the north of Spain. An analogous change takes place in relation to the *longitude*, but more slowly, and after a traverse of a greater distance; since the mean temperature, but for causes of a particular and local nature, is not widely different under the same parallel. In proportion as we approach the pole, the extent occupied by particular races embraces a greater number of geographical divisions.

The insects of America, even those of its northern provinces, at least as far as Canada, may be said to differ specifically from those of Europe; but the species of Greenland may rather be regarded as European. The last-named country, so far as the entomological geography of the ancient continent is concerned, is assumed by Latreille as the point of departure for his first meridian. In any view it may be regarded as intermediate between the two hemispheres. The Canaries, the Cape de Verd Islands, and Madeira, are African, judging from their entomological productions. The meridian above named will thus follow a middle line between these islands and the most eastern cape of South America, that of St Roque, near Rio Grande, in Brazil. It will pass by the western isles, or archipelago of the Azores, and by the island of Ascension, and will abut to the westward of Sandwich Land. Its longitude will be thirty-four degrees to the west of the meridian of Paris. According to Latreille's observations on the insects collected by Olivier in Persia, their general relationship to those of the south of Europe and the north of Africa, and the essential differences which they present when compared with the entomological productions of the East Indies, it may be inferred that the most signal changes in the species take place in a southerly direction towards the frontier lines of Persia and Hindustan, and in a northerly direction at a short distance from the eastern slopes of the Uralian Mountains and Lake Aral, a little beyond the sixtieth meridian east of Paris. We may fix this limit approximately at sixty-two degrees, somewhat to the west of the Obi, and of Balk and Candahar, for the sake of affording the means of continuing a duodecimal division; for if we add 62 to 34, the difference between the first meridian and that of Paris, we have the number 96, a quantity susceptible of being divided, without fractions, into eight parts, each equal to the thirtieth portion of the circle. We thus separate the ancient continent into two great bands, of which one is western and the other eastern; and if we assign to the latter the same extent in longitude as the former, that is, ninety-six degrees, it will terminate 158 degrees of eastern longitude from the meridian of Paris. Departing from Kamtchatka, it will pass by the Carolinas, and from thence between New Holland and New Zealand. If augmented by one fourth, or by twenty-four degrees, this eastern band would be bounded by the 182d meridian east of Paris, and passing at a short distance from East Cape, over Behring's Straits, would stretch beyond the Friendly Islands, and form, without any material error in relation to our entomological views, a line of demarcation between Asia and America. The remaining 144 degrees complete the equatorial circle, and compose the extent in longitude of that great zone proper to the insects of America. It may also be divided, and under the same denominations of eastern and western, into two equal portions, each of seventy-two degrees. Thus the entire circle of the equator may be regarded as divisible into four arcs, of which the values are, 72, 72, 96, and 120, or in the proportion of six thirtieths, eight thirtieths, and ten thirtieths. The extent in longitude of the ancient continent will comprise 216 degrees, and that of the new 144.

The lesser zones or climates are denominated *arctic* or *antarctic* by M. Latreille, according to their position on

this or the other side of the equator. The climate included between the 84th and 72d degrees of north latitude is named the *polar* climate. Then follow as far as the equator, and always in divisions of twelve degrees, the following climates, viz. the *sub-polar*, the *superior*, the *intermediate*, the *super-tropical*, the *tropical*, and the *equatorial*; and as each hemisphere is partitioned into two great divisions, the climates of each are distinguished by the name of western and eastern. The antarctic climates consist of only three in number, as we know little of what exists amid those chilly regions beyond the 60th degree of south latitude, and thus in that direction both the polar and sub-polar climates may be suppressed. We shall illustrate these views by a few applications to the northern and western kingdoms of Europe, the best known portions of the old world.

The *polar* climate presents us with the insects of the greater part of Greenland, and with those of Iceland and of Spitzbergen. In the *sub-polar* climate we shall find those of Norway, of the north of Sweden, and of Russia in Europe. These two of course contain the insects of the coldest climates of the earth. We may regard as belonging to the *superior* climate the species of Great Britain, of the south of Sweden, of the north of France as far as the inferior course of the Loire, of Prussia, of Germany Proper, and of the south of Russia as far as the Crimea exclusive. The *intermediate* climate, at equal distances from those of the equator and the pole, will comprehend all the species of the south of Europe, and of a portion of the west of Asia. Those of the north of Africa, and as far as the equator, may be classed under the climates called *super-tropical*, *tropical*, and *equatorial*. These western climates may be divided into two equal parts, each consisting of forty-eight degrees, by a meridian which, passing fourteen degrees to the east of Paris, in the vicinity of Vienna, would leave to the east the most southern part of Italy, Turkey in Europe, Egypt, &c. Now it has been already remarked, that many of the insects of the environs of Vienna are also known to occur in the Levant, and that those of the kingdom of Naples, of Egypt, and of the south-east of Europe, appear to differ in many respects from the southern and western species of that division of the globe. We can here, then, effect the formation of sub-climates. If we divide the eastern portion, of which the extent in longitude is 120 degrees, into four equal sections of thirty degrees, by meridians, we shall have sub-climates, of which the boundaries seem very accordant with nature. Thus the first would comprehend Hindustan, Thibet, Little Bucharica, &c. while the second would detach almost all the Philippine Islands, China Proper, and the regions of the north as far as a short way beyond the river Lena. Corea, Japan, and the countries of the Manchous and Tongouses, &c. would form the third subdivision. The fourth would present Kamtchatka, and the other countries which terminate the north-east of Asia. America may likewise be subdivided after a similar manner.

It must, however, be borne in mind that nature, in her distribution of the localities proper to the various races of animals, often swerves from her more regular and accustomed courses, and that the *lines of habitation* form numerous curves and sinuosities, not unfrequently crossed or interrupted by others of a somewhat different nature. We must, therefore, in considering such views as the preceding, make abstraction of particular modifications which alter or derange our theoretical views. Latreille's is but an unfinished sketch of a highly interesting geographical map of Entomology, in which he has endeavoured, as well as he could, to mark out various boundaries, and to divide them according to certain principles in harmony with his

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In the opinion of Humboldt, the causes of the distribution of species, whether in the vegetable or in the animal kingdom, are among the number of mysteries to which natural science cannot attain. This science, or at least that branch of it which takes cognizance of zoological geography, is not occupied in the investigation of the origin of beings, but of the laws in accordance with which they are now distributed over the surface of the earth. It enters into the examination of things as they are, the co-existence of vegetable and animal forms in each latitude, at different heights, and at different degrees of temperature; it studies the relations under which particular organizations are more vigorously developed, multiplied, or modified; but it approaches not problems the solution of which is impossible, since they touch the origin or first existence of the germs of life. “We may add,” says that enlightened naturalist, “that the attempts which have been made to explain the distribution of various species over the globe, by the sole influence of climate, date at a period when physical geography was still in its infancy; when, recurring incessantly to pretended contrasts between the two worlds,

it was imagined that the whole of Africa and of America resembled the deserts of Egypt and the marshes of Cayenne. At present, when men judge of the state of things, not from one type arbitrarily chosen, but from positive knowledge, it is ascertained that the two continents, in their immense extent, contain countries that are altogether analogous, and that there are regions of America as barren and burning as the interior of Africa.”² It is indeed true that the migration and distribution of organized bodies can no more be solved as a problem in physical science than the mystery of their original creation; and that “the task of the philosopher is fulfilled when he has indicated the laws in accordance with which nature has distributed the forms of animal and vegetable life.”³

In regard to those exquisite tribes which form the more immediate subjects of our present observations, it is known that the increasing intensity and continuance of heat exert a powerful influence on the size, structure, and external adornment of the species. The nearer, in general, that we advance towards equinoctial countries, the more remarkable do we find these creatures, for their largeness of dimension, their singularity of form, and their depth as well as splendour of colour. An accurate knowledge of the distribution of insects is of the highest interest to the geologist and geographer as well as to the entomologist, and may be the means of determining, in doubtful or disputed cases, the natural and what may be called the original limits of countries; as, for example, in the case of islands situated at nearly equal distances between two distant continents. But we cannot here pursue the subject under a more extended form.⁴

Having thus cursorily considered the geographical distribution of insects, we may now devote a brief space to their *local* distribution, or favourite haunts, according to their kind, in any given district. The surface of a country, it has been observed, consists either of mountains, hills, and valleys, or of plains. In either case it may be bare and exposed, or diversified by forests, groves, or copses; and it may also be dry and sandy, or rich and well watered by lakes and rivers. Such parts as are uncovered are greatly varied by the hand both of art and nature, and present heaths or grassy downs, marshes, meadows, or tillage land, each of which is characterized by a difference of soil as well as of vegetable surface. In each the careful entomologist will discover peculiar kinds of insects. “As mountains and hills have usually their own Flora, the insects appropriated to alpine plants can only be met with where their pabulum is found. Here also those northern insects that are impatient of a warm climate will take their station if they migrate to the southward. The predacious beetles likewise sometimes frequent a mountainous district. *Carabus glabratus* was first taken by Professor Hooker on Ingleborough; and probably, if the Welsh and Scotch mountains were duly investigated by an entomologist, many novelties would reward his toils. The valleys and plains, especially those of a sunny exposition, abound in insects. When the heat of the atmosphere indisposes you for motion, you will find it no unprofitable or unpleasant employment, lying on the grass, to search for minute beetles, which you will there find coursing about amongst the tufts and roots of the herbage. Thus you may procure many of the *Pselaphidæ*, which you would not otherwise meet with. Even when the grass is grown up, insects are fond of alighting upon

¹ *Edinburgh Review*, vol. liii. p. 334.

² *Personal Narrative*, vol. v. p. 180.

³ *Ibid.* vol. iii. p. 496.

⁴ In addition to the works already mentioned, the reader may consult an excellent *Essai sur les Coléoptères de la Guyane Française*, par M. Th. Lacordaire, in the *Nouv. Annales du Muséum*, t. ii. p. 35; and *Thoughts on the Geographical Distribution of Insects*, in the 6th No. of the *Entomological Magazine*.

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The aquatic beetles of the genera *Dytiscus*, *Colymbetes*, &c. of course occur in the water. During the evening twilight, however, they frequently leave their moist abodes, and wing their way over the adjacent country. When surprised, after their nocturnal adventures, by the rising sun, they will plunge into whatever water is nearest at hand, and thus rain barrels and washing tubs are sometimes not looked into in vain. Chance often throws into the hands of an entomologist what he has long sedulously sought for without success; and an open window and a lighted candle will sometimes procure what a traverse through the forest, worthy of a North American Indian, would not have obtained. By collecting aquatic plants, duckweed, and “the green mantle of the stagnant pool,” and afterwards examining these productions at leisure in a basin of water, many valuable insects of the minuter kinds may be procured. Although the *Gyrinus Viola aquatica* is said to inhabit salt water, that element may be regarded as decidedly adverse to insect life. Brackish water, however, produces several peculiar species, such as *Hydraena marina*, and the large-eyed Cimicidæ. According to Latreille, the genus *Pimelia* occurs only in soils impregnated with saline particles, or where the genus *Salsola* abounds.

Heaths, though in a general view unproductive of insect life, yield some very beautiful species, such as *Carabus nitens* and *arvensis*, and *Cicindela sylvatica*. In regard to soils, such as are light, according to Mr Kirby, are most prolific in insects. Warm sandy banks are frequented by *Cicindela campestris*, *Opatrum sabulosum*, *Helops quisquilius*, &c.; and chalk is extremely attractive. The *Licini*, *Papilio Cleopatra*, several species of *Dasytes*, and *Lamiæ*, seem to delight in the latter substance. Many others are found in chalk-pits, which Mr Kirby does not think should be regarded actually as chalk insects; but rather that they simply fall into the pits, and then become more discernible in consequence of the stronger contrast of colour. By watching in one of these pits during a warm day, vast numbers of insects may be taken. Of all soils clay offers the fewest inducements to the entomologist.²

Old trees, felled timber, and planks which have lain long upon the ground, should be carefully examined by the collector, as on the under sides of the latter, as well as beneath stones, many species seek repose and shelter. Thorn and other fences, whether dead or living, are very productive; and gates, posts, and wooden rails, ought in no wise to be neglected. Although the sea itself, according

to the authority last quoted, produces no true insects, yet many and varied tribes are known to haunt its shores. On the sand hills of the Norfolk coast Mr Kirby found *Ægialia globosa* and *Cicindela hybrida*. *Rynchænus horridus* likewise inhabits thistles growing near the sea. Fuci and other marine rejectamenta, which border the margins of friths and estuaries, produce peculiar species of *Cercyon*, some *Aphodii*, and many *Staphylinidæ*. That singular insect *Oxytelus tricornis* has been captured in a situation like that now indicated. The inundations of rivers in spring, summer, and autumn, sweep innumerable insects from their hiding places; and when the waters begin to subside, the examination of the floating grasses, broken twigs, and various debris which line the indented shores, will afford an ample field for the investigations of the entomologist. To him indeed the most barren scene, whether of dreary moor or desolate mountain, can never be devoid of interest,—for the more untrodden the path the stronger and more rational are his hopes of becoming possessed of some of those treasures which are everywhere scattered over the wilderness of nature,—hitherto unperceived perhaps by human eye, but nevertheless performing an essential part in the great and solemn mystery of creation.

The geological relations of insects do not appear to have attracted the notice of naturalists,—we mean their more direct connection with rocks, independent of that intermediate relationship which results from the dependence of particular plants on certain soils, and the known alliance of many tribes of insects with peculiar forms of vegetable life. Mr. Wailes always found the larvæ of *Enicoceri* on rough slimy stones, and he found it as great a waste of time to look for them on a smooth limestone, as to turn up a fragment of basaltic rock (whinstone) in search of geodephagous insects. The repugnance of beetles to basalt he had previously noticed. The subjacent rock of the wild district of Teesdale is almost exclusively composed of the basalt of the great whin-sill, the formation of which is regarded as a knotty point by geologists. Of course the loose and superficial stones of the country are its fragments, and among these scarcely a beetle is to be found, except a few which are superlatively common elsewhere, though *inter rariores* in the district referred to. “So far,” says Mr Wailes, “as my observations, whether confined to single stones, or extended over a whole district, go, any place having limestone, particularly the magnesian, for its subjacent stratum, will afford abundance of the *Geodephaga*, as well as most other Coleoptera, whilst they will be found very thinly scattered over a basaltic region. It is strange to notice the almost uniform absence of these insects on turning up a whin which has accidentally found its way into a heap of other stones, though every one of the latter may have one or more tenants under it. Must we not look to the comparative dryness of the limestone and humidity of the whin for an explanation? We can readily account for the great predominance of the land *testacea* on a limestone district; but lime does not enter into the composition of beetles.”³

Insects may also be viewed in relation to their seasons of appearance, or the most appropriate periods for the collection of the different kinds. Such as gather honey and the pollen of plants are among the first to proclaim the approach of spring; and their appearance may be dated from the blossoming of certain trees and flowers of common occurrence. Other plants, likewise accompanied

¹ *Introduc. to Ent.* iv. 499.

² *Ibid.* p. 304.

³ *Entomological Magazine*, iii. 257. For a correct chemical analysis of the constitution of insects see page 63 of this volume of the *Encyclopædia*.

Coleoptera. by peculiar insects, blossom later; and thus we may trace a mutual relationship between the two kingdoms throughout the sparkling spring, the leafy summer, and the melancholy autumn,—till relentless winter sets his seal upon insect life, and either renders it entirely torpid, or sheds occasionally a feeble ray on some forlorn company of gnats, whose dances, now no longer “choral,” exhibit but a sad representative of that more genial season when the “living air” was filled with their not unjoyful murmurs. With these and a few other exceptions, the earliest insect season commences with the flowering of the willow (*Salix caprea* of Linnæus, *Saugh* of the Scottish schoolboy), which is accompanied by the golden flowers of the crocus, and the beautiful green of the expanding gooseberries. “Then is your time,” says Mr Kirby, “to collect many species of wild bees and *Diptera*, not afterwards to be met with; and various other insects now begin to emerge from the pupa. Another and later season is marked by the general blossoming of the buttercup (*Ranunculus bulbosus*), accompanied by the marsh-marygold (*Caltha palustris*), and ladies’ smock (*Cardamine pratensis*), when you may hunt the pastures, meadows, and marshes with success, and take some insects that do not show themselves later. The coprophagous insects are now abundant. Amongst others, *Aphodius testudinaris*, a perfectly vernal species, is now only to be taken, and usually flying. A third insect season indicated by Flora, and a very prolific one, commences with the blossoming of the hawthorn, when you must desert the meads for the inclosures. At this time all nature begins to put on her gayest attire, and all her insect tribes are now on the alert, and fill the air. They are almost universally attracted by the sweet and lovely blossoms of the plant just named; so that, by examining them, you may entrap some of every order, and many that during the year will appear no more. Even many of the saprophagous insects will sip nectar from the flowers. The umbelliferous plants proclaim the fourth season of insects, particularly the wild carrot and parsnip. You will scarcely ever fail to find, if the weather is genial, *hymenopterous* and *dipterous* insects of various genera, especially such as have a short tongue, engaged in collecting the honey from those plants. Here you may take some of the rarer *Chrysidæ*, *Crabronidæ*, *Cercerides*, &c. and occasionally even *Coleoptera*. The last insect season may be dated from the general flowering of the thistle tribe. When these are in blossom is the best time of all to collect the humble-bees (*Bombus*), the leaf-cutter bees (*Megachile*), and many other *Apiariæ*, Lat. which alone, by their long tongues, can imbibe the honey and collect the pollen of these flowers. The male humble-bees frequent them to the last, and often seem as if they were intoxicated with their sweets.”¹

The preceding chapters contain whatever we have to say of a general nature regarding the CLASS of insects. We shall now proceed to the particular history of those primary divisions called *Orders*, the name and nature of each of which have been already briefly expounded at the commencement of this article.

ORDER I.—COLEOPTERA.²

Coleopterous insects have usually four wings, the two superior of which, called elytra, resemble horizontal,

somewhat convex scales, which meet in a straight line along their inner margins, where they form what is called the dorsal suture. The inferior wings, which are the true organs of flight, are membranaceous, transparent, transversely folded, and covered and protected by the elytra or wing-cases. They are all masticating insects, provided with mandibles and maxillæ.

Of all the insect tribes these are the most numerous, the best known, and the most generally interesting. Their singular and varied forms, their brilliant colouring, the great size of many species, and that solid consistence which renders their collection and preservation comparatively easy, have long secured for them the devoted attention of the entomologist. Some advantages also result to their study and classification from the clearly defined and articulate forms of their external organs. The name and principal characters of the order were bestowed and defined by Aristotle, and have been adopted by almost all succeeding writers on the subject. Other characters have no doubt been added to his ancient definition of *wings in a sheath*,—such as the transverse folding of these organs, and the straightness of the suture by which the elytra are united; and several exceptions to the supposed universal attributes of the order have been discovered,—such as the female glow-worm, which has neither wings nor sheaths, and the genus *Meloe*, and many *Carabi*, which, though furnished with sheaths or elytra, are entirely destitute of true or membranaceous wings. So also, in the genera *Buprestis*, *Molorchus*, and others, we may discover exceptions to the transverse folding of the last-named organs; and the exact fitting or junction of the elytra, forming the dorsal suture, ceases to hold in the genus *Meloe*,—so that none of these characters can be regarded as universal; but as they are very generally prevalent, and a few exceptions do not invalidate a rule, it is advisable that they should be retained for the purposes of definition.

Coleopterous insects, like others, are composed of three principal portions, head, thorax, and abdomen. The head varies greatly both in size and form, according to the different tribes. In the great section of the *Geodephaga*, or ground-beetles, it is usually of a somewhat triangular form; in many of the short elytra’d tribes (*Brachelytra*) it is orbicular; while among the weevils (*Curculionides*) it is prolonged into a pointed rostrum or beak. The hinder part is frequently contracted into a short neck, and is inserted into a cavity of the thorax, in which it moves as in a socket. The head bears two *antennæ*, of which the form and structure differ not only in the different genera, but even in the sexes of the same species. They usually, however, consist of ten or eleven distinct articulations, the latter number being the more frequent. They are inserted in the front of the head, anterior to, and rather beneath, the region of the eyes. Their various forms, as characteristic of particular groups, will be afterwards described. The eyes of Coleoptera, in the perfect state, are two in number, and composite. In certain Staphylinidæ, two small yellowish points have been observed, which some naturalists have regarded as analogous to the simple or stemmatic eyes; but the sentiments of Latreille are adverse to that opinion. The actual eyes are either entire, notched, or even occasionally so completely intersected by a little corneous stalk, as to exhibit (as in the genus *Gyrinus*) the appearance of a pair on either side. The mouth consists of a *labrum*, two *mandibles*, two *maxillæ*, each furnished with one or two articulated *palpi*, and a

¹ *Introduc. to Ent.* vol. iv. p. 508.

² The derivation or etymology of the different orders has already been given in our introductory observations,—see pages 59 and 60 of this volume. Our present order corresponds to the *ELEUTHERATA* of Fabricius.

Coleoptera. *labium* composed of two parts, the *mentum* and *ligula*, and accompanied by a pair of palpi. The mandibles are usually of a corneous consistence, but they are membranaceous and of small size, in such as take little apparent nourishment, or feed on the juices of flowers, or on excrementitious or putrescent animal fluids. The maxillæ are of a softer texture than the mandibles. When there are a pair of palpi on each maxilla, the exterior ones never consist of more than four joints; those of the labium have usually three articulations.

The *thorax* of the Coleoptera, like that of other hexapod insects, is likewise divisible into three principal portions, each of which is characterized by a particular degree of development. The *mesothorax* is very narrow, whilst the corselet or *prothorax*, and the *metathorax*, exhibit a considerable bulk. This is an important feature in the structure of the skeleton or tegument of the coleopterous order. The *prothorax* is always free in its movements, while the two other portions are united together, and nearly immoveable. The component parts of the *mesothorax* are in fact rudimentary, and those of the *scutellum* are soldered together. But the elements of the latter portion, that is, the *præscutum*, the *scutum*, the *scutellum*, commonly so called, and the *postscutellum*, still exist, and their joinings are quite perceptible in certain genera. The *prothorax* supports only the first pair of legs, while the *mesothorax* bears the second pair and the elytra. The second pair of wings and the third pair of legs are attached to the *metathorax*.

The elytra and wings take their origin from the lateral and superior margins of that portion of the body to which they are attached. The elytra are usually of a very firm or almost crustaceous consistence, opaque, and without reticulations. The true wings are large, veined, and concealed beneath the elytra. The latter always exist (with the exception of the females of a few species), but many species are apterous, so far as concerns the existence of the membranaceous wings. In general the elytra equal the body in length, but they are sometimes, as among the *Staphylinidæ*, much shorter. They are usually free, and extended during the act of flight; but among several carabidaceous insects they seem united by the dorsal suture, and are consequently incapable of extension. In these instances the true wings are wanting.

The *abdomen* of the Coleoptera is scissile, that is, attached to the *metathorax* by its largest transverse diameter. Its inferior or ventral part is less extended longitudinally than the superior, and this restriction is chiefly owing to the development of the sternum of the *metathorax*, which is prolonged backwards, and thus, as it were, usurps the place of the abdomen. This may be very distinctly observed in the genus *Copris*, in which the segments of the abdomen seem crowded together. In some species the first segment appears divided into two parts by the sternum, which projects along their line of union. Inferiorly, the abdomen is always of a firm or horny consistence; but the upper part is generally soft, being covered by the elytra and wings. When these are wanting or abbreviated, the abdomen is equally hard above as below, as in the genus *Meloe*, and the *Staphylinidæ*, or brachelytrous tribes.

The legs vary in their structure and development. The anterior pair, or those of the *prothorax*, are frequently more strongly formed in the male than in the female; and in the former sex the tarsi are often broader than in the latter. The legs are usually described as composed

of five pieces, the *haunch*, the *trochanter*, the *thigh*, the *Coleoptera. tibia*, and the *tarsus*. M. Audouin has shown the existence of a sixth portion, moveable, constantly concealed within the interior of the body, and serving to articulate the haunch with the epimera. We have already mentioned it under the name of *trochantin*.

The internal structure of the Coleoptera has recently been illustrated by several ingenious observers, such as Ramdhor, Audouin, and Dufour.

The apparatus for the purposes of nutrition in coleopterous insects may be summed up as follows: 1st, Organs of manducation; 2^d, salivary glands; 3^d, a digestive tube; 4th, biliary vessels. The entire order Coleoptera is composed of *masticating* species, which are consequently provided with instruments of a more or less resistant nature, adapted for seizing, cutting, and triturating the food previous to its being swallowed. For this purpose the mouth is furnished with a pair of corneous mandibles, sometimes simply incisive, sometimes dentated or toothed. Their motion is transverse and horizontal. There is also a pair of maxillæ, usually of a more membranaceous consistence than the mandibles, an upper lip or labrum, an under lip or labium, and from four to six palpi. The salivary glands, which in orthopterous and hemipterous insects present all the characters common to such organs, are rudimentary in size, and few in number, among the coleopterous tribes. They contain a colourless saliva, and their existence hitherto has been ascertained chiefly in genera of the families of *Melasma*, *Taxicornes*, *Stenelytra*, *Trachelides*, *Rhincophora*, and *Aphidiphaga*. The digestive tube possesses an extent which varies singularly in relation to the habits of life of each particular tribe. In a few it scarcely exceeds the length of the body; while in others, and these are the greater number, it greatly surpasses that extent. The œsophagus is generally short; the crop more or less obvious; the gizzard is in some families garnished interiorly with triturating pieces; the chylic ventricle is of variable size, and either smooth or beset by papillæ; the small intestine likewise varies in length; the large intestine consists most frequently of a dilatable cæcum; the rectum is sometimes greatly elongated in the female sex.

The texture of the digestive tube is musculo-membranous, and is composed of three tunics of varying thickness. The biliary or hepatic vessels are always inserted at the posterior extremity of the chylic ventricle. They are of great extent, extremely slender, singularly folded, and of a cellular-membranous texture. Their number and the mode of their connection vary in the different tribes and genera, but they are always of an equal number, or in pairs. There are never less than a single pair, nor more than three. Sometimes their insertion is limited to the chylic ventricle, in which case they are either free and floating by one extremity, or they form an arch variously twisted, of which the two extremities are implanted on the same circle. Sometimes the insertion is double, and obtains at one end on the chylic ventricle, and at the other on the cæcum. The bile contained in these vessels varies from a deep violet and brown colour, to yellow and white. It is sometimes even diaphanous.

The generative system among the Coleoptera is thus described by M. Dufour. "Les Coléoptères ont, ainsi que les autres insectes, deux sexes séparés, et l'acte de la reproduction est un véritable accouplement. L'organe générateur mâle se compose, 1^o. de deux testicules formés, soit par les replis agglomérés d'un seul vaisseau sper-

¹ See Dufour's *Résumé des Caractères anatomiques propres aux Coléoptères en general et aux Carabiques en particulier*. Ann. des Sciences Nat. t. viii. p. 36.

Coleoptera. matique, soit par un ou plusieurs sachets, soit enfin par des utricules dont le nombre, la configuration, et la grandeur varient suivant les familles; 2°. de deux canaux déférens variables pour leur longueur, quelquefois reployés en épiphyse; 3°. de vésicules séminales plus ou moins nombreuses, et de formes diverses suivant les genres de Coléoptères; 4°. d'un conduit éjaculateur tantôt fort long, tantôt très-court; 5°. d'une verge retractile renfermée dans une armure copulatrice dont la conformation se modifie à l'infini. On distingue dans l'organe générateur femelle de tous les Coléoptères, 6°. deux ovaires dont chacun se compose d'un calice plus ou moins marqué, et d'un nombre variable suivant les genres, de gaines ovigères uniloculaires ou multiloculaires, terminées le plus souvent par une pièce charnue où se fixe un ligament suspenseur; 7°. une glande sébacée d'une structure diversement compliquée, insérée à l'origine de l'oviducte, et destinée à fournir une humeur propre à lubrifier ou à enduire les œufs à l'époque de la ponte; 8°. un oviducte plus ou moins long qui se continue en un vagin; 9°. enfin, dans quelques cas rares un appareil sécréteur particulier propre à former une enveloppe commune ou une coque aux œufs.¹

Besides the ordinary secreting organs, certain coleopterous species are provided with a kind of excrementary secreting apparatus, which is binary, and common to both sexes. Its function is the formation of an acrid humour, liquid or gaseous, which the insect expels as a means of defence when menaced or attacked.

The respiratory organs of the Coleoptera consist in stigmata placed along the lateral portions of the body, and of tracheæ, sometimes tubular, sometimes utricular, which disseminate the air through all parts of the system.

The nervous system is composed of a brain or upper ganglion,—of ganglia placed in the median line, variable in their number, and communicating with each other and with the brain by means of a double cord,—and of nerves, properly so called, which emanate from the ganglia.

The abdominal cavity of these insects always encloses a splanchnic adipose tissue, of which the abundance and colour vary according to the genera, and which appears to be connected with the purposes of nutrition.²

In addition to the usual differences, the sexes frequently present external distinctive characters in the antennæ and other parts. The male is supposed to perish soon after the sexual union, and the female does not long survive the deposition of her eggs. These eggs, which of course vary in size, form, colour, and consistence, are deposited in various localities, and among very different substances, in accordance with the instincts and economy of the species, and the habits of the larvæ about to be produced. These larvæ are also very dissimilar to each other in this varied order; but they may be generally described as soft bodied, with the exception of the head and the upper portion of the three first segments of the body, which are of a firmer or more scaly consistence. They are furnished with six feet; and the eyes, which in the perfect state are composite, are in this early condition small granuliform bodies, sometimes amounting to six on each side. The parts of the mouth bear a relation, both to their immediate mode of life, and their future development in the perfect insect. The mandibles are very strong and corneous in such species as feed on ligneous substances; they are coriaceous in such as feed on leaves, and almost membranaceous in those which prefer carcasses, or other matters in a state of putrescence. The antennæ of these larvæ are usually very short, cylindrical or conical, and composed of a small number of articulations.

Coleopterous insects enjoy a considerable length of life, Coleoptera. at least in the larva state. The period of endurance, however, of that early condition, is extremely various in the different genera of this most numerous order. Indeed, even among individuals of the same species, the continuance of the different stages of growth varies in accordance with the temperature of particular seasons, or the more or less abundant supply of food. Many species pass the winter in a listless state, abstaining almost entirely from eating, and consequently, even after the lapse of several months, present scarcely any apparent increase of their dimensions. No sooner, however, are they awakened from their temporary trance by the enlivening beams of the returning sun, than they greedily attack their favourite food, and their growth is almost instantaneous. It has been remarked that the larvæ which feed on leaves, such as those of *Crioceris*, *Altica*, and *Chrysomela*, remain but a brief period in the larva state; while the subterranean and root-devouring species, on the contrary, not unfrequently continue for two or three years in their dark abodes. Attentive observation has also ascertained that those Coleoptera which pass the winter in the egg state are the shortest lived in the form of larvæ;—they are hatched, nourished, developed, reproduce, and perish, all in the course of the summer first ensuing,—while such as pass the winter in the larva state, or that of nymph, are the longest lived in both of those conditions. It is chiefly in the form of larva that the Coleoptera produce such injury to agriculture, and other branches of rural industry. The ravages of species belonging to the genera *Bruchus*, *Curculio*, *Calandra*, *Melolontha*, *Crioceris*, *Altica*, *Anthrenus*, *Dermestes*, and numerous others, are unfortunately better known than any counteracting remedies of easy application.

The larvæ of the coleopterous tribes usually change their skins three times, and many of those which live in the earth construct a kind of cocoon, in which they undergo their transformations. These are of the kind formerly mentioned under the name of *complete* metamorphoses.

Linnaeus, Geoffroy, Fabricius, Olivier, Latreille, and others, have established many divisions, more or less natural, in the coleopterous order. The number of the articulations of the tarsi varies from three to five, and their amount in each limb has been assumed as the basis of the great sectional divisions of the coleopterous order, so generally adopted by the continental naturalists. As these divisions pervade all foreign works of importance on the Coleoptera, we shall here explain their nature. Geoffroy having observed that all the species of a genus or of a family were characterized by the same number of articulations of the tarsi, and that the differences presented by these parts always bore a relation to other differences in the general organization, he conceived the idea of grounding his primary divisions on their particular structure.

Many extensive families of coleopterous insects are distinguished by *five* articulations to the tarsi; that is, by five joints on each foot. (See Plate CCXX. fig. 2 e.) All of these fall under the first general section called *Pentamera*, from *πεντα*, *five*, and *μερος*, *part* or *article*. Another extensive division is characterized by *five* articulations to the tarsi of the two anterior pair of feet, while the posterior or third pair possesses only *four* articulations. All the species so formed belong to the section *Heteromera*, so called from *ἕτερος*, *different*, the tarsi being dissimilar to each other. Numerous Coleoptera exhibit the tarsi composed throughout of four articulations. These

¹ *Ann. des Sciences Nat.* t. viii. p. 33.

² *Ibid.* p. 40.

Coleoptera are ranged under the general section *Tetramera*, from *τετρα*, four. Lastly, many species have no more than three, and some no more than two joints, to the tarsi, and these belong respectively to the sections *Trimera* and *Dimera*. It has even been supposed that an insect exists, the tarsi of which are furnished with only a single joint; and for its reception the section *Monomera* (from *μονος*, alone) has been established. Later and more considerate observation, however, has led to the belief that both of the last-named sections are resolvable among the trimorous species, and that the supposed absence of the second and third joints arises from their extreme minuteness.

"Nihil notatu dignius videtur," observes Mr Fischer, "constanti tarsorum insectorum imprimis coleopterorum formatione, quæ, quidquid etiam naturæ scrutatores, quidam contra eam in medium protulerint, methodum ordinis insectorum in sectiones vel series minores dirimendi offert tutissimam."¹ The extreme simplicity, and consequent ease of application, of the sectional rules deduced from the structure of the tarsi, has probably induced the continental naturalists to adopt them more readily than they would have done had they foreseen the occasional contradictions to which they lead. The fact cannot be disguised that the system is in many instances artificial,—for several insects differ in the number of their tarsi, which are yet nearly allied by their general structure and attributes,—while it would be easy to show that the mere agreement in the number of those parts by no means carries along with it a corresponding relationship in the form of the other more important organs.² The truth is, that the articulations of the tarsi differ in some instances even in the sexes of the same species, as may be seen in *Cryptophagus fumatus* and *C. pallens*; and the consequence, as Mr Macleay has pointed out, of forming the primary divisions in accordance with their amount, has been, that many genera are separated, and thrown to a great distance from the place which nature has assigned them.³

While, therefore, the British naturalists have availed themselves of whatever aid these sectional divisions have legitimately afforded, they do not trammel themselves by a uniform adherence to the system, independent of its accordance with nature.⁴

We have already endeavoured, in the preceding introduction, to illustrate the geographical distribution of insects in general. We shall here add a few observations more especially applicable to the coleopterous tribes.

The coleopterous insects of Europe in general, according to M. Latreille, bear a strong affinity to those of Western Asia and Northern Africa. These traits of resemblance become more obvious, when, the qualities of the soil and the temperature being analogous, we approach towards the northern tropic. It is under the forty-fourth degree of north latitude that we begin to perceive certain species of carnivorous Coleoptera, of the Lamellicornes, of the heteromerous section, and of the Curculionides, characteristic of the warmer regions of the earth. There also may be observed species of a larger size, and of an

aspect more imposing, than characterize their congeners Coleoptera of the north. The dominion of the *Carabi*, properly so called, so notable over all the northern and temperate countries of Europe, and in the more western regions of Asia, ceases towards the thirty-fifth degree of north latitude. These predaceous insects are succeeded by the genera *Anthia* and *Graphipterus*. Viewed in relation to entomological characters, Europe may be said to extend further eastward than it does in accordance with our actual political divisions, as the insects of the Levant, and even of Persia, exhibit a very European aspect. Austria and Hungary, from their central situation and other local circumstances, are numerically richer in species than the western countries of Europe. These latter, however, possess, in consequence probably of their littoral position, and the influence of the oceanic waters, several peculiar species, which, though unknown in the East, nevertheless extend their localities in a lengthened line from north to south. However gorgeous may be the productions of tropical regions, the European continent presents to the entomologist a rich and varied assemblage both of carnivorous and herbivorous Coleoptera. Many of these it possesses in common with other countries, while of some it has to boast a more exclusive possession. The great tribe of the Carnivora, and especially the Carabi or larger predaceous beetles—the *Staphylinidæ* or brachelytrous kinds—the *Clavicornes*—the genera *Aphodius*, *Meloe*, *Calidius*, *Leptura*, *Chrysomela*,⁵ *Lixus*, &c.—are there proportionally more numerous than in any other quarter of the world. Latreille has observed that the herbivorous Coleoptera seem to prevail in South America. Many species of the northern countries of the new world greatly resemble those of the northern and temperate parts of Europe, while others are identical. Of these some may be regarded as naturally distributed alike over Scandinavia, Greenland, the adjacent islands, and North America,—while the greater proportion, which are xylophagous or timber-eating insects, have very probably been transported by artificial means, that is, in cargoes of wood, and in the timbers of our vessels. Notwithstanding many examples which might be adduced to illustrate a certain agreement which exists between the species of Europe and North America, the more general as well as precise truth is, that the entomology of North America is connected by a stronger affinity with that of the southern division of the new world than with that of our own continent and islands. We cannot, for instance, exhibit a single example of that division of *Cetonia* of which the thorax presents a posterior lobe, nor of *Galerita*, *Tetraonyx*, or *Parandra*, genera which are distributed throughout the whole of America. One strong feature of conformity has indeed been observed, that North America and Europe both possess many carnivorous Coleoptera entirely unknown in the equatorial regions either of the old world or the new.⁶

The coleopterous order is extremely numerous in species. Comte Dejean's collection, probably the most extensive hitherto made, is said to contain above twenty

¹ *Genera Insectorum*, Præf. p. 5.

² "Ce n'est pas assez," says Clairville, "pour pallier les fréquentes anomalies qui se rencontrent, de dire que tel insecte a cinq articles aux tarses quoiqu'on n'en découvre que quatre. Il devrait en effet en avoir cinq d'après la règle qu'on a établie. Cependant ces explications, toutes ingénieuses qu'elles sont, ne peuvent me convaincre, et je ne puis me déterminer à supposer plus d'articles aux tarses qu'on ne peut réellement en découvrir, en y mettant toute l'attention possible. Le nombre des articles doit être clair, positif, et uniforme, sans quoi le caractère est vacillant. Au reste, je ne disconviendrai pas que sans être rigoureusement propres à diviser les ordres, ils ne puissent très-bien servir pour un tableau dans lequel les genres seroient ordonnés selon le nombre des articles des tarses." (*Entomologie Helvétique*, p. 30.)

³ *Horæ Entomologicæ*, part i. p. 6.

⁴ M. Lacordaire, however, has recently shown that the *Chrysomelidæ* are very numerous in the tropical regions of South America. See *Nouvelles Annales des Mus.* t. ii. p. 94.

⁵ *Introduction à la Géographie générale des Arachnides et des Insectes, ou des climats propres à ces Animaux.* Par Latreille.

⁶ *Entomologia Edinensis*, Introduc. p. 23.

Coleoptera. thousand different kinds; and Mr Stephens' *Nomenclature of British Insects* (second edition) presents us with the names of 3614 indigenous Coleoptera.

In relation to the economical uses of the order, we may observe that coleopterous insects are scarcely if at all applied in the arts. Those employed in medicine are chiefly the *Cantharis vesicatoria*, commonly called the Spanish Fly, and the *Myiabis Cichorii*, which in China and the Levant is likewise used as a blistering application. The Romans are supposed to have made use of certain coleopterous larvæ for dietetical purposes; and some of the South American tribes are known to devour with delight the fattened larvæ of the *Curculio palmarum*. We shall conclude these introductory observations by a few remarks

On the collecting and preserving of Coleopterous Insects.

This is a very simple matter to those who are zealous in the cause. By far the best method is for the collector to provide himself with a few stout phials half filled with whisky, or any other ardent spirit which he may happen to prefer. When the insects are caught, which they can only be in any considerable number or variety by a sedulous search under stones, and in the other localities afterwards indicated in our notices of the different genera, they may be popped into the phial, where in most instances they die almost instantaneously. This is not only the most humane process, but it is also the best mode of preserving their more delicate portions uninjured. It likewise puts an end to all contention among themselves, which is by no means the effect of the ordinary method of collecting in small boxes,—for in the latter case the larger and more voracious invariably devour the smaller or least assuming; and thus many captures, regarded with pleasure in the morning, are found to have disappeared in the afternoon. If time and opportunity are wanting for the immediate purpose of *setting* the specimens, that is, placing them in their most appropriate positions, they may be allowed to remain in the phials for days or weeks without being injured, although in that case greater care is afterwards necessary, especially with the smaller specimens, in consequence of a certain softness in the articulations, induced by maceration in the spirits. When an entomologist (in search of Coleoptera) is employed in what we may call the *home circuit*, he requires during his excursions nothing more than a couple of glass phials, as we must suppose him possessed of all other appliances within his dwelling. But during a more distant and prolonged journey, he must provide himself with a few small boxes made either of wood or tin (the last is lighter and thinner, and therefore more commodious), lined with cork at top and bottom, and deep enough to contain an upper and an under range of pins. In these the insects caught during the day may be transfixed in the course of the evening, so that the phials may be left empty for the captures of the ensuing morn. Notes ought to be taken of the places of capture, and the insects should be so arranged in the boxes that, by means of numerals or other marks, any individual may be afterwards recognised in relation to its own particular locality.

The *setting* of an insect consists merely in placing its limbs and antennæ in a natural position, and fixing them

in the same for a time by means of pins, on a small board on which there is a layer of cork. (See Plate CCXX. figs. 10 and 12.) They stiffen in a few days, and may then be transferred to their proper places in the cabinet. If not set when either moist or recent, they may be softened by being placed for a night in any small vessel containing a layer of wet sand, and covered with a damp cloth to prevent evaporation. The same process, continued for a somewhat longer time, is equally efficient in regard to foreign species. Each specimen, if not stuck, should, previous to setting, be transfixed by passing a pin through the elytra and abdomen, at right angles with the plane of its position,—enough of the pin being made to project beyond the feet as will suffice to fix its point firmly in the cork.

When mould appears upon coleopterous specimens, they ought to be exposed for some hours at the distance of two or three feet from a brisk fire, and then delicately brushed with a hair pencil. When mites or acari make their appearance among them, they ought either to be exposed for a few minutes to a high temperature, which kills the living parasites without injuring the dead insects, or each specimen ought to be carefully washed by means of a hair pencil dipped in spirit of turpentine. A piece of sponge constantly saturated with that fluid, or a supply of camphor, should be kept in each drawer. With a view to maintain a collection in good order, it is very advisable that all specimens obtained from correspondents by purchase or exchange should, previous to their being placed in the cabinet, be submitted to the ordeal of a bath either in spirit of turpentine or camphorated spirit of wine. If mites or acari are once introduced into a cabinet of considerable extent, their eradication is extremely troublesome. As many collectors are careless of their duplicate specimens, and as it is of course with these that they supply their friends, much injury is frequently inflicted by the introduction even of a single insect in bad condition into a cabinet previously in a proper state.¹ We must now proceed to a more detailed exposition of the coleopterous tribes. They are grouped together under four great sections, according to the number of joints in the tarsi.

PENTAMERA.

All the Tarsi composed of Five Joints.²

FAMILY I.—CARNIVORA, Cuv. ADEPHAGA,³ CLAIRV.

The first primary division of the coleopterous order contains a numerous and varied assemblage, all of which, however, agree in being, as the name imports, of a voracious disposition. Each maxilla is furnished with two palpi, so that there are six in all, including those of the labium.

In the larva state, these insects are elongated, cylindrical, composed of twelve rings or segments, exclusive of the head, which is large, of a scaly texture, and provided with two strong mandibles curved at their extremities. The mouth is also furnished with a pair of maxillæ divided into two branches, one of which is formed by a palpus. The ligula bears two palpi, which are shorter than those of the maxillæ. The head is moreover provided with a pair of short conical antennæ, and six small simple

¹ *Entomologia Edinensis*, Introduction, p. 57.

² We have already stated our opinion of the artificial combinations which occasionally result from the use of this principle of sectional division, and in our *Entomologia Edinensis* we have, with our coadjutor, the Rev. James Duncan, followed another mode of arrangement. But in presenting a general view of the subject, and one in which numerous foreign genera are included, we think that greater clearness will result from an adherence to the system of the continental entomologists. We therefore now follow M. Latreille.

³ So named from ἀδελφᾶγος, voracious.

Coleoptera
Pentamera. eyes on each side.¹ The first segment of the body is covered by a squamous shield,—the others are soft. The first three segments are each furnished with a pair of legs, of which the extremity is curved forwards.

Of course many modifications occur in the form and aspect of adephagous larvæ. For example, those of the *Cicindelæ* have the upper portion of the head hollowed out in the centre, while the inferior portion is bulged. Two of the eyes on each side are much larger than the others, and the shield of the first segment of the body is also large, and of a semicircular shape. The eighth segment bears two small hooked processes in its upper surface. Among the generality, however, of these larvæ, the head is weaker and more regular, and the eyes are of equal size. The shield is square, and does not project over the sides; the eighth segment wants the processes; but the terminal segment is furnished with two conical appendages, besides a membranous tube formed by the prolongation of the anal portion of the body. These appendages are toothed and horny in the larvæ of *Calasoma* and *Carabus*. In *Harpalus* and *Licinus* they are more elongated, fleshy, and articulated. In these and other genera, the form of the mandibles in the larvæ approaches that of the same species in the perfect state.

The adephagous Coleoptera have always a first stomach, which is short and fleshy,—a second, which is more elongated, and shaggy on the surface, by reason of the numerous small vessels with which it is furnished,—and a short and slender intestine. The hepatic vessels, four in number, are inserted near the pylorus. These insects may be regarded as terrestrial (*Geodephaga*) and aquatic (*Hygrodephaga*), according to their mode of life.

The genera of the former subdivision of the order dwell and take their food upon the surface of the earth. They are hence known under the name of ground-beetles. The feet of these *terrestrial* species are formed for tolerably rapid motion, and the two posterior pair are inserted at equal distances. The mandibles are obvious and discovered, the terminal portion of the maxillæ is straight inferiorly, and curved only at its extremity. The body is generally oblong,—the eyes projecting. The tracheæ are tubular or elastic, and the intestine is terminated by an expanded cloaca, provided with two small sacs which produce an acrid humour.²

TRIBE 1ST, CICINDELETÆ, Lat.

This tribe corresponds to the genus *Cicindela* of Linnaeus. Its genera are distinguished by a hook or nail, which is articulated by its base to the tip of the maxillæ. All the species have a strong head, with large eyes, projecting toothed mandibles, and a short ligula concealed behind the mentum. The labial palpi are composed of four distinct articulations, and, in common with the maxillary palpi, are generally shaggy, or somewhat clothed. The precedence is usually assigned to these insects in our systematic arrangements, from motives probably similar to those which have induced ornithologists to place the accipitrine order at the head of the class of birds. The greater proportion of the species are exotic.

GENUS MANTICORA,³ Fab. Tarsi alike in both sexes, and composed of cylindrical articulations. Mandibles large and arched. Head very large. Eyes small, and not greatly projecting. Back of the thorax forming a kind of

Coleoptera
Pentamera. semicircular lobe, prolonged as far as the posterior margin. Abdomen pediculated, almost entirely enveloped by the clytra, which are nearly heart-shaped, soldered, and laterally carinated.

M. maxillosa, Fab. (Plate CCXXI. fig. 1.) Entirely black, and covered with scattered hairs. The mandibles have four interior teeth, of which the third is the least. The antennæ are slender and filiform, their third articulation angular and elongated. The thorax appears as if divided into two by a transverse groove near the anterior margin, which is prolonged laterally, and beneath, as far as the origin of the fore-legs. There is no scutellum visible. The legs are large, and covered with stiff hairs.

This formidable-looking insect, which measures more than an inch and a half in length, presents the aspect of a large spider. It inhabits sandy soil in the southern parts of Africa, and is the only known species of the genus, unless the *M. pallida* of Fab. referred by Mr Macleay to his genus *Platychiles*,⁴ is still to be regarded as a *Manticora*.

GENUS MEGACEPHALA,⁵ Lat. The first three joints of the anterior tarsi of the males dilated, short, almost in the form of a reversed triangle, more strongly ciliated inwards than externally. Labial palpi longer than the maxillary,—their first articulation elongated, projecting beyond the mentum, the second very short, the third very long and cylindrical, the last securiform. Labrum short and transversal, leaving the mandibles exposed.

This genus was constituted by Latreille by the removal of certain species of *Cicindelæ* of Fabricius. It occurs both in Africa and America. Those from the former country are apterous, from the latter winged. We know little more of their habits than that they are extremely active. We are acquainted with fifteen species, none of which occur in Europe.

M. megaloccephala, Lat. Of a bronzed black colour; the mouth, antennæ, and feet pale yellow. Elytra with rows of hollow spots. From Senegal.

In the genus *Oxycheila* of Dejean (*Species Gén.* t. i. p. 15) the labrum is very large, with a projecting point, and covers the mandibles. It is formed from the *Cicindela tristis* of Fab., and is named from ὀξύς, *pointed*, and χεῖλος, *lip*.

GENUS CICINDELA, Lin. (Plate CCXXI. figs. 2 and 5.) The first three joints of the anterior tarsi of the males dilated, elongated, nearly cylindrical, and more strongly ciliated inwards than externally. Labial palpi not surpassing the length of the maxillary; their first two joints very short, the first not passing beyond the extremity of the mentum, the third cylindrical, the last slightly enlarged at its extremity.

The name by which our present genus is distinguished is used by Pliny as synonymous with *Lampyrus*, to designate a kind of luminous insect, a frequenter of corn fields.⁶ It likewise appears to have been applied by ancient writers to various destructive insects which it would now be difficult to identify, although they are no doubt known to naturalists. In modern times it was originally bestowed by M. Geoffroy on the species at present classed under the genera *Malachius* and *Telephorus*, and was afterwards transferred by Linnaeus to the insects above defined, as well as to other species not now included in *Cicindela*.

Their larvæ inhabit holes in the earth, the entrance to which, while the occupant lies in ambuscade, is closed by the upper portion of its head. They are exceedingly

¹ So says Latreille. Some authors state the number of these eyes as only three on each side.

² *Règne Animal*, tom. iv. p. 358. An abstract of the anatomical characters of the insects of this division, by M. Dufour, will be found in the *Annales des Sciences Nat.* tom. viii. p. 36.

³ *Μαντιχώρα* is the name of a fabulous animal mentioned by Aristotle, Ælian, and Pliny.

⁴ *Annulosa Javanica*, vol. i. p. 9.

⁵ From μέγας, *great*, and κεφαλή, *head*.

⁶ Plin. viii. c. 26.

Coleoptera voracious, and seize with their maxillæ whatever insect prey approaches within their tyrannous grasp. The bodies of these larvæ are long, cylindrical, whitish, and furnished with six scaly feet. When approached by human footsteps, or otherwise threatened by danger, they rapidly descend into their subterranean retreats. When two of these larvæ happen to form their domiciles in the immediate neighbourhood of each other, the stronger devours the weaker, with a view to obviate any interference with his own pursuits. They seal up the entrance to their dwellings when about to change their skins or assume the state of nymph.

The perfect insects are extremely beautiful, of light and active forms, exceedingly swift in their motions, and adorned by brilliant metallic colours. The prevailing hues are different shades of golden green, spotted with white or pale yellow. They frequent dry and sandy soils, where they seem to enjoy the prevalence of bright sunshine. The species are extensively distributed over all the regions of the earth. Their organs of locomotion, and those more immediately subservient to the preservation and nutrition of the individual, are very fully developed, and present in the most perfect form all the attributes which distinguish the entomophagous or insect-eating *Coleoptera*. They were named by Linnæus the tigers of the insect tribes. "Though decorated with brilliant colours, they prey upon the whole insect race; their formidable jaws, which cross each other, are armed with fearful fangs, showing to what use they are applicable; and the extreme velocity with which they can either run or fly renders hopeless any attempt to elude their pursuit. Their larvæ are also equally tremendous with the imago, having six eyes, three on each side, seated on a lateral elevation of the head, which look like those of spiders; and, besides their threatening jaws, armed with a strong internal tooth, being furnished with a pair of spines resembling somewhat the sting of a scorpion, which stand erect upon the back of the abdomen, and give them a most ferocious aspect."¹ It is this last apparatus which, according to Clairville, serves the purpose of an anchor in retaining these larvæ at any desired height in their sandy cells.

Dejean's catalogue (2d edition) contains 201 species of the genus *Cicindela* as now restricted.

C. campestris. Green, with five whitish spots on the margin of each elytron, and another in the centre. The spots on the elytra vary in shape and disposition, and some of them are occasionally obliterated. The female has two fuscous spots towards the base of the elytra, and is distinguished, in addition to the more slender tarsi, by having the abdomen divided into six segments; that of the opposite sex consisting of seven, with the penultimate one more or less emarginate. This sexual distinction, first observed by Gyllenhal, exists in most genera of the tribe.

This beautiful insect frequents dry sandy places exposed to the sun, most commonly in the neighbourhood of

heaths, and is distributed more or less abundantly over all parts of Britain. We have traced it through most of the Highlands of Scotland, as far as the south of Sutherland, and we doubt not that it extends to the most northern extremity of the island. It is an inhabitant of most European countries, ranging from the shores of the Mediterranean to Siberia. This is the most abundant of the British species, and the only one yet found in Scotland. The supposed species *C. Maroccana*, Fab. which occurs in Spain and along the coast of Barbary, is now regarded as one of its varieties.

Besides the preceding, five or six other species are described as British. *C. germanica*, an English insect, common in France and Germany, differs in its habits from the rest of the genus. When we attempt to seize it, it does not fly off like the others (although it is winged), but endeavours to escape by running rapidly among the herbage by which it may be surrounded.

The genus *Euprosopus* of Latreille and Dejean, of which the tarsi are equally ciliated on both sides, was established on *Cicindela quadrimaculata* of Fab. The species are said to dwell on trees. In the genus *Therates*, Lat. the tarsi are nearly alike in both sexes. The internal maxillary palpi are very small, indistinct, and apparently unarticulate. The species are confined to the eastern parts of Asia, such as Java, the isles of Sunda, and those to the north of New Holland. *C. labiata* of Fab. belongs to the genus last named, which is synonymous with *Eurychiles* of Bonelli.² *C. aptera* of Olivier forms the genus *Tricindyla* of Latreille.

GENUS *COLLIURIS*, Lat. Fourth articulation of all the tarsi prolonged obliquely inwards in both sexes. Body narrow and elongated. Thorax almost cylindrical, narrowed anteriorly. Antennæ short, thickening more or less towards the extremity. Last article of the labial palpi dilated.

The title of *Colliuris* was bestowed originally by Degeer, upon an insect belonging to the genus *Casnoia* of Lat. It was established according to its present character by Fabricius under the name of *Collyris*, which has been altered as above by the majority of authors. These insects appear to be all provided with wings. All the species yet met with have been found in the most southern countries of Asia, and in the islands lying north of New Holland.

C. longicollis, Dej. Blue, sometimes tinged with violet. Thighs and hind tarsi ferruginous red. Elytra deeply punctured. This species was taken in Java by the excellent Westermann of Copenhagen, who presented it to Comte Dejean as the true *C. longicollis* of Lat. The insect so named by Latreille (*Gen. Crust. et Insect.* i. p. 174) is the *C. emarginata* of the *Species Général*, t. i. p. 165.

We shall conclude our sketch of this tribe by presenting a *synoptical view* of its most recent constitution, according to the system of Dejean.

¹ *Introd. to Entomology*, vol. ii. p. 263.

² *Mem. della R. Acad. di Torino*, xxiii. part 1st, p. 248.

CICINDELETÆ.

Mentum with a tooth in the centre of its notch. The three first joints of the anterior tarsi	not dilated in the males.....	1. <i>Manticora</i> .
Mentum without a tooth in the centre of its notch. Joints of the tarsi nearly equal.	Third joint of the anterior tarsi of the males dilated in the males. Penultimate joint of the labial palpi not elongate. not inflated. Labial palpi elongate, at least as long as the maxillary pair, the last joint securiform. Upper lip transverse or slightly notched. First joint of the labial palpi covering the mandibles, slightly elongate, not exceeding the maxillary pair; last joint not securiform.....	not extending beyond the notch of the mentum.... 2. <i>Platychile</i> .
		extending beyond the notch of the mentum..... 3. <i>Megacephala</i> .
		triangular..... 4. <i>Oxycheila</i> .
		semi-oval..... 5. <i>Iresia</i> .
		6. <i>Cicindela</i> .
		7. <i>Dromica</i> .
		8. <i>Eprosopus</i> .
		9. <i>Ctenostoma</i> .
		10. <i>Therates</i> .
		11. <i>Tricondyla</i> .
		12. <i>Colliuris</i> .

TRIBE 2D, CARABICI, Lat.

This important tribe corresponds to the old and unrestricted genus *Carabus* of Linnæus. The maxillæ are terminated simply by a point or hook, which is not articulated, as in the preceding genera. The head does not exceed the breadth of the thorax, and is more frequently somewhat narrower. The mandibles, with few exceptions, are but sparingly toothed. The ligula is usually projecting, and the labial palpi exhibit only three free articulations.¹ Many species are apterous, that is, have no membranous wings beneath the elytra. Their odour is often fetid, and their bodies exude an acrid fluid. The habits and economy both of the larvæ and perfect insects are exceedingly various. Some conceal themselves under the earth, others beneath stones, or the bark of trees. They are active in their movements, and are very generally distributed, being, however, more characteristic of temperate than equatorial regions. M. Geoffroy bestowed the generic name of *Buprestis* upon carabideous insects, on account of the injury which he supposed them capable of inflicting on cattle; and it is possible that the caustic humour with which many of them are imbued might be productive of bad effects in the event of their being swallowed along with better and more accustomed pasture. To whatever species this evil tendency was attributed, the ancients appear to have regarded its other characters

with admiration, for the physicians of olden times held it as equal in virtue to Cantharides. Linnæus, however, transferred the name of *Buprestis* to the genus *Cucujus* of Geoffroy, although none of the latter genus in any way corresponded to the *Βουπρεστις* of the Greeks. The change proposed by the great reformer has been universally adopted, and the word *Carabus* is now most familiar to the ear of the entomologist.

As the larvæ of the Carabici dwell in subterranean retreats, a knowledge of their habits and history is difficult to acquire. The body is of an elongated form; the legs are six in number, and of a scaly texture; and the maxillæ are strong and pincer-like. With these they seize upon the larvæ of other insects, which constitute their favourite food. They are extremely voracious.

In relation to the economical purposes of the human race, the tribes now under consideration are of no great utility. It is mentioned, however, by the younger Geoffroy, that while he was collecting insects on the coast of Senegal, a negro brought him a jar containing many thousand specimens of a small carabideous species, which had evidently been previously collected by design. On inquiry he found that they were used for making soap, some of which, of a black colour, he afterwards examined, and found it to possess all the qualities of the European article. Olivier asks whether we could not extract from our indigenous species an alkaline matter subservient to the same ends?²

¹ In the genus *Cicindela* the radical joint is free, on which account the palpi are said to consist of four articulations; but among the Carabici it is adherent, and, forming only a support to the others, is not itself regarded as an articulation.

² *Hist. des Insectes*, vol. iii. No. 35, p. 11.

Coleoptera
Pentamera.

A.

Exterior palpi not subulate or awl-shaped at their extremity; the last articulation not united with the preceding so as to form an oval body with a sharp point, or a conical one with a slender and acicular termination.

*

Two anterior tibiae with a deep emargination in the internal side separating the two spines, which are usually placed near each other, at the extremity of that side.

SECTION 1ST, TRUNCATIPENNES.

This group derives its name from the aspect of the elytra, which appear as if cut at their extremity, or more or less truncated. This is the prevailing character, although *Odocantha dorsalis* and Dejean's new genus *Stenodactyla* present a rounded termination; but in seeking a natural system, it is the totality of organization or assemblage of characters by which we must be guided, and not by a single feature, although by its wide prevalence that feature may have been assumed, as in the present instance, for a general basis in the naming of the entire group. The two following genera present rather a situation than a truncation of the extremities of the elytra.

GENUS ANTHIA,¹ Weber, Fab. Terminal joint of the palpi almost cylindrical, or slightly enlarged at the extremity. Antennae filiform. Labrum rounded, advanced, and almost entirely covering the mandibles. No tooth in the centre of the emargination of the mentum. Anterior tarsi slightly dilated in the males. Body thick, more or less elongated. Thorax more or less heart-shaped. Elytra convex, not much truncated, or nearly round at their extremity.

The insects of this genus are of considerable size. Their usual colours are black spotted with white. They inhabit the African deserts, and are not altogether unknown in those parts of Asia which extend from the Red Sea to Bengal. According to Leschenhault de Latour, they emit a caustic fluid when handled. In the males of some species the thorax is dilated and bilobed posteriorly. Both sexes are destitute of wings. Dejean's Catalogue contains seventeen species, all of which, except one, are African.

A. maxillosa, Lat. Black and smooth. Mandibles very long. Thorax bilobed posteriorly. This is a large insect from the Cape of Good Hope. It measures nearly two inches in length.

A. decemguttata, Dej. (Plate CCXXI. fig. 8.) Usually black above, the eyes brownish, a small white spot on each side of the anterior portion of the thorax. The elytra have each four deep grooves, with another in the centre common to both. These grooves are garnished with an ash-coloured or brownish down, which sometimes entirely disappears, and then each groove exhibits two rows of small excavated spots, with a longitudinal and slightly elevated line in the centre. Each elytron has also five spots formed of whitish down,—the first near the base of the exterior margin; the second a little in advance of the middle, in the second groove; the third and fourth rather behind the middle, and on the same line, in the first and third grooves; the fifth near the exterior margin, at the extremity between the second and third grooves. The under parts of the body and feet are of a more shining black. The thighs are sometimes reddish brown.

This species is extremely common at the Cape of Good

Hope. It is subject to great variation in its markings, and has been described under various names in its different conditions. According to Dejean, the *Anthia quadriguttata*, Fab. which we have figured in this work (Plate CCXXI. fig. 3), is nothing more than a variety of the above, with three of the spots effaced from each elytron.

GENUS GRAPHIPTERUS,² Lat. Last article of the palpi cylindrical. Antennae filiform, much shorter than the body. Labrum projecting, rounded, and nearly covering the mandibles. No tooth in the centre of the emargination of the mentum. Anterior tarsi not sensibly dilated in the males. Body large and flattened. Thorax heart-shaped. Elytra plane, broad, of a slightly elongated oval, more or less suborbicular.

We owe to Latreille the dismemberment of these insects from the *Anthia*, with which they were combined by Fabricius. However, they are equally apterous, inhabit the same parts of the world, and exhibit analogous colours. Although several insects of the north of Africa have been discovered in Italy and the south of Spain, the warmer countries of Europe have as yet been sought in vain for any species of either of the genera just named.

G. multiguttatus, Dej. (Plate CCXXI. fig. 7.) Dull black above, of a brighter black below. Thorax margined with white. The elytra with a sinuous margin of white, and eight spots on each of the same colour.

This species was brought by Olivier from Egypt, and given to his friends and correspondents under the above name, although it certainly does not agree with the description of the insect so named by the author in his *Entomologie* and the *Encyclopédie Méthodique*.

GENUS APTINUS, Bonelli. Terminal article of the palpi rather larger than the preceding, and slightly enlarged towards the extremity. Antennae filiform. Labrum short, and leaving the mandibles exposed. No tooth, or a very small one in the centre of the emargination of the mentum. The first three articles of the anterior tarsi sensibly dilated in the males. Thorax heart-shaped. Elytra oval, increasing in breadth towards their extremity.

This genus greatly resembles *Brachinus*, with which it was combined by Fabricius, and with which it is still frequently confounded.³ All the species belong to Africa (chiefly the Cape district) and the southern parts of Europe. Like the Brachini, they occur in groups under stones, and affect mountainous situations. They are similarly characterized by their power of emitting a penetrating vapour. The larger species inhabit tropical climates. The *A. balista*, Dej. measures from five to eight lines in length. It is black, with a fulvous throat and truncated elytra. It occurs in Navarre, and various parts of Spain and Portugal. A smaller species, of a deep black, with sulcated elytra, the antennae and palpi fulvous, the feet russet yellow, was discovered by Dejean among the eastern Pyrenees. It is extremely common under stones on the mountains in the vicinity of Pratz de Mollo, and is named *A. pyrenæus*.

GENUS BRACHINUS,⁴ Weber, Fab. This genus scarcely differs from the preceding. It is, however, characterized by the possession of wings, the anterior tarsi are not usually dilated in the males, the truncation of the elytra is rather square than oblique, and these parts are usually more parallel, or less enlarged at their extremities, than among the Aptini.

¹ The name *Ανθία* is bestowed by Aristotle on a fish.

² The name probably refers to what may be construed into an occasional resemblance of written characters upon the wings,—*γραφεω* and *πτερον*.

³ All the foreign species of the above genus in the Comte Dejean's printed Catalogue (1st edition) are *Brachini*.

⁴ Probably from *Βραχύνω*, I shorten, in allusion to the truncated form of the elytra.

Coleoptera
Pentamera.

Coleoptera
Pentamera.

The Brachini, as far as yet known, have no representative in Scotland. But as the southern parts of the kingdom produce five species, we are not without hope that some of these may ere long be discovered on the northern side of the Tweed. It is, however, evidently a southern genus, for of the nineteen species of the first division of Dejean, only one, the *B. Hispanus* of Kollar, is found in Europe. It was taken at the southern extremity of Spain, by an Austrian naturalist, who happened to disembark in the bay of Algesiras in the course of his voyage to Brazil. Of the twenty-one species which constitute the second division of the genus, eight occur in Europe; and of these five are English.¹ The character by which the generality of these insects are so remarkably distinguished is, that the abdomen contains peculiar organs which secrete a caustic liquor of an extremely penetrating odour. When this is propelled by the insect on any threatened danger, it produces a detonating sound, and evaporates. M. Dumeril has remarked, that when this reservoir is opened by dissection, the liquid effervesces, and evaporates instantaneously. Paper imbued with a blue vegetable dye is changed by its action, first into a reddish hue, and then into yellow. When the vesicle which contains it is placed upon the tongue, and compressed, a peculiar and rather agreeable savour is felt in the mouth. A sharp pain, however, soon follows on the spot affected, where a yellow colour becomes perceptible, similar to that produced by a drop of nitric acid. Leon Dufour has made us acquainted with the apparatus employed in the production of this fluid.²

It is stated by Rowlander that the Brachini are capable of producing eighteen or twenty discharges at a time. Mr Stephens has invariably found them ready to discharge their ammunition at all times, especially when roughly handled; and Mr Cooper informed him that a specimen he met with at Cobham in the spring, performed the operation no less than thirteen times in rapid succession.³

B. Jurinei, Dej. (Plate CCXXI. fig. 6.) Testaceous. The elytra black, grooved, with the lateral margins and a central spot testaceous. From Senegal.

GENUS CASNONIA, Lat. Terminal article of the palpi of an oval form, almost pointed at the end. Antennæ much shorter than the body, their articulations of nearly equal length,—the first being shorter than the head. Tarsi filiform; the last article at most bifid. Thorax in the form of an elongated neck, cylindrical, and very narrow anteriorly. Head nearly lozenge-shaped, prolonged and narrowed posteriorly.

The Casnoniæ are insects of singular forms, reminding the observer of the aspect of *Raphidia* and *Apoderus*. They composed the original genus *Colliuris* of Degeer; Linnæus placed them among his *Attelabi*, while Fabricius and Herbst ranged them in the genus *Odocantha*. Latreille formed the genus in which we now place them. It is synonymous with *Ophionca* of Klug.⁴ Most of the species come from America. *C. cyanocephala* occurs in Bengal.

GENUS ODOCANTHA, Fab. Characters nearly the same as the preceding. Thorax elongate oval, nearly cylindrical. Head oval, narrowed behind, but not posteriorly prolonged.

O. melanura, Fab. Greenish blue, the base of the antennæ, chest, and feet testaceous. The elytra testaceous,

with a spot of blackish blue at the extremities. The ends of the thighs black. Coleoptera Pentamera.

Dejean retains only two species in this genus, as above defined, viz. the one just described, which is the sole British species, and *O. Dorsalis*. The former insect occurs in the temperate and colder countries of Europe, in moist and marshy places; the latter is from North America.

We pass over the genus *Zuphium*, of which one species, *Z. olens*, is remarkable for occurring in France, Spain, Italy, the southern provinces of Russia, and the East Indies,—the genus *Polistichus*, of which *P. fasciolatus* is found in Britain,—the genus *Helluo* of Bonelli, of which all the species are foreign to Europe,—the genus *Drypta*, which has representatives in Africa, New Holland, and the East Indies, and of which *D. emarginata* is British (for a representation of *D. ruficollis*, see Plate CCXXI. fig. 9),—the genera *Galerita*, *Ctenodactyla*, *Agra*, *Cymindis*, Lat. (*Tarus*, Clairville, of which *T. basalis*, Gyll. occurs in the south of Scotland), and *Calleida*.

GENUS DEMETRIAS, Bon. Hooks of the tarsi dentated beneath. Terminal article of the palpi cylindrical. The first three articles of the tarsi almost triangular, the last strongly bilobed. Body elongated. Head oval, slightly narrowed posteriorly.

These little insects, as far as we know, are all European. They are frequent in spring, on briars and hedges. We have four British species, one of which, *D. obscurus*, we owe to the recent researches of Mr Newman.

GENUS DROMIUS,⁵ Bon. Resembles the preceding; but the articles of the tarsi are entire, and nearly cylindrical. The species are apterous.

The Dromii formed part of the genus *Lebia* of Latreille, till their separation by Bonelli. They are almost all European, and are commonly found under stones, and beneath the bark of trees. Britain produces about twenty species.

GENUS LEBIA. Hooks of the tarsi dentated beneath. Terminal article of the palpi nearly cylindrical and oval, and truncated at the end, but never securiform. Antennæ filiform. Articles of the tarsi nearly triangular or heart-shaped, the penultimate bifid or bilobed. Body short and flat. Thorax short, transversal, broader than the head, prolonged posteriorly in the middle. Elytra broad, and nearly square.

This genus, which is comparatively numerous in European species, and is likewise known in America, and more sparingly in Africa, has been divided by Bonelli into two. The type of the first division (genus *Lamprias*) is *Leb. chlorocephala*, a beautiful little insect, of a brilliant bluish green, with the base of the antennæ, legs, breast, and thorax red, the tarsi black. It occurs occasionally near Edinburgh, and has been taken as far north as Lairig, in Sutherland. The type of *Lebia* proper is *L. crux minor*, and this second division is characterized by the penultimate joint of the tarsi being bilobed, while in the first it is said to be simple. However, as far as we are able to perceive from an inspection of our north-country specimens, there is a bilobation in that part also in *Lamprias*. But other distinctive characters will be found detailed in the works of Messrs Curtis and Stephens, both of whom follow Bonelli in regarding the two divisions as distinct genera. Dejean's *Catalogue* contains sixty-four species.

¹ The *Catalogue des Col.* 2d ed. contains seventy-seven in all.

² Mém. sur le Brachine Tirailleur, *Ann. du Mus.* t. xvii. p. 70, and *Ann. des Sciences Nat.* t. vi. p. 320.

³ Stephens' *Illustrations*, vol. i. p. 35.

⁴ *Entomologiæ Brazilianæ Specimen.*

⁵ From *δρῶμις*, a runner.

SECOND SUB-TRIBE.

SECOND SUB-TRIBE.

Claws with teeth beneath. Body	more or less wide, and depressed. Elytra nearly square. Last joint of the labial palpi	more or less elongate. Last joint of the labial palpi	strongly securiform, at least in the males. Penultimate joint of the tarsi	not bilobed.....	14. <i>Cymindis</i> .		
				bilobed.....	15. <i>Calleida</i> .		
				not securiform. Claws	with very large teeth.....	16. <i>Onypterygia</i> .	
						bilobed.....	17. <i>Demetrias</i> .
				with small teeth. Penultimate joint of the tarsi	not bilobed.....	18. <i>Dromius</i> .	
					forming a right angle with the sides.....	19. <i>Plochionus</i> .	
				strongly securiform. Posterior margin of the thorax	produced in the middle.....	20. <i>Aspasia</i> .	
				not securiform. Posterior margin of the thorax	forming a right angle with the sides. Penultimate joint of the tarsi	not bilobed.....	21. <i>Lebia</i> .
						bilobed.....	22. <i>Coptodera</i> .
				Claws without teeth. Antennae	filiform. Upper lip	short, transverse, and leaving the mandibles uncovered. Last joint of the labial palpi	not securiform. Elytra ovate, more or less elongate
winged.....	26. <i>Brachinus</i> .						
scarcely elongate, nearly orbicular.....	27. <i>Corsyra</i> .						
strongly securiform.....	28. <i>Drepanus</i> .						
simple. Upper lip quadrate, wider than long. Joints of the four anterior tarsi	more or less triangular or heart-shaped.....	29. <i>Dyscolus</i> .					
	nearly cylindrical.....	30. <i>Promecoptera</i> .					
longer than broad. Elytra	rather short and wide, more or less square or ovate.....	31. <i>Thyreopterus</i> .					
	more or less elongate and parallel.....	32. <i>Catascopus</i> .					
wanting. Last joint of the labial palpi	rather strongly securiform.....	33. <i>Eucheyla</i> .					
		scarcely elongate, nearly orbicular.....	34. <i>Graphipterus</i> .				
not securiform. Elytra ovate, more or less elongate.....	35. <i>Anthia</i> .						

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SECTION 2D, BIPARTITI, Lat. SCARITIDES, Dej.

Almost all the genera of this group (seventeen in number in the system of Dejean) were constituent portions of the old genus *Scarites* of Fabricius and Olivier. They possess several characters in common. The exterior palpi are not subulate or awl-shaped at their extremity. The elytra are not terminated by a truncation, but are either entire or slightly sinuated. The abdomen is separated from the thorax by an obvious intermediate neck-shaped portion.¹ The first article of the antennæ is always the largest. The anterior legs are often broad and palmated, and strongly notched interiorly. The anterior tarsi present no marked disparity in the sexes, and are unprovided with brushes beneath; but simply ciliated.²

In the *Coléoptères d'Europe* of MM. Latreille and Dejean, the Scaritides seem to be regarded as not carnivorous. But in opposition to this opinion, so contrary to analogy, we have the authority, as Mr Macleay has noted, of two accurate observers, MM. Olivier and Lefebvre de Ccrisy. The latter, who resides at Toulon, possesses peculiar facilities for acquiring a knowledge of their natural habits. He states them to be nocturnal insects of prey, which, during the day, lurk motionless in holes of the earth, and sally out at night to attack Melolonthidæ and other insects.³

The insects included in this division are rather strongly distinguished from the conterminous groups. As they are destined to live chiefly beneath the surface of the earth, their structure is more peculiarly adapted than that of the other Coleoptera to a subterranean mode of life. The body is narrow, the anterior thighs thickened, the tibiæ dilated, and furnished with strong spines, presenting a broad surface, well fitted to remove the soil;—the head and thorax are strong, and the latter is attached to the abdomen by a short peduncle or footstalk. In the last-mentioned particular they differ from most other pentamerous beetles, which usually have the thorax closely applied to the abdomen, and the hinder angles rectangular or even salient, which necessarily prevents any considerable degree of lateral motion. But in insects which excavate holes scarcely exceeding their body in width, some provision is necessary to enable them to turn their anterior portion in different directions, otherwise their progress would be nearly in a straight line. This object, which is analogous to that which is provided for in moles and other burrowing quadrupeds, by the flexibility of the vertebral column, is attained by the interposition of a narrow cylindrical piece between the abdomen and thorax, on which the latter moves as on a pivot, its hinder angles being rounded off that its motions may be performed with greater facility. The form of the antennæ is likewise in beautiful accordance with the habits of the insects. They are composed of nearly globular articulations attached to each other by a slender filament, bearing some resemblance to a series of beads rather loosely strung. By a structure of this kind, they are rendered greatly more pliant and flexible than in the other Pentamera (the joints of the antennæ in which are generally conical), and therefore present no obstacle to the insect's progress through a resisting medium.⁴

These insects are usually of a uniform black colour. The larva of *Ditonus bucephalus*, the only one that has

been attended to, presents, according to Latreille, the same form and habits of life as those of *Cicindela*. They are more particularly characteristic of torrid countries, although Great Britain and the rest of Europe produce several genera.

GENUS ENCELADUS, Bon. *Scarites*, Oliv. Mentum inarticulate, soldered, covering almost all the under part of the head, strongly notched, with a bifid tooth in the centre. Terminal article of the labial palpi distinctly securiform. Antennæ filiform; the first article a little longer than the others.

The species of this genus differ from most of their section in having their anterior tibiæ unemarginate, which allies them to the *Simplicimanus* of Dejean, or *Grandipalpi* of Lat. The example figured, *E. gigas* (see Plate CCXXI. fig. 4), is a large insect of which the locality seems doubtful. Latreille believed it to come from Madagascar and equinoctial Africa, while Dejean regards it as South American.

GENUS ACANTHOSCELIS, Lat. *Scarites*, Fab. Mentum articulated, almost plane, strongly trilobed. Labrum very short, tridentate. Mandibles large, advanced, strongly toothed interiorly. Terminal article of the labial palpi almost cylindrical. Antennæ moniliform; the first article very large; the others much less, but enlarging insensibly towards the extremity. Body short and convex. Thorax convex, transverse, almost square. Elytra short, and very convex. Anterior tibiæ strongly palmated; posterior short, broad, arched, and spinous. Trochanters almost as large as the posterior thighs.

This genus is formed upon *Scarites ruficornis* of Fab. (Plate CCXXI. fig. 17), an insect above eight lines in length, black, with the palpi and antennæ ferruginous. It is native to the Cape of Good Hope.

GENUS SCARITES,⁵ Fab. Mentum articulated, concave, strongly trilobed. Labrum, mandibles, and terminal article of the palpi as in the preceding genus. Body rather elongated, cylindrical, or slightly flattened. Thorax convex, almost crescent-shaped, notched anteriorly, rounded posteriorly, and frequently somewhat prolonged in the middle. Anterior tibiæ strongly palmated, posterior simple. Trochanters much shorter than the posterior thighs.

The insects of our present genus are of considerable size, of a black colour, usually shining, and are characteristic of sandy countries near the sea coast, or of districts impregnated with saline particles. They occur in the warmer countries of Europe, Asia, Africa, and America. Dejean enumerates fifty-eight species. Three are said to occur in Britain, *S. Beckwithii* of Stephens, *S. subterraneus*, and *S. levigatus*, Fab. The two latter are, however, doubtful natives. The second is in fact an American insect (see Plate CCXXI. fig. 10),—the third is frequent in the south of France, and along the Mediterranean shores.

GENUS CLIVINA,⁶ Lat. *Scarites*, Fab. Mentum articulate, concave, and trilobed. Labium slightly advanced, and cut almost square. Mandibles slightly projecting, not toothed interiorly. Terminal article of the labial palpi almost cylindrical. Antennæ moniliform; the first article as long as the two succeeding united. Body more or less elongated. Thorax square or globular. Anterior tibiæ almost always palmated.

¹ The foreign genus *Ozæna*, in which the peduncle is scarcely perceptible, may be regarded as an exception to the last-named character.

² *Species Général*, t. i. p. 355.

³ *Annulosa Javanica*, No. i. p. 24.

⁴ *Entomologia Edinensis*, p. 77.

⁵ From Σκαριζῶ, *I run swiftly*.

⁶ *Clivina* is the name of an augurial bird mentioned by Pliny.

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Pentamera. These small insects are usually found under stones, by the banks of rivers, and elsewhere. They are common all over Europe, more especially in its southern parts. They also occur in Africa, America, and the East Indies. We have two British species, *C. fossor*, Gyllenhal, which is brownish black, with the mouth, antennæ, and legs rufous, the elytra punctate striate, of the same colour as the thorax,—and *C. collaris* of Herbst, of which the head and thorax are brownish black, and the elytra chesnut colour. Dejean regards the one as a variety of the other. They are described as distinct by English entomologists. We lately found a rare and interesting species, *C. arctica*, on the mountain range on the north side of the valley of Clova, in Forfarshire. It is known to occur, though rarely, in Lapland, the north of Sweden, Finland, and sometimes as far to the east as the environs of St Petersburg. It forms the genus *Leiochiton* of Curtis,¹ so named from λειος, *smooth*, and χιτων, *a covering*, the upper surface and other parts being remarkable for glossiness.

The genus *Dyschirius*, Bonelli (named from δυς, *two*, and χιρας, *a division of the foot or leg*), which some au-

thors do not admit as distinct from *Clivina*, contains those species of which the thorax is globular, and the anterior tibiæ palmated only at the extremity, and simple exteriorly. Sixteen species are found in Britain.²

GENUS DITOMUS, Bon. Mentum articulated, concave, and trilobed. Labrum slightly notched. Labial palpi slightly elongated, the terminal article almost cylindrical. Antennæ filiform, the articles elongated and nearly filiform. Thorax cordiform or crescent-shaped. Anterior tibiæ not palmated.

This genus was established by Bonelli on the *Scaurus sulcatus*, and certain *Carabi* of Fabricius, which Rossi and Olivier had placed in *Scarites*. The species are of middle size, dark or blackish in their colouring, and frequently deeply punctured. They inhabit the southern parts of Europe, the north of Africa, and the west of Asia. We have figured *D. violaceus* on the plate last referred to, fig. 16. *D. fulvipes* of Lat. a common insect in the south of France, and occurring, though rarely, as far north as Paris, has some claims to be regarded as a British species. We are acquainted with eighteen species in all.

¹ *British Entomology*, vol. viii. p. 346. Of the genus *Clivina*, including *Dischirius*, &c. Dejean's *Catalogue* enumerates forty-four species.

² We take our indications of the amount of indigenous species from Mr Stephens' *Nomenclature of British Insects*. Second edition. 1833.

Synoptical Table of the preceding Section (SCARITIDES), according to the system of Dejean.

Mentum inarticulate,	nearly covering the under side of the head. Inner side of the anterior tibiae	without a notch.....	1. <i>Enceladus</i> .		
		strongly notched.....	2. <i>Siagona</i> .		
	leaving uncovered a great part of the mouth,	broad, very short, and without a perceptible tooth in the centre of its notch.....	3. <i>Coscinia</i> .		
		rather narrow, short, and trilobed.....	4. <i>Melænus</i> .		
Mentum articulate, leaving great part of the mouth uncovered. Anterior legs	palmated. Mandibles	strongly dentate on the inner side. Thorax	convex, rounded behind, and of- ten a little pro- duced in the middle. Posterior tibiae	straight and nearly simple	5. <i>Scarites</i> .
			short, broad, bent, and covered with spines.....	6. <i>Acanthoscelis</i> .	
			quadrate, and nearly cylindrical.....	7. <i>Scapterus</i> .	
			broad, flat, nearly heart-shaped, emarginate posteriorly.....	8. <i>Pasimachus</i> .	
		very slightly or not at all dentate internally,	projecting greatly. Last joint of the labial palpi	elongate and pointed.....	9. <i>Oxystomus</i> .
				nearly cylindrical. Thorax nearly	square, and somewhat cylindric
			heart-shaped, and rather flat		11. <i>Camptodontus</i> .
			projecting very little.....	12. <i>Clivina</i> .	
	not palmated. Antennæ	short and nodose. Joints of the antennæ	distinct, and scarcely thickening towards the apex.....	13. <i>Morio</i> .	
			scarcely distinct, and thickening perceptibly towards the apex.....	14. <i>Ozana</i> .	
		filiform, the joints elongate and nearly cylindrical. Labial palpi	somewhat elongate. Anterior tarsi	dilated in the males.....	15. <i>Carterus</i> .
				alike in both sexes.....	16. <i>Ditomus</i> .
			much elongate.....	17. <i>Apotomus</i> .	

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SECTION 3D, QUADRIMANI, Lat. HARPALICI, Bon.

In this division Latreille includes those groups of Carabici which, resembling the preceding in the pointed termination of the elytra, have the four anterior tarsi dilated in the males; the first three or four articulations are in the form of a reversed heart or triangle, and are nearly all terminated by acute angles; their under part is usually furnished (excepting the *Aphoni*) with two ranges of papillæ or scales, with an intermediate linear space. The body is always winged, generally oval and arched, or convex above, with the thorax broader than long, or at most nearly isometrical, square, or trapezoidal. The head is never suddenly contracted posteriorly. The antennæ are of equal thickness throughout, or are slightly and insensibly enlarged towards the extremity. The mandibles are never remarkably strong. The external palpi are terminated by an oval or fusiform joint of greater length than that which precedes it. The tooth of the notch or emargination of the mentum is always entire,—in some wanting.¹ The legs are robust, the tibiæ spiny, and the hooks of the tarsi simple. The intermediate tarsi, even in the females, are short, and, with the exception of the dilatation, are formed nearly like the anterior. The species prefer warm and sandy situations exposed to the sun.

GENUS HARPALUS, Lat. Dej. (PLATE CCXXI. fig. 11.) The first four articles of the four anterior tarsi strongly dilated in the males, broader than long, and very decidedly triangular, or cordiform. Terminal article of the palpi somewhat elongated, slightly oval, or almost cylindrical and truncated at the extremity. Antennæ filiform. Labrum in the form of a transverse square. Mandibles slightly advanced, arcuated, and not very sharp. A simple tooth, more or less developed, in the middle of the emargination of the mentum. Body oblong, more or less elongated. Head more or less rounded, narrowed posteriorly. Thorax more or less square, cordiform, or trapezoidal. Elytra more or less elongated, and almost parallel.

The genus *Harpalus* of Latreille, as conceived in his *Genera Crustaceorum et Insectorum*, comprised all those insects which Dejean has united in the tribes *Harpaliens* and *Feroniens*, and the genera *Callistus*, *Oodes*, *Chlænus*, *Epomis*, and *Dinodes*, of the *Patellimanes* of the latter author. Bonelli, in his *Observations Entomologiques*, reduced the genus to the insects which now constitute the tribe *Harpaliens* of Dejean, itself consisting of twenty-eight genera. The *Harpalidæ* of the British writers include,

besides our present genus, many genera of the sections afterwards mentioned under the names of *Simplicimani* and *Patellimani*. Coleoptera Pentamera.

The genus *Harpalus*, even as now restricted and above defined, is very extensive, and probably contains nearly one half of the species of the section. The larvæ of these insects, as far as we are acquainted with them, dwell beneath the ground. Their form is conico-cylindrical; their head large, armed with strong mandibles, resembling those of the perfect insect; the posterior part of their body exhibits a membranous tube, terminated by a prolongation of the anal region, and two fleshy articulated appendages. Their metamorphoses are likewise subterranean. The Harpali are distributed over all the earth. They are, however, obviously more abundant in the temperate and even boreal regions of the northern hemisphere, than in equinoctial or southern countries. Comte Dejean's collection contains 179 species, while Mr Stephens enumerates (including the doubtful kinds) 58 species as indigenous to Britain, besides 15 *Ophoni*, which Dejean combines with *Harpalus*.

We may name as one of the most abundant of the genus *H. ruficornis*, of a pitchy-black colour, the antennæ and legs rufous, the elytra pubescent striated, the interstices punctured. This insect is spread over all Europe. We took it at Cape Wrath. It occurs in Siberia. M. Goudot brought it from Northern Africa.

H. æneus is distinguished by various shades of green above, with a brassy or coppery lustre; the under side black; external margin of the elytra punctulated, the antennæ and legs rufous. This species is extremely variable. It is generally of a rich bronzed green; the males highly polished, the females more obscure, sometimes brownish black. Mr Kirby once took a specimen of this insect, which he immersed in hot water, and was surprised to observe what he at first supposed an intestine thrust itself forth; on a nearer inspection he found it was an intestinal worm, thicker than a horse-hair, and of a brown colour.²

This group (the Quadrimani), in the system of Dejean (where it is named Harpaliens), includes many minor genera not recognised in the *Règne Animal*, and contains the genera *Tetragonoderus* and *Pelecium*, which in Latreille's arrangement belong to other sections. As we cannot enter into a detailed exposition of the characters of those genera, we shall here exhibit Dejean's latest views by means of a synoptical table.

HARPALICI.

FIRST SUB-TRIBE.

Mentum trilobed.

Antennæ	{	filiform.....	1. <i>Pelicism.</i>
		moniliform.....	2. <i>Eripus.</i>

SECOND SUB-TRIBE.

Mentum deeply notched.

This sub-tribe may be separated into two divisions.

FIRST DIVISION.

Antennæ moniliform.

The tooth in the notch of the mentum	{	simple. Last joint of the labial palpi.....	{	ovate.....	3. <i>Cratocerus.</i>
				cylindric, and truncated at the extremity...	4. <i>Somoplatus.</i>
		wanting.....			5. <i>Daptus.</i>

¹ The ligula or anterior portion of the mentum is always, according to Latreille, in this as well as in the two following genera, remarkably salient, obtuse or truncated at the end, and is accompanied by two distinct membranous paraglossæ in the form of auricles (oreillettes).

² For the other British species we must refer the reader to the works of Messrs Stephens and Curtis. We have described such as occur near Edinburgh in our *Entomologia Edinensis*. The characters of the foreign kinds are detailed in Dejean's *Species Général*.

Antennæ filiform.
May be divided into two subdivisions.

Notch of the mentum with a bifid tooth in the middle.

Body	{	flat and rounded.....	6. <i>Cyclosomus</i> .
		elongate.....	7. <i>Promecoderus</i> .

Tooth in the notch of the mentum simple or wanting.

Last joint of the palpi securiform.....8. *Axinotoma*.

Last joint of the palpi not securiform. The four first joints of the intermediate tarsi of the males	
more or less triangular or heart-shaped.	Last joint of the palpi
more or less cylindric or ovate, and truncated at the extremity. Fourth joint of the four anterior tarsi of the males	
triangular or heart-shaped. Head	
more or less rounded and triangular, and contracted behind. The tooth in the notch of the mentum	more or less quadrate or triangular, not contracted behind. The tooth in the notch of the mentum
more or less obvious. Mandibles	wanting. Mandibles
projecting but little. The four first joints of the intermediate tarsi of the males	more or less pointed. Upper lip
obtusely dilated. The four first joints of the four anterior tarsi of the males	The tooth in the notch of the mentum
as long as wide, and slightly triangular..	obtuse.....9. <i>Acinopus</i> .
dilated	strong and very acute..... 10. <i>Cratacanthus</i> .
not dilated.....	quadrate11. <i>Paramecus</i> .
dilated.....	deeply notched.....12. <i>Cratognathus</i> .
	almost quadrate..13. <i>Agonoderus</i> .
	obtuse, and not salient.....14. <i>Barysomus</i> .
obtuse, and not salient.....	15. <i>Amblygnatus</i> .
very slightly dilated	not dilated...16. <i>Platymetopus</i> .
salient and pointed.....	dilated.....17. <i>Gynandropus</i> .
very slightly dilated	cylindric, or very slightly ovate 18. <i>Selenophorus</i> .
as long as wide, and slightly triangular..	smaller than the following.....19. <i>Anisodactylus</i> .
dilated	20. <i>Bradybænnus</i> .
not dilated.....	21. <i>Geodromus</i> .
	22. <i>Hypolithus</i> .
	23. <i>Gynandromorphus</i> .
	24. <i>Harpalus</i> .
very slightly dilated	25. <i>Geobænus</i> .
terminating in a point.....	26. <i>Stenolophus</i> .
broad and nearly square	27. <i>Acupalpus</i> .
	28. <i>Tetragonoderus</i> .

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SECTION 4TH, SIMPLICIMANI.

This section resembles the preceding so far as regards the termination of the elytra;¹ but the two anterior tarsi only are dilated in the males, without however forming a square or orbicular pallet; sometimes the first three articles are obviously broader, and the succeeding one is in that case always much less than its antecedent; sometimes the latter and the two preceding ones are larger, almost equal, and in the form of a reversed or triangular heart. The joints of the four following tarsi are more slender and elongated, almost cylindrical, or in the form of a lengthened and reversed cone.

The *Simplieimani* of Latreille consist of genera belonging to the tribe *Carabiques Feroniens* of Dejean, with the addition of *Tetragonoderus*, Dejean (Harpalici), *Cataseopus*, Kirby (Truncatipennes), and a few others.

GENUS ZABRUS, Clairville. The first three articles of the anterior tarsi dilated in the males, broader than long, strongly cordiform. Terminal article of the palpi almost cylindrical, and truncated at the extremity. Antennæ filiform, and but slightly lengthened. Labrum of a square form, broader than long, slightly notched anteriorly. Mandibles little advanced, rather strongly arcuated, almost obtuse. A simple tooth in the middle of the emargination of the mentum. Body thick and convex. Thorax transverse, square, trapezoidal, or rounded on the sides. Elytra convex, rarely elongated, frequently very short, almost parallel, and rounded at the extremity.

These insects are usually found under stones, or marching about the fields, occasionally on the stalks of grass or other herbage. We are acquainted with about twenty species, of which not more than two are British. The majority of the others occur in the southern parts of Europe. There is one from Teneriffe.

GENUS FERONIA, Lat. Dej. The first three articles of the anterior tarsi dilated in the males, broader than long, and strongly triangular or cordiform. Terminal article of the palpi more or less elongated, cylindrical, or slightly securiform. Antennæ filiform, more or less lengthened. Labrum square, broader than long, sometimes almost transversal, quadrate anteriorly, or slightly notched. Mandibles more or less advanced, and more or less arcuated and pointed. A bifid tooth in the middle of the emargination of the mentum. Thorax more or less cordiform, rounded, square, or trapezoidal, never transverse. Elytra more or less elongated, oval, or parallel. Intermediate tibiæ always straight.

A great variety of opinion is maintained by entomologists regarding the distribution of the component parts of this extensive genus. Bonelli, in the synoptical table annexed to the first part of his *Observations Entomologiques* (in 1809), published the generic characters of *Platysma*, *Pæcilus*, *Abax*, *Molops*, *Percus*, *Melanius*, and *Pterostichus*. At an after period MM. Megerle and Ziegler established *Argutor*, *Steropus*, *Cophosus*, and *Omasus*, the latter genus, it is believed, corresponding to *Melanius* of Bonelli. All these were admitted provisionally into the first edition of Comte Dejean's *Catalogue*, published in 1821. In the third volume, however, of the *Species Général* of that great collector, he observes as follows: "Ma collection depuis cette époque s'étant considérablement augmentée, je me suis trouvé souvent très-embarrassé pour placer dans ces différents genres les espèces qui je rece-

vais, surtout les exotiques, et quelquefois plusieurs d'entre elles me paraissaient intermédiaires entre deux genres, et appartenir autant à l'un qu'à l'autre. Plus je recevais d'insectes, plus je me trouvais embarrassé, et lorsque je voulus classer définitivement toutes mes espèces dans chaque genre, et établir les caractères de chacun de ces genres, après plusieurs essais infructueux, je finis par être convaincu que cela était réellement impossible." Dejean then thought of following the example of Sturm, who reduces (in his *Deutschlands Fauna*) all the genera above named to those of *Abax*, *Molops*, *Pterostichus*, and *Platysma*; but after a deliberate re-examination, even these did not appear sufficiently marked; and he finally determined to combine them all in one under the name of FERONIA, a term previously used in a comprehensive sense by Latreille in the first edition of the *Règne Animal*.

The genus *Feronia*, then, of Dejean is one of the most extensive in the coleopterous order, containing above 230 species. It is subdivided by the last-named author into ten sections, corresponding to the same number of genera as established by Bonelli, Megerle, Ziegler, and Sturm.

According to Latreille's views, the genus is divisible into three groups as follows: 1st, The species, generally winged, of which the body, more or less oval, is a little convex or arcuated above, with the antennæ more filiform, the head proportionally narrower, and the mandibles somewhat less projecting. In their habits these insects approach the genera *Harpalus* and *Zabrus*. Such are the *Amaræ*, of which the thorax is transverse (and which Dejean admits as a distinct genus); the *Pæcili*, where it is almost as long as broad, and where the rather short antennæ have the third article compressed and angular; and the *Argutores*, which resemble the *Pæcili*, but have proportionally shorter antennæ, with the third joint not angular.

2d, The species usually furnished with wings, but of which the body is straight, plane, or horizontal above, with the head nearly as wide as the body. Such is the genus *Platysma* of Bonelli, to which Latreille unites *Omasus* of Ziegler and Dejean, and *Catadromus* of Macleay.

3d, This division contains *Feroniæ*, analogous to those of the preceding one in their general characters, but distinguished by the want of wings.²

We shall conclude by observing that our English entomologists have adopted all those minor genera, in so far as they are applicable to the British species, and have even proposed several others of still more limited application. We regret that our necessarily narrow limits prevent our entering into minute details.³ We shall merely indicate a few of the species. *F. madida* is shining black, the elytra ovate, rather convex, subpunctate-striate, with a puncture on the third interstice a little behind the middle. This is the *F. concinna* of Sturm and Dejean. A variety occurs with the thighs and sometimes the tibiæ rufous; it constitutes the *F. madida* of the latter author. They are not distinct. Both varieties are in this country among the most common of coleopterous insects, occurring beneath stones, at the roots of trees, &c. both on low grounds and on mountains. They seem less common in Germany than in any other country in Europe. *F. nigrita* is also of frequent occurrence in all parts of Britain. It is of a shining black, the thorax subquadrate, narrowed behind, the elytra with obsoletely punctured striæ, and three impressed dots on the disk. *F. orinomum* is like-

¹ As usual, there are exceptions to the rule:—"Plusieurs Carabiques simplicimanes," says Latreille, "ont l'extrémité de leurs élytres fortement sinuée au bout, et se distinguant à peine, sous ce rapport, des *Truncatipennes*." (Note to *Règne Animal*, t. iv. p. 399.)

² For a further exposition of Latreille's views, see *Règne Animal*, tom. iv. p. 395.

³ For the arrangement of the indigenous species, see Mr Stephens' *Nomenclature of British Insects*, 2d edition.

Coleoptera wise shining black, often faintly tinged with brassy; elytra striated, with more than four impressed dots on the disk of each. By the comparison of an extensive series of specimens of this insect which we have collected in various parts of Scotland, we are satisfied that *F. (Omaseus) Bulwerii* of Stephens is not specifically distinct. A species frequent under stones in woods and fields, and the last which we shall here mention, is *F. melanaria*. It is black, apterous, moderately convex, the thorax with a bi-striated fovea in each of its posterior angles, the elytra with striæ nearly impunctate.

GENUS BROSCUS, Panzer. *Cephalotes*, Bon. First three articles of the anterior tarsi dilated in the males, broader than long, and decidedly cordiform. Terminal article of the labial palpi elongated and slightly securiform. Antennæ filiform, and but slightly lengthened. Labrum of a square form, broader than long, almost transverse. Mandibles slightly arcuated, and rather sharp. A simple tooth in the middle of the emargination of the mentum. Thorax cordiform, convex, and much contracted posteriorly. Elytra rather long, slightly oval, or parallel.

This genus was established by Bonelli on the *Carabus cephalotes* of Fabricius, and was also distinguished about the same period by Panzer under the name of *Broschus*. We adopt the latter term as more familiar to the English collectors. Of the five species with which we are acquainted, two belong to Europe, one to the north of Africa, one to Mount Sinai, and the fifth to Asia Minor. They are all of considerable size, and bear a resemblance to the genus *Steropus* of Megerle.

The only British species is *B. cephalotes*, which is of an elongated form, black, with the head thinly punctured, and the elytra very finely punctate-striate. It occurs in sandy places over many parts of Britain; and in the vicinity of Edinburgh is plentiful under stones, and marine rejectamenta, on the shore between Portobello and Musselburgh. We found it as far north as Keoldale, near Cape Wrath. The attitude this insect assumes when disturbed is rather peculiar. The two anterior pair of legs are brought close together, and extended straight outwards at right angles with the under surface of the body. The hind legs are bent upwards, and project in a similar way from the opposite surface. The antennæ are drawn close to the sides of the thorax, and the mandibles extended to their utmost stretch, while a considerable degree of rigidity is imparted to the whole. It takes this posture most readily in cold weather; at other times, when more active, it prefers seeking safety by flight, or by burrowing in the sand.¹

"The habit of these insects," it is elsewhere observed, "is very curious. They are found only in the sand on the sea shore, and live in dens about three inches deep and half an inch wide, which are made in a diagonal position in the sand, where it is mixed with decomposed stalks of *Elymus arenarius*. They appear to rove during the day occasionally; but upon any alarm they run swiftly to their dens, projecting from the mouths of which their heads may be seen watching for prey. On holding another beetle to the hole, the one within would immediately seize hold of it with its jaws, and continue so tightly fixed as to suffer itself to be drawn out without quitting its hold. They appear to be very ferocious insects; and, from the number of elytra and other parts strewn about the sand, it may be supposed that they prey on each other."² The latter observation, we may remark, applies to many insects; although the human race (certainly in that respect

the most noted) have been supposed to present the only Coleoptera instances of identical species waging war upon each other. Pentamera.

Even tiger fell and sullen bear,
Their likeness and their lineage spare.
Man only mars kind nature's plan,
And turns the fierce pursuit on man.³

The natural position of the genus *Broschus* seems to be that assigned it by Mr Curtis, between the Scaritides and the species which in the *Entomologia Edinensis* is placed at the head of the genus *Feronia*, viz. *F. madida* (*Steropus madidus*, Meger.). In common with the former, *Broschus* possesses an elongated form, rather short stout legs, and a pedunculated thorax, which adapt it to a subterranean mode of life. In the latter the thorax is also pedunculated, and the legs thick and strong, while the more rigid structure of the antennæ, admitting less easily of being applied to the sides of the thorax to facilitate progression in a cylindrical hole, together with the general configuration of most of the other parts, assimilate it more decidedly to the other *Feroniæ*, to which its habits perfectly correspond.

GENUS MORMOLYCE, Hagenbach.⁴ Exterior palpi very short; the terminal article cylindrical, and almost rounded at the extremity. Antennæ setaceous, almost as long as the body; the third article as long as the two following. Labrum almost square, notched anteriorly. Mandibles short, arcuated, rather sharp, and toothed interiorly. A simple tooth in the middle of the emargination of the mentum. Body remarkably depressed. Head narrow, elongated, much prolonged posteriorly. Thorax almost lozenge-shaped. Elytra flat, thin, greatly dilated, much wider and longer than the abdomen.

The aspect of this genus is one of the most remarkable with which we are acquainted. We place it among the *Simplicimani* (*Feroniens*) in accordance with the example of Latreille and Dejean, the latter of whom observes, "J'ai placé cet insecte près des *Sphodrus*, mais ce n'est que provisoirement, car j'ignore de quelle manière les tarses sont dilatés dans les males, et même s'ils ne sont pas semblables dans les deux sexes." In regard to its locality he further observes, "D'après M. Hagenbach, elle se trouve dans la partie occidentale de Java; d'autres personnes croient qu'elle vient de la Cochinchine."⁵ Our recent acquisition of an extensive series of specimens of the only known species enables us to determine both of those doubtful points. The tarsi are alike in both sexes, and our collection was brought from Java.

The insect above alluded to (*Mormolyce phyllodes*, Plate CCXXI. fig. 13⁶) measures nearly three inches in length and an inch and a half across the dilated portion of the elytra. It is entirely of a blackish-brown colour, somewhat paler on the edges of the abdomen. It is furnished with wings, and the elytra have the appearance of being reticulated. The figure just referred to will convey an accurate idea of its form. We have supplied the principal collections of Europe with this rare and singular insect, of which, says Dejean, to whom we had the pleasure to transmit a pair, "il est presque impossible de se faire la moindre idée par la description." He also terms it "un insecte extraordinaire, qui paraît appartenir au premier aspect à la famille des *Mantis*, mais qui est cependant un Coléoptère, et même un véritable Carabique, ainsi qu'il est facile de s'en convaincre par ses caractères génériques."

Passing over the genus *Sphodrus*, of which *S. leucophthalmus* is the only British species, we come to

GENUS CALATHUS, Bon. First three articles of the

¹ *Entomologia Edinensis*, p. 82.

² *Entomological Magazine*, No. 1, p. 92.

³ *Rokeby*, canto iii.

⁴ *Mormolyce Novum Colcopterorum Genus*, Nuremberg, 1825.

⁵ *Species Général*, t. v. part 2, p. 714.

⁶ The parts of the mouth are represented on the same plate, fig. 12, a, b, c, d.

Coleoptera anterior tarsi dilated in the males. Hooks of the tarsi
Pentamera toothed beneath. Terminal article of the palpi elongated,
almost cylindrical, and truncated at the extremity. Antennæ rather elongated, filiform, and slightly compressed. Labrum of a square form, broader than long, very slightly notched anteriorly. Mandibles not much advanced, slightly arcuated, and rather sharp. A bifid tooth in the middle of the emargination of the mentum. Thorax trapezoidal, or almost square, little, if at all, contracted posteriorly. Elytra rather elongated, slightly oval, little contracted anteriorly, and rounded at the extremity.

This genus, as Mr Stephens observes, presents a peculiar outline from the shape of the head, trapeziform thorax, and elliptic elytra, by which it is readily distinguished from the neighbouring genera. The species usually reside among short herbage on banks, and are frequently observed upon quick-hedges.¹ They are generally of a black or brown colour, rarely metallic. They are ex-

tremely active in their movements. The only species we shall here notice is the *C. microcephalus* of Dejean,² which we discovered in the summer of 1832 in the highlands of Forfarshire, Perthshire, and Aberdeenshire. It forms an addition to our British species, and is distinguishable from the others by the following characters:—Shining black; antennæ, palpi, legs, and margin of the thorax testaceous; the thorax rather long, somewhat narrowed behind, with the hinder angles obtuse; elytra not much elongate, with slender impunctate striæ, the second and third from the suture with two impressed points. In size it nearly agrees with the very common *C. melanocephalus*. On the continent it occurs in Sweden, France, Switzerland, and Germany, chiefly in woods and on mountains.

Here follows the synoptical table of the preceding section, according to the system of Dejean, and including many genera of which we cannot give the detailed characters.

FERONIENS, Dej. (Chiefly) SIMPLICIMANI, Lat.

DIVISION FIRST.

First joint of the anterior tarsi dilated, at least in the males.

This division contains only one genus..... 1. *Stenomorphus*.

DIVISION SECOND.

The two first joints of the anterior tarsi dilated in the males.

Tooth in the notch of the mentum	{	bifid.	{	Last joint of the labial palpi	wanting.....	2. <i>Omphreus</i> .				
					simple.....	3. <i>Melanotus</i> .				
					{	nearly cylindrical, truncated at the tip, and slightly securiform. Thorax	{	ovate, and terminating nearly in a point. Thorax	flat, nearly square, slightly or not at all contracted behind.....	4. <i>Pogonus</i> .
									convex, heart-shaped, considerably contracted behind.....	5. <i>Cardiaderus</i> .
{	{	{	{	Last joint of the labial palpi	{	nearly cylindrical, truncated at the tip, and slightly securiform. Thorax	convex, nearly ovate.....	6. <i>Baripus</i> .		
							flat, contracted behind, more or less heart-shaped.....	7. <i>Patrobus</i> .		

Third joint of the antennæ as long as the two following united. Elytra

- much wider than the abdomen 13. *Mormolyce*.
nearly of the same breadth as the abdomen 14. *Sphodrus*.

considerably elongate, very slightly triangular, or nearly square. The tooth in the notch of the mentum

- simple. Thorax more or less heart-shaped; the hinder angles always distinct. Elytra
flat, elongate-ovate, without distinct anterior angles 15. *Platynus*.
slightly convex, ovate or elongate-quadrate; the anterior angles always distinct 16. *Anchomenus*.
rounded; without distinct posterior angles 17. *Agonum*.
wanting 18. *Olisthopus*.
triangular, or very strongly securiform 19. *Trigonotoma*.

trilobed or slightly notched. Last joint of the maxillary palpi

- not securiform, almost cylindrical, and truncated at the tip. Last joint of the labial palpi
almost cylindrical. Middle lobe of the mentum
produced and nearly pointed 20. *Catadromus*.
scarcely produced and almost truncated 21. *Lesticus*.
nearly wanting 22. *Distrigus*.
rounded 23. *Abacetus*.
elongate, and terminating nearly in a point 24. *Drimostoma*.
strongly securiform 25. *Microcephalus*.

Third joint of the antennæ shorter than the two following united. Three first joints of the anterior tarsi in the males

scarcely elongate, distinctly triangular or heart-shaped. Mentum

deeply notched. The tooth in the notch

- simple or bifid. Three first joints of the anterior tarsi of the males
without appendages beneath. Last joint of the maxillary palpi
cylindric or securiform. Body
short, thick, and convex; thorax more or less elongate or depressed; rounded, quadrate, or trapezoidal. The tooth in the notch of the mentum
simple. Thorax
bifid. Last joint of the labial palpi
not securiform. Middle legs
not at all or slightly arched 26. *Feronia*.
much arched 27. *Camptoscelis*.
strongly securiform 28. *Myas*.
convex or heart-shaped. Mandibles
wide, and projecting little 29. *Cephalotes*.
narrow, and projecting much 30. *Stomis*.
flat and nearly square 31. *Abaris*.
pretty strongly securiform 32. *Rathymus*.

- bifid 33. *Pelor*.
simple 34. *Zabrus*.
slightly ovate 35. *Amara*.
furnished with appendages beneath 36. *Lophidius*.
more or less square or heart-shaped, not at all or very slightly transverse 37. *Antaretia*.
transverse, rounded on the sides, slightly produced in the middle behind 38. *Masoreus*.

- wanting. Thorax
transverse, rounded on the sides, slightly produced in the middle behind 38. *Masoreus*.

Coleoptera
Pentamera.

SECTION 5TH, PATELLIMANI, Lat.

This section is chiefly distinguished from the preceding by the mode in which the two anterior tarsi are dilated in the males; the first joints (usually the first three, then the fourth, in others only the first two) sometimes square, sometimes partly of that form, and the others heart-shaped or reversed triangular, but always rounded at their extremity, and not terminated, as in the preceding sections, by acute angles,—form an orbicular pallet or lengthened square, of which the under surface is usually furnished with brushes or close set papillæ, without any intermediate vacancy. The legs are generally long and slender. The thorax is frequently narrower throughout its whole extent than the abdomen. The species frequent, for the most part, moist places on the banks of rivers.

In the *Règne Animal* this section is composed of the *Patellimani* of Dejean, of a portion of his *Feroniens* (Gen. *Dolichus*, *Platynus*, *Agonum*, *Anchomenus*, *Patrobus*), and of the genus *Pelicism* of Kirby, referred to the *Harpaliens* in the *Species Général*. It is subdivided by Latreille into two principal groups.

a. Head insensibly contracted behind.

GENUS AGONUM, Bon. First three articles of the anterior tarsi dilated in the males, longer than broad, and slightly triangular or cordiform. Terminal article of the palpi lengthened, cylindrical, more or less oval, and truncated at the extremity. Antennæ filiform, rather elongated. Labrum slightly convex, of a square form, broader than long, almost transversal. Mandibles not much advanced, slightly arcuated, rather sharp. A simple tooth in the middle of the emargination of the mentum. Thorax more or less rounded, without obvious posterior angles. Elytra oval, more or less elongated.

Of this genus *A. sexpunctatum* is a beautiful species, of which the head and thorax are golden green, the elytra copper-red, finely striated, and impressed with six large punctures. There is only one recorded instance of its being taken in Scotland,—on the banks of the water of Leith, a little to the west of Edinburgh.¹ Several other species are, however, common in Scotland. There

are about thirty kinds in Britain; and Dejean's collection contains fifty-six. Coleoptera
Pentamera.

The genus ANCHOMENUS is nearly allied to the preceding, but the labrum is plane, the thorax more or less cordiform, with obvious posterior angles. The body is not so flat. We are acquainted with above forty kinds, of which not more than five inhabit Britain. We consider *Platynus angusticollis* as belonging to this genus.

In the genus CHLÆNIUS of Bonelli, the tooth of the emargination of the mentum is bifid, the external maxillary palpi are terminated by an almost cylindrical article, slightly restricted at the base, that of the labial being in the form of a reversed and lengthened cone. There are 115 species of this extensive genus, of which about eight are as yet recognised as British. They are ornamental insects, being frequently adorned with green, and burnished with a metallic lustre. They are spread over almost all the earth,—Europe, Asia, Africa, and America. They seem, however, rare in the southern division of the new world, and, as far as we know, have not yet been found in New Holland.² *Carabus saponarius* of Olivier,³ which is used in Africa instead of soap, belongs to the genus *Chlænus*. It was brought from Senegal by M. Geoffroy, fils.

In the genus LICINUS the first two articles of the anterior tarsi are dilated in the males. The terminal article of the palpi is broad and securiform, and there is no tooth in the middle of the emargination of the mentum. The species are confined to Europe and the north of Africa. In the genus BADISTER the first three articles of anterior tarsi are dilated in the males, and the terminal article of the palpi is oval. The species are confined to Europe.

b. Head suddenly contracted behind the eyes.

This division of the *Patellimani* contains the genera PELICIUM of Kirby and CYNTHIA of Lat., both from South America, and three other genera, viz. PANAGÆUS (see Plate CCXXI. fig. 15), of which the head is very small compared to the size of the body,—LORICERA (Ibid. fig. 14), of which the first joint of the antennæ is robust, almost as long as the three following united, the second and fourth short, with strong hairs, the third longer than the second, likewise furnished with hairs,—and PATROBUS.

¹ Ent. Ed. p. 99.² For the sectional division of this genus, see Dejean's *Species Général*, t. ii. p. 297.³ Coléoptères, t. iii. p. 35, Pl. 3. fig. 26.

Synoptical Table of the preceding Section, according to the System of Dejean.

PATELLIMANI.

Notch of the mentum with a tooth in the middle. Anterior tarsi dilated in the males	at most in the two first joints. Last joint of the maxillary palpi	strongly securi- form. The tooth in the notch of the mentum	simple	1. <i>Eurysoma</i> .	
			bifid	2. <i>Panagæus</i> .	
		not securiform	3. <i>Geobius</i> .		
	in the three first joints. The tooth in the notch of the mentum	simple. Antennæ	simple. Last joint of the palpi	beset with hairs	4. <i>Loricera</i> .
				not securiform, { rather elongate, ovate, and terminating nearly in a point	5. <i>Callistus</i> .
		{ elongate, and truncated at the tip	10. <i>Oodes</i> .		
		strongly securiform	6. <i>Vertagus</i> .		
		bifid. Last joint of the palpi	elongate, and	truncated at the apex	7. <i>Chlænus</i> .
			{ strongly securiform	8. <i>Epomis</i> .	
	short and slightly securiform		9. <i>Dinodes</i> .		
Notch of the mentum without tooth in the middle. Mandibles	pointed. Last joint of the palpi	not securiform	11. <i>Rhembus</i> .		
		rather strongly securiform	12. <i>Dicælus</i> .		
	obtuse. Anterior tarsi dilated in the males,	in the two first joints	13. <i>Licinus</i> .		
		in the three first joints	14. <i>Badister</i> .		

Coleoptera
Pentamera.

* *

Anterior tibiae without an emargination on the internal side, or presenting one that begins close to their extremity, or that does not extend on their anterior face, and forms merely an oblique and linear canal.

SECTION 6TH, GRANDIPALPI, Lat. SIMPLICIPEDES, Dej.

In this section of the *Carabici* the ligula is often extremely short, terminated in a point in the centre of its summit, and accompanied by pointed paraglossæ. The mandibles are robust. The terminal joint of the exterior palpi is usually larger, compressed into the form of a reversed triangle, or hatchet-shaped in some,—almost spoon-shaped in others.¹ The eyes are prominent. The elytra are entire, or simply sinuated at their posterior extremity. The abdomen is usually bulky when compared to the other parts of the body. These Carabici are for the most part of great size, often richly coloured, or ornamented with metallic splendour. They are active in their movements, and voracious in their dispositions. They are divisible into three groups.

1st, Body always thick, without wings; labrum always bilobed; terminal article of the external palpi always very large; emargination of the mentum toothless; internal side of the mandibles entirely dentated (or nearly so) throughout their length.

GENUS PAMBORUS, Lat. Tarsi similar in both sexes. Terminal article of the palpi securiform. Antennæ filiform. Labrum bilobed. Mandibles but slightly projecting, greatly curved, strongly toothed interiorly. Mentum almost plane, slightly notched anteriorly. Thorax almost cordiform. Elytra elongate oval.

This genus is formed upon a large insect from New Holland, the *P. alternans*, which we have represented in Plate CCXXII. fig. 1. It is the only one yet known. In a collection received some time ago from New Holland (transmitted to the Edinburgh Museum by Colonel Lindsay), and submitted to our examination by Professor Jameson, there is either a distinct species, or a strongly marked variety,—the third and fourth striæ of the elytra being much more regular than usual. Comte Dejean, with whom we communicated on the subject, regards it as a species.

GENUS CYCHRUS, Fab. Tarsi similar in the two sexes. Terminal article of the palpi very strongly securiform, almost spoon-shaped, and more dilated, in the males. Antennæ setaceous. Labrum bifid. Mandibles narrow, and toothed interiorly. Mentum strongly notched. Thorax cordiform, little, if at all, raised at the edges, and not prolonged posteriorly. Elytra fixed, carinated laterally, and embracing the sides of the abdomen.

C. rostratus is common all over Britain, and is sometimes taken at a great height upon the mountains. *C. elongatus* and *attenuatus* are said to occur in England. We have represented that discovered by Professor Bonelli among the mountains of the north of Italy, Plate CCXXI. fig. 22. Eleven species are known in all. They are found in Europe, Asiatic Russia, and North America.

The genus SPHÆRODERUS of Dejean is formed by dismemberment of the preceding. It is a sub-genus peculiar to America. We have represented *S. nitidicollis*, Plate CCXXI. fig. 19.

2d, Body thick, and mostly apterous, as in the preceding genera, but the emargination of the mentum provided with an entire or bifid tooth, and the mandibles

armed at most with one or two teeth situated at their base.

GENUS PROCERUS, Megerle. Tarsi similar in both sexes. Terminal article of the palpi very strongly securiform, and more dilated in the males. Antennæ filiform. Labrum bilobed. Mandibles slightly curved, very sharp, smooth, with only a single tooth at their base. A very strong tooth in the middle of the emargination of the mentum. Thorax almost cordiform. Elytra elongate oval.

The Proceri are large and remarkable insects, the giants of the European Carabici. In regard to their colours, they are either entirely black, or black beneath, with a tinge of blue or green above. The elytra are extremely rough. They appear to inhabit exclusively the mountains and forests of Carniola, Illyria, Turkey in Europe, parts of Hungary, the south of Russia, the Caucasus, and Asia Minor. *P. Duponchelii*, Dej. was lately taken in the environs of Athens. M. Fischer is of opinion (*Entomographie de la Russie*), that *P. tauricus* (Plate CCXXI. fig. 21) and *Caucasicus* are, the former the male, the latter the female, of the same species; but Dejean now possesses both sexes of each, and regards them as distinct. The synonymes of the species, however, are still confused and contradictory.

GENUS CARABUS, Lin. Fischer, Dej. The first four articles of the anterior tarsi dilated in the males, the first three very strongly, the fourth often more slightly. Terminal article of the palpi more or less securiform, and more dilated in the males. Antennæ filiform; the third article cylindrical, and scarcely longer than the others. Labrum bilobed. Mandibles slightly curved, more or less sharp, smooth, with only a single tooth at their base. A very strong tooth in the middle of the emargination of the mentum. Thorax more or less cordiform. Elytra more or less elongate oval. Wings not fitted for flight.

The great genus *Carabus* of Linnæus originally contained the whole of those extensive natural groups which now constitute the family of Carabici, with which we are still engaged. Even as now restricted, it is one of the most numerous with which the entomologist is concerned, and is rendered highly interesting from the size and beauty of many species. The genera with which the *Carabi*, as above defined, bear the most direct relations, are *Procerus*, *Procrustes*, *Calosoma*; but, as Dejean observes, they differ from the first by the anterior tarsi, dilated in the males,—from the second by the form of the labrum and mentum,—and from the third by several characters easily perceived on comparison.

The greater proportion of the true Carabi, which form a very interesting and well-observed genus, occur in the comparatively temperate countries of Europe, the Caucasus, Siberia, Asia Minor, Syria, and the north of Africa, as far south as the 30th degree. A few are also found towards the two extremities of America, and it is not improbable that others may be ascertained to inhabit the intermediate countries.² A very fine species (*C. cribellatus*, Adams) is native to the polar regions of Siberia;³ and Sir Joseph Banks captured another as far south as Terra del Fuego;⁴ of the latter circumstance, Dejean, who has done so much to illustrate the family, does not appear to be aware. “Depuis long temps je supposais néanmoins qu'on devait les retrouver à l'extrémité de l'Amérique Méridionale; M. Eschscholtz, qui fait pour la seconde fois le tour du monde avec le Capitaine Kotzebue, vient de confirmer cette supposition, et dans une lettre écrite à M. le Comte de Mannerheim il lui annonce

¹ It is often more dilated in the males than in the other sex, particularly in *Procerus*.

² Règne Animal, t. iv. p. 412.

³ Entomographie de la Russie, tab. 8, fig. 13.

⁴ Introduc. to Ent. vol. iv. p. 493.

Coleoptera qu'il a trouvé au Chili un véritable Carabe."¹ None of the genus, however, has as yet been found either in Southern Africa or New Holland. Count Dejean possesses 163 species, which he has arranged in sixteen divisions. In the first thirteen are comprised all those of which the elytra are arched or convex, in the three last those in which they are plane. The nature of the surface of the elytra furnishes the other secondary characters, in pretty close accordance with the methods of Bonelli and Clairville.² Among the continental species, the *C. rutilans* (Plate CCXXI. fig. 20), *hispanus*, &c. exhibit perhaps the most ornamental examples within the range of the European Coleoptera; and our own *Carabus nitens*, an inhabitant of the heathy wastes, yields to few, even of the exotic species, in its lustrous and metallic splendour.

The name of Carabus (Καραβος), applied generically by Linnæus to so vast a group, occurs in Aristotle's history of animals, and denotes sometimes a winged coleopterous insect, at other times a species of crustaceous animal. Latreille supposes it to be a contracted form of *Scarabæus*. In addition to the characters already given, we may mention that the species of the genus, as now restricted, are all of considerable dimensions. Their colours are usually black with a tinge of purple, or greenish with a golden hue. The form of the body is elongated; the head, always narrower than the thorax, is generally of greater extent forwards than transversely, and is borne almost in a horizontal position. The eyes are globular, and behind them the head assumes a narrow neck-like form. The mandibles, which are strong and pointed, are usually destitute of dentation, and may be observed to cross each other when the insect is in a state of repose. The thorax is narrower than the abdomen, is bordered with a slightly recurved margin, and is almost always emarginate in its basal line; its superior portion (strictly speaking the *prothorax*) is more extended than the inferior parts, and covers posteriorly the scutellum of the mesothorax, which, naturally but slightly developed, presents to view its summit only. The elytra are also margined after the manner of the thorax, and their upper surface, rarely smooth, is variously characterized, according to the species, by striæ, furrows, depressed points, or rows of bead-like elevations. The true or membranaceous wings are either wanting or exist in a very rudimentary condition. The species therefore are incapable of flight; but, to make amends for this deficiency, their legs are strong and lengthened, the trochanter is greatly developed, and the tarsi of the anterior pair (in the males) are dilated, with their first four articulations spongy on their inferior face.

All the species are eminently voracious and carnivorous. They not only prey upon the soft bodied and defenceless caterpillars, and on all other insects weaker than themselves, but they even seize upon and devour their own species. They usually avoid strong light, are partial to a certain degree of moisture, and conceal themselves during the heat of the day beneath stones, among mossy herbage, in garden rubbish, or under the stems or within the hollows of fallen trees. We have noted the usual habits of each of the species in the descriptions which follow; and, in regard to their general distribution, we may observe, that their principal seat appears to be the north temperate zone, that they are extremely rare in the warmer regions of the earth, and probably disappear altogether within the tropics. Their larvæ and metamorphoses are but slightly known. Many of the perfect in-

sects exhale a penetrating and fetid odour, and when touched exude a dark-coloured caustic humour.

Mr Stephens enumerates nineteen species of British Carabi. The claims, however, of three or four of these (such as *C. purpurascens*, *convexus*, *auronitens*) to be regarded as truly indigenous, are extremely doubtful. The occurrence of an insect on our island shores is sometimes accidental, and results from the fortuitous impulsion of winds or waves. It is well that the visits of these erratic strangers should be recorded, as they afford an interesting illustration of the extreme extent in one direction of their geographical range; but they cannot on that account be considered as "children of the soil." We shall here give a few brief notices of the Scottish species.

C. catenulatus, Fab. Oblong-ovate, black, the margins of the thorax and of the elytra violaceous; elytra with interrupted crenated striæ, and three rows of impressed dots, the spaces between the dots slightly elevated. Common throughout Scotland, both on mountains and in plains.

C. monilis, Fab. Oblong-ovate, thorax coppery, elytra brassy-green or violaceous, with three series of oblong tubercles, and three equal elevated lines between them. The colour of this species is very variable. It is rare in Scotland, and we have not yet observed it during our excursions to the northern counties.

C. arvensis, Fab. Ovate, greenish coppery, or brassy above, elytra with three series of oblong tubercles, and three crenulated lines between them, the central line rather elevated. Not as yet known to be generally spread over Scotland, but collected at several distant points. Pentland Hills, Island of Arran, vicinity of Jedburgh.

C. cancellatus, Fab. *C. morbillosus*, Leach. Oblong, metallic green or brassy, elytra with three rows of oblong tubercles, and a single smooth elevated line between them. Not unfrequent in decayed wood and under stones. Neighbourhood of Edinburgh; parish of Durness, Sutherland.

C. hortensis, Fab. Ovate, thorax black, margined with purple, elytra brassy brown, with three rows of excavated dots. Common near Edinburgh, occurring in gardens, pathways, &c., during spring and summer, and pretty widely spread over Scotland, but much rarer in the northern counties than *C. catenulatus*, and not partaking with that species in the height of its occasional localities. Only one specimen found in Sutherland among many scores of other species of the genus.

C. violaceus, Linn. Elongate, black, the margins of the thorax and of the elytra violaceous; elytra dull black, granulated. An elegantly shaped species, not unfrequent in Scotland, in woods and fields, and among garden rubbish. It also occurs among the mountains, and has been taken at Cape Wrath.

C. glabratus, Fab. Oblong, entirely black, the elytra very finely granulated, so as to appear smooth and shining. Inhabits the Pentland Hills, but is very scarce in our southern districts. Not unfrequent among the Grampians and other mountain ranges in the north, where it occurs on the summits of the highest hills. Taken at Cape Wrath, and in other parts of Sutherland.

C. nitens, Linn. Ovate, head and thorax golden coppery, elytra brilliant green, margined with coppery-red, and having three blackish ribs on each. Under side of the body, and legs, shining black. This, though one of the smallest, is the most richly adorned of the British Carabi, and is one of the most beautiful of coleopterous insects. It is pretty generally spread over the upland and moorish districts of Scotland. We did not find it in

¹ *Species Général*, t. ii. p. 33.

² *Règne Animal*, t. iv. p. 412.

Coleoptera Sutherland, but we have specimens from the shires of
Pentamera. Mid-Lothian, Lanark, Dumbarton, Argyll, Perth, and For-
far. It is always regarded as a valuable acquisition, on
account of its extreme beauty.

C. clathratus. Oblong-ovate, of a dark brassy hue, thorax rather square, the posterior angles not much produced, the elytra with three elevated lines, and a triple series of deep golden excavations. This is one of the largest and finest of the British Coleoptera. It has hitherto been regarded as a very rare insect, but a closer examination of the wilder districts will probably bring it into more frequent view. We were the first to take it in Scotland,—which we did many years ago, and in considerable numbers (nine or ten specimens in a few days), in the island of Colonsay, the hospitable habitation of John Macneill, Esq. It has been since taken by Mr Macleay in Caithness. Capt. Graham, R. N. and others, also captured several specimens in different parts of Sutherland (near Invershin, on the point of Tongue, and the vicinity of Lairig), in the month of August 1833; and Mr George Little has collected it for some seasons at Ormsary, on the mainland of Argyllshire. On the continent this beautiful insect is found in Siberia, Sweden, Hungary, Italy, and the south of France, especially in the environs of Montpellier. It varies singularly in regard to the development of the true or membranaceous wings. Those which occur in the south of Europe are large, and furnished with wings; those of Sweden and Siberia are apterous, and of smaller size.

GENUS CALOSOMA,¹ Weber, Fab. First four articles of the anterior tarsi dilated in the males; the first three very strongly, the fourth often more slightly. Terminal article of the palpi very slightly securiform. Antennæ filiform; the third article slightly compressed, sharp on the outer edge, and sensibly longer than the others. Labrum bilobed. Mandibles broad, very slightly curved, more or less sharp, transversely striated, without obvious teeth on their interior. A strong tooth on the middle of the emargination of the mentum. Thorax short, almost transversal, more or less rounded. Elytra usually of a square form, more or less elongated, rarely oval or rounded. Wings most frequently fit for flight.

This genus is very widely distributed. There are about thirty species in all, spread in different proportions over Europe, Asia, Africa, and America. *C. sycophanta* (Plate CCXXII. fig. 2) and *inquisitor* have occurred in Britain. The genus is as yet unknown in Scotland.

3d, The third and last division of the *Grandipalpi* of Latreille presents an assemblage of characters which clearly distinguish its component parts from those of the two preceding. Most of the species are winged. The anterior tarsi of the males are always dilated. The labrum is entire. The exterior palpi are merely somewhat dilated or thicker at the extremity, the last joint being in the form of a reversed and elongated cone. The internal side of the mandibles presents no tooth deserving of notice; the one in the

middle of the emargination of the mentum is bifid. Coleoptera
The centre of the superior margin of the ligula is Pentamera.
elevated to a point. On the internal side of the anterior tibiae of several there is a short emargination, or one of the two spurs is inserted higher than the other, so that in this respect these *Carabici* are somewhat ambiguous, and might be placed, as well as those of the ensuing section, immediately after the *Patellimani*. They usually inhabit moist situations. A few, such as *Omophron*, seem to connect their tribe with that which follows,—the aquatic Carnivora.

In some in which the body is flattened, or convex and suborbicular, the eyes are of ordinary size; the antennæ linear, and generally consisting of elongated and almost cylindrical joints; the external sides of the maxillæ are bearded, and the two internal spines of the two anterior tibiae are on a level at their origin; these tibiae have merely a simple longitudinal canal. In *LEISTUS*, Fræhlich (*Pogonophorus*, Lat.), the exterior palpi are much elongated, the mandibles are dilated at their base, the head is suddenly narrowed behind the eyes, and the antennæ are long and slender. All the species belong to Europe, and the greater proportion are found to occur in Britain. *NEBRIA*, Lat. resembles *Leistus*, but the palpi are much shorter, the mandibles not dilated, the head not restricted, and the antennæ proportionally thicker, and composed of shorter articulations. Several of the species, such as *N. Gyllenhalii*, *brevicollis*, &c., are classed by English entomologists in the genus *Helobia* of Leach. In *OMOPHRON* of Lat. (see Plate CCXXI. fig. 18), the first joint only of the two anterior tarsi is dilated in the males.

In other genera the body is tolerably thick, and the eyes large and prominent; the antennæ are slightly enlarged near the extremity, and composed of short joints, mostly in the form of a top or reversed cone; one of the two spines of the internal extremity of the two anterior tibiae is inserted higher than the other, with a notch between them. The four or first three joints of the anterior tarsi of the males are in general but slightly dilated. The palpi are more elongated. They occur chiefly by the sides of rivers in Europe and in Siberia. We may here place the genus *ELAPHRUS*,² in which the thorax is convex, rounded, narrowed posteriorly, and nearly of the same length as the head. The elytra are convex and almost parallel. This genus was separated with great propriety by Fabricius from *Cicindela* of Linn. It is constituted by a few small species, generally distinguished by metallic lustre, and of which one of the most beautiful, *E. lapponicus*, was lately presented to us by Professor Lyell, the learned author of the *Principles of Geology*. It has been hitherto only known as a native of Lapland, and was discovered by Mr Lyell on the north-west side of Catlaw, a mountain in Forfarshire, on a spot nearly 2000 feet above the level of the sea. Several of the smaller species which formerly belonged to *Elaphrus* now form the genus *Notiophilus* of Dumeril. Such are *N. aquaticus*, *biguttatus*, &c.

¹ Καλός, beautiful, and σῶμα, body.

² Fabricius derives the name from Ελας, a marsh. We think it may be more plausibly traced to Ελαφρος, light, active.

Synoptical Table of the preceding Section, according to the System of Dejean.

SIMPLICIPEDES.

Elytra carinated on the sides, and embracing a part of the abdomen. Lateral edges of the thorax

- scarcely or not at all elevated, and not produced. Anterior tarsi
- alike in both sexes..... 1. *Cychrus*.
 - dilated in the males..... 2. *Sphæroderus*.
 - much elevated, and produced behind..... 3. *Scaphinotus*.

Elytra not carinated on the sides, and not embracing the abdomen.

Upper lip

- The tooth in the notch of the mentum
- with two or three lobes.
 - simple. Anterior tarsi
 - dilated in the males.
 - Upper lip
 - trilobed..... 7. *Procrustes*.
 - bilobed.
 - Third joint of the antennæ
 - cylindric, and scarcely longer than the others..... 8. *Carabus*.
 - compressed, sharp exteriorly, and sensibly longer than the others..... 9. *Calosoma*.
 - not dilated in the males..... 5. *Procerus*.
 - wanting..... 4. *Pamborus*.
 - entire.
 - The tooth in the notch of the mentum
 - bifid.
 - Last joint of the palpi
 - scarcely or not at all securiform. Antennæ
 - nodose and elongate. Anterior tarsi dilated in the males,
 - in the three first joints,
 - nearly in a square form, more or less elongate..... 10. *Leistus*.
 - triangular or heart-shaped 12. *Nebria*.
 - in the first joint only..... 13. *Omophron*.
 - short and rather thick. Last joint of the palpi
 - elongate and obconic. Anterior tarsi dilated in the males,
 - in the four first joints. Thorax
 - quadrate, and wider than the head 15. *Blethisa*.
 - rounded, and of the same width as the head..... 16. *Elaphrus*.
 - short, and somewhat inflated..... 17. *Notiophilus*.
 - rather strongly securiform..... 18. *Metrius*.
 - simple..... 5. *Tefflus*.
 - wanting..... 11. *Pteroloma*.

Coleoptera
Pentamera.

B.

SECTION 7TH, SUBULIPALPI, Lat. Dejean.

These form of themselves the second general division of the Carabici, and are distinguished from the preceding sections by the form of the exterior palpi, of which the penultimate obconical joint is united to the following, forming with it a common oval or fusiform body, terminated either gradually or suddenly in a point, or in the manner of an awl. The two anterior tibiae have always an emargination on the inner side. The first two articles of the anterior tarsi are alone dilated in the males. This division contains only three genera, as follows :

Last article of the palpi	{ at least as large as the preceding. Penultimate article of the maxillary palpi	as large as the last....1. <i>Trechus</i> .
		smaller than the last..2. <i>Lachnophorus</i> .
		much shorter than the preceding..3. <i>Bembidium</i> .

Of the two great tribes, viz. CICINDELETÆ and CARABICI, with the principal genera of which we have just been engaged, there are 2494 species enumerated in the last edition of the Catalogue of Comte Dejean. We come now to

TRIBE 3D, HYDROCANTHARI, Lat.

This tribe is composed of the undivided genera *Dytiscus* and *Gyrinus* of the old writers. Their feet are adapted for swimming; the last four being compressed, ciliated or laminiform, and the last two at a distance from each other. The mandibles are almost entirely covered. The body is always oval, the eyes but slightly prominent, and the thorax much wider than long. The terminal hook of the maxillæ is curved from its base; those at the extremity of the tarsi are often unequal.

All these aquatic Coleoptera pass both their first and final stage of existence in the fresh and placid waters of lakes and marshes, or the undisturbed parts of tranquil rivers, and are distributed over all the countries of the earth, wherever such localities occur, from Greenland to Van Diemen's Land.

The old genus *Dytiscus* (Plate CCXXII. fig. 3 and 4) embraced a vast assemblage of aquatic insects which the more minute observance of modern times has partitioned into many genera. They form a truly amphibious family; for although water is their favourite element, they survive for a long time on moist land, and most of them fly about in the evening and morning twilight, and even during the darkness of the dewy night, with great power and celerity. They vary considerably in size, according to the species, some being extremely small, while others measure between one and two inches in length. They are fierce and voracious in their habits, preying indiscriminately upon whatever smaller and softer tribes they are able to subdue. They are frequently observed resting on the surface of the water, with their legs expanded, their heads downwards, and the terminal segment of their bodies in contact with the air. It is thus that they carry on the process of breathing, for they cannot respire except by bringing a globule of atmospheric air in contact with the

stigmata, which are placed on the sides of the abdomen, just beneath the outer margins of the elytra. Being specifically lighter than water, when they feel the necessity of respiration they have nothing to do but to allow themselves to float to the surface, where, by a peculiar action of the tips of the elytra and the terminal segment of the body, a portion of air is brought into contact with the stigmatic openings. The bodies of the larvæ of these insects (Plate CCXXII. fig. 6) consist of eleven well-defined segments. The head is large, flattish, covered above by a scale or shield marked down the centre by a longitudinal furrow. On each side there are five or six black tubercles which are regarded as eyes, and anterior to the eyes are placed the antennæ, consisting of three articulations. The mouth is armed with a pair of strong, horny, curved, sharp-pointed mandibles, which serve to seize and transfix the prey. According to Swammerdam and Degeer, these organs are pierced so as to act as suckers, by means of which the animal juices are absorbed. Near the extremity of the abdomen two delicate appendices may be perceived, pointing obliquely downwards. By means of these the larva appears to suspend itself occasionally from the surface of the water when it wishes to respire. The principal stigmatic openings are at the end of the abdomen, and consist of two small cylindrical bodies, which, when the creature floats, come in contact with the air, and communicate with the tracheal vessels, which are seen to traverse beneath the skin on either side of the body. The movements of these insects in the larva state are effected in the water, partly by the legs and partly by an undulatory motion of the tail. They prey upon other larvæ, such as those of dragon-flies, ephemeræ, gnats, &c. As an instance of their great voracity, it may be mentioned that we once observed one of the larger kinds transfix and suck out the juices of thirteen well-grown tadpoles in a single day. When the period of their transformation has arrived, they leave the water and bury themselves in the moist soft earth of a neighbouring bank. There they work for themselves an egg-shaped chamber, in which they assume the nymph state. (Plate CCXXII. fig. 9.) How long they remain in that condition is not very precisely known, from the difficulty of rearing them in confinement throughout their entire changes, but it is believed that the insect is not long of making its appearance in the perfect state. It may then be kept alive in a tumbler for several seasons, and the larger kinds (*Dytisci* proper) soon assume a certain degree of tameness and familiarity, will follow the finger around the walls of their transparent prison, and, coming to the surface at an accustomed signal, will demand, according to their own mode of expression, a young earthworm, or a piece of fresh beef or mutton; for on these and several other articles they feed from the first with extreme, and as it were accustomed greediness.¹ They may thus be said to be aquatic in the larva state, terrestrial in that of nymph, and amphibious in their winged condition.

GENUS DYTISCUS,² Linn. Antennæ setaceous, longer than the head. External palpi filiform, or a little enlarged towards their extremity. Anterior tarsi patelliform in the males, the middle pair with their basal joints dilated; the hind pair long, thick, and tapering to the apex, where there are two very small claws. Plate CCXXII. fig. 3 and 4.³

The Dytisci are large aquatic beetles, the characteristic habits of which have been sketched in our preceding

¹ Esper kept a living specimen of *Dytiscus marginalis* in a glass vessel for three years and a half. It fed on beef.

² From *dytiscus*, a diver.

³ Figure 5 of the plate above referred to represents the head of *D. serricornis*, a species remarkable for the anomalous form of the antennæ. (See *Nov. Act. Acad. Scient. Stockh.* xx. 1, 3.)

oleoptera general observations. We are acquainted with about
pentamera fourteen species, six or seven of which inhabit Britain.

D. punctulatus seems to be the most common in Scotland. It thrives well in confinement, and will live for a year or two in any small vessel, feeding on earthworms and shreds of beef or mutton.¹ *D. marginalis*, when recently captured, has a smell resembling liquorice. It is said to kill *Hydrous piceus*, which is a much larger and apparently stronger insect, by piercing it between the head and thorax, the only part of the body which is unprotected. Esper asserts that it is much affected by atmospheric changes, and that it indicates these, when in a state of confinement, by the height at which it remains in its jar.

In the genus *COLYMBETES*² of Clairville (fore leg, Plate CCXXII. fig. 7), the four anterior tarsi have their three first joints equally dilated in the males, and forming collectively a small pallet in the form of a lengthened square. The antennæ are at least as long as the head and thorax. The eyes are slightly or not at all projecting. Many of these insects are common in ditches and small brooks, and their habits resemble those of the preceding genus. There are about seventy species in all, of which one half inhabit Britain.

The genus *ACILIUS* was first proposed by Dr Leach in the *Zoological Miscellany*. It is distinguished by the great flatness of the species; by the hairy elytra of the females, which have but few striæ; and by the basal joint of the tarsi in the second pair of legs not being dilated.

In the genus *HYGROBIA*³ of Lat. the antennæ are shorter than the head and thorax, the body is ovoid, and very thick in the middle, and the eyes are prominent. (Plate CCXXII. fig. 11.)

In *HYDROPORUS*⁴ of Clairville, the four anterior tarsi are nearly similar, and spongy underneath, in both sexes, and are composed apparently of only four joints, the fifth being deficient, or very small, and concealed along with a portion of the fourth in a cleft of the third articulation. The scutellum is not apparent.⁵ In *NOTERUS*⁶ of the same author, the antennæ are slightly dilated in the middle, and the last joint of the labial palpi is emarginate, and appears forked. In *HALIPLUS*,⁷ Lat. there are only ten distinct joints in the antennæ; the external palpi are fusiform, or have a more slender termination, tapering to a point; the body is convex and ovoid beneath; all the tarsi are filiform, composed of five cylindrical joints, and have nearly the same form in both sexes.

All the preceding genera of *Hydrocanthari* belonged to the old genus *Dytiscus*. The remainder of the tribe are comprised in the

GENUS *GYRINUS*,⁸ Linn. Antennæ shorter than the head, the basal joint very large, and produced externally into a triangular ciliated lobe, the rest forming a clavate mass, attached by a short peduncle to the upper side of the first joint. Anterior legs rather long, and projecting like arms; the others compressed, ciliated, and formed for swimming. (Plate CCXXII. figs. 8 and 12.)

In this genus the body is oval and generally very glossy. The head is sunk in the thorax almost to the eyes, and these are large, and divided by a horny process or border, in such a way that there seems to be two above and two below. Only seven joints of the terminal portion of the antennæ are distinctly visible. The singular auriform shape of these organs induced Latreille to form

the Gyrini into a family along with *Parnus*, under the name of *Otiophori*. But at an after period that great entomologist approximated the genus to the *Dytiscidæ*, thereby correcting the error he had previously committed of confounding, as Mr Macleay observes, a relation of analogy with one of affinity. The Gyrinidæ live in society, and several species are extremely common on our ponds, and ditches by the way side. They swim flat upon the surface, with their shining backs above water, chasing each other in circles, or darting about in more irregular gyrations. When hemmed into a corner of the pond, they make their escape by darting beneath the surface, carrying along with them a portion of air, which shines like quicksilver. Britain produces several species of this genus. They are known in England by the name of whirlgigs. These insects fly well, and transport themselves with ease and rapidity from place to place. The females deposit their eggs on the leaves of aquatic plants. The eggs are very small, lengthened in the form of little cylinders, and of a white colour tinged with yellow. According to the observations of Degeer, they produced minute six-footed larvæ in the course of eight days, which swam in the water, or crept along the sides of the vessel in which they had been deposited. Neither he nor Roesel, however, could succeed in rearing them to a state of completion. These larvæ (Plate CCXXII. fig. 17) exhibit rather a singular aspect, and at first sight resemble small Scolopendræ. They are of a dingy white or greyish colour, and their clear transparent skin permits the view of their internal structure. Their bodies are long, slender, cylindrical, and divided into thirteen rings, which are deeply incised. The head is oval, very much elongated, and flattened both above and below. It is armed in front with a pair of comparatively large curved jaws, tipped with brown, which, when closed, meet with their points in advance of the head, but are capable of wide extension. The structure of these parts demonstrates a carnivorous disposition. The antennæ are very delicate, divided into four articulations, and equal the head in length. The first segment of the body is nearly twice as long as the others, and the three pairs of feet are attached to the first three segments. The eight following rings are garnished with very singular, long, slender, transparent filaments, which float in the water without being apparently under the guidance of the animal. From their resemblance to the gills of the Phryganæ and Ephemeræ, it is probable that these are the respiratory organs. The twelfth or penultimate segment of the body is furnished with four of these filaments, of much greater length than the preceding, and covered with long hairs or secondary filaments. The last segment, which is much less than the others, is terminated by four long and remarkable hooks, placed parallel to each other, with their points bent beneath inwards. The whole body seems filled with little globules of air, which are in frequent motion, sometimes towards the head and sometimes towards the other extremity. Modeer has described the transformations of these creatures in the Memoirs of the Royal Academy of Sweden. About the beginning of August, according to that author, the larvæ leave the water, and, crawling up the stems of reeds or other aquatic plants, they are transformed into nymphs, beneath the envelope of a small cocoon, pointed at both ends, and formed of a substance resembling grey paper. Towards the end of the same month the perfect insect is

¹ *Entomologia Edinensis*, p. 127.

² From *κολυμβάω*, to swim.

³ For the other genera, see the works of Messrs Stephens and Curtis. The Scotch species are described by Messrs Wilson and Duncan in the *Entomologia Edinensis*.

⁴ From *υγρεος*, humid.

⁵ From *ἄλς*, the sea, and *πλοος*, sailing.

⁶ From *ὕγρεος*, moist, and *βίος*, life.

⁷ From *ὕδωρ*, water, and *παρος*, a passage.

⁸ From *γυρᾶω*, to go in a circle.

Coleoptera excluded, and immediately jumps into the water. Modeer adds, that the cocoons are very frequently found pierced by the ovipositor of an ichneumon fly.

Great Britain produces nine species of the genus *Gyrinus* (including *G. villosus*, which belongs to *Potamobius*, Leach¹). There are twenty-six in all. They are rare in Africa and Asia, but are widely spread over Europe, North and South America, and New Holland. We have received a large species from Java. They are also found at the Cape and the Isle of France.

The most common and best-known species in this country is *G. natator*, of an oval form, bluish-black, extremely glossy, the inflected margin of the elytra, apical segments of the abdomen, and legs, ferruginous. This agile little creature appears to have been rather a favourite object of observation with the entomologist. "Water, quiet still water," says Mr Knapp, "affords a place of action to a very amusing little fellow (*Gyrinus natator*), which, about the month of April, if the weather be tolerably mild, we see gamboling upon the surface of the sheltered pool; and every schoolboy who has angled for minnows in the brook is well acquainted with the merry swimmer in his shining black jacket. Retiring in the autumn, and reposing all the winter in the mud at the bottom of the pond, it awakens in the spring, rises to the surface, and commences its sports. They associate in small parties of ten or a dozen near the bank, where some little projection forms a bay, or renders the water particularly tranquil; and here they will circle round each other, without contention, each in his sphere, and with no apparent object, from morning until night, with great sprightliness and animation; and so lightly do they move on the fluid, as to form only some faint and transient circles on its surface. Very fond of society, we seldom see them alone, or, if parted by accident, they soon rejoin their busy companions. One pool commonly affords space for the amusement of several parties, yet they do not unite or contend, but perform their cheerful circlings in separate family associations. If we interfere with their merriment they seem greatly alarmed, disperse or dive to the bottom, where their fears shortly subside, as we soon again see our little merry friends gamboling as before. This plain, tiny, gliding water-flea seems a very unlikely creature to arrest our young attention; but the boy with his angle has not often much to engage his notice; and the social active parties of this nimble swimmer, presenting themselves at these periods of vacancy, become insensibly familiar to his sight, and by many of us are not observed in after-life without recalling former hours—scenes of perhaps less anxious days; for trifles like these, by reason of some association, are often remembered when things of greater moment pass off and leave no trace upon the mind."² Wordsworth has likened a beetle to

A mailed angel on a battle day;

and Messrs Kirby and Spence describe the subjects of our present notice as being "covered with lucid armour, —when the sun shines they look like little dancing masses of silver and brilliant pearl."³ They however exhale a disagreeable and rancid odour.⁴

FAMILY II.—BRACHELYTRA, LAT.⁵

In this, the second family of Pentamerous Coleoptera, Latreille places those genera which have only a single

palpus to each maxilla, or four in all, including the labial pair. The antennæ, sometimes of equal thickness, and at others slightly enlarged at the extremity, are usually composed of lenticular or graniform articulations; the elytra are much shorter than the body (from which circumstance they derive their name), and the latter is narrow, elongated, generally depressed, with the coxæ of the two anterior legs very large. The posterior extremity of the body is provided with two vesicles, which are protruded at will.

These Colcoptera composed the great genus *Staphylinus* (of Linnæus) before its subdivision by more recent writers. Ancient authors appear to have bestowed the name of *Staphylinus* on certain species, which, from the characters assigned them, and their reputed injurious effects on horses, we can scarcely refer to any of the modern genera of brachelytrous insects. Mouffet, however, having satisfied himself that some ancient passage did apply with sufficient correctness, made use of the term *Staphylinus* in relation to the present group; and whatever may have been its original application, its meaning is now no longer ambiguous in the modern systems. The genus, as constituted by Linnæus, was first dismembered by Fabricius of two of its component groups, under the generic names of *Pæderus* and *Oxyporus*; and in still more recent times numerous other subdivisions have taken place, which have raised the original genus to the rank of an ordinal section or comprehensive family.

Some writers regard the Staphylini as forming the passage from the Coleoptera in general to the Forficulæ or ear-wigs, which compose the first genus of the *orthopterous* order. In their habits they somewhat resemble the Silphæ and Necrophori. They have usually a large, flattened head, strong mandibles, short antennæ, and a thorax as wide as the abdomen, which is long, narrow, and generally depressed. The elytra are very short and truncated, although they still suffice to cover the long membranous wings, which, when not in use, are compactly folded. The upper portion of the segments of the abdomen, being exposed in consequence of the shortness of the elytra, is, contrary to the usual rule among the coleopterous tribes, of as firm a consistence as that beneath. From the terminal segment of the abdomen two vesicles are protruded or retracted at the pleasure of the animal, and from these, when irritated, a subtile vapour makes its escape with a strong odour of sulphuric ether. "Though most of the micropterous species," Mr Kirby observes, "have a fetid smell, yet there are some exceptions to this amongst them. One species (*S. suaveolens*, K. MS.), related to *S. micans*, Grav. which I once took, smelt precisely like a fine high-scented ripe pear; another, *Oxytelus morsitans*, like the water-lily; a third, *O. rugosus*, like water-cresses; and lastly, a fourth (*S. fuscipes*) like saffron." M. Leon Dufour has described the apparatus by which these odours are produced.⁶ The insects of this family, when attacked or touched, elevate the extremity of their abdomen, bend it in various directions, and frequently protrude the vesicles above alluded to. They also use the point of the abdomen to close or unfold their wings. The tarsi of the two anterior legs are frequently broad and dilated, and their coxæ, as well as those of the intermediate pair, are very large. The species usually occur in damp places, under stones, in earth, and excrementitious matters. Some live in mushrooms and fungi, or in

¹ *Orectochilus* of Eschscholtz and Dejean.

² *Journal of a Naturalist*, p. 307.

³ *Introduc. to Ent.* vol. ii. p. 372.

⁴ For the Scottish species, see *Entomologia Edinensis*, p. 130.

⁵ From *βραχὺς*, short, and *ἐλὺτρον*, sheath. MICROPTERA, Gravenhorst. STAPHYLINUS, Linn.

⁶ *Ann. des Sciences Nat.* t. viii. p. 16.

Coleoptera rotten wood, while a few of the smaller species are found on flowers. They are all swift, active, and voracious.

The larvæ bear a close resemblance to the perfect insect. In figure they more nearly resemble an elongated cone, the base of which is formed by the head; the terminal segment is prolonged into a tube, and is accompanied by two conical and hairy appendages. Their food and habits of life are very similar to those of the imago.

According to M. Dufour, the only essential difference between the alimentary canal of the brachelytrous tribes and that of the carnivorous Coleoptera consists in the absence of the crop. The first stomach is small and destitute of folds; the second is very long and pilose; the intestine is extremely short. The biliary vessels are inserted at the same lateral point as in the Carnivora, and present in some species, near the middle, a knot or vesicle, not observable in any other insects. Their sexual apparatus differs greatly from that of the carnivorous Coleoptera.¹

Many of the species of this family are of minute dimensions, and a knowledge of their names and characters is of difficult attainment. Many more of the described species than have been hitherto collected no doubt exist in Britain, and many of the Scandinavian species will probably be discovered to inhabit Scotland. There is every reason, indeed, to believe that an assiduous entomologist would here reap a rich harvest among a tribe of insects which seem characteristic of, though by no means peculiar to, temperate or northern countries. Notwithstanding the obscurity in which many of our smaller species are still involved, Great Britain already possesses nearly *eight hundred* recorded species of brachelytrous insects, while the last edition of Dejean's Catalogue (1833), including European and exotic kinds, gives only 789.²

In a family so extensive, and of late so minutely subdivided, we must satisfy ourselves with a few brief indications of the principal genera. It is divided into five great sections.

1st, FISSILABRA.

In these the head is completely exposed, and separated from the thorax (which is sometimes square or semi-oval, sometimes rounded or cordiform, and truncated) by a neck or sensible restriction. The labrum is deeply bilobed.

In OXYPORUS,³ Fab. (Plate CCXXII. fig. 13), the maxillary palpi are filiform, those of the labium terminated by a large and lunate article. The antennæ are large, perfoliate, and compressed. The anterior tarsi, of which the last (and next to it the second) joint is the longest, are not dilated. The species inhabit *Boleti* and *Agarici*. In ASTRAPÆUS, Grav. the four palpi are terminated by a larger and nearly triangular article. The anterior tarsi are greatly dilated, and the first and last joints are the longest. In STAPHYLINUS, Fab. (the true *Staphylini*), all the palpi are filiform, and the antennæ are inserted between the eyes, above the labrum and mandibles. Some, particularly the males, have the anterior tarsi greatly dilated, and the antennæ rather distant at the base; the length of the first joint being equal at most to that of a fourth of the whole number. The head is but slightly

elongated. These, according to the views of some authors, alone constitute the genus.⁴ Our largest British species, *S. Olens* (Goerius, Leach), is placed here by Latreille, along with a more ornamental example, *S. erythropterus* (Plate CCXXII. fig. 16). Others are linear, with the head and thorax in the form of an elongated square, and the antennæ approximated at the base, and strongly geniculate and granose. The anterior tarsi are either not at all or but slightly dilated. The anterior tibiæ are spinous, with a stout spine at the extremity. The labrum is small. These form the genus *Xantholinus* of some authors. In PINOPHILUS of Grav. the palpi are filiform, but the antennæ are inserted before the eyes, outside the labrum, and near the exterior base of the mandibles. In LATHROBIUM (Plate CCXXII. fig. 21) of the same author (*Pæderus*, Fab.), the palpi are terminated suddenly by a pointed and often indistinct article, much smaller than the preceding; those of the maxillæ are longer than the labial; the antennæ are inserted as in *Pinophilus*; the anterior tarsi are strongly dilated in both sexes; and the length of the last joint of the four posterior tarsi is almost equal to that of the four preceding taken together.

2d, LONGIPALPI.

In this section the head is also completely exposed, but the labrum is entire, the maxillary palpi nearly as long as the head, with a clavate termination formed by the third joint, the fourth concealed or but slightly visible, and, when apparent, terminating the club in the form of a small point; the preceding much enlarged. These insects dwell chiefly along the shores of rivers, or on banks in the vicinity of water.

In PÆDERUS, Fab. (Plate CCXXII. fig. 15), the antennæ, inserted before the eyes, are filiform, or gradually increase in thickness. In EVÆSTHETUS of Grav. the antennæ are likewise inserted before the eyes, but are hardly longer than the head, and almost entirely moniliform; the body is but slightly elongated, and the head as wide as the thorax. In STENUS,⁵ of Lat. (Plate CCXXII. fig. 20), the antennæ are inserted near the margin of the eyes, and are terminated by a triarticulated club. The extremity of the mandibles is forked. The eyes are large.

3d, DENTICRURA, Lat.

This section differs from the preceding in the form of the maxillary palpi, which are much shorter than the head, and always consist of four distinct articles; the anterior tibiæ, at least, are dentated or spinous along their exterior side. The last joint of the tarsi, which in most are bent under the tibiæ, is as long as all the preceding joints combined, or longer; and the first or first two are usually so small or so concealed that their total number does not seem to exceed two or three. In several males the forepart of the head, and even the thorax, is armed with horns. The antennæ are inserted before the eyes. With the exception of the *Tachini*, the anterior tarsi are no longer dilated.

In OXYTELUS, Grav. the palpi have an awl-like termination, the antennæ are mostly granose, and gradually enlarged towards the extremity. The tarsi present only

¹ Ann. des Sciences Nat.; and Règne Animal, p. 432.

² Mr Stephens arranges his British *Brachelytra* in five families, containing eighty-two genera. How vague, from its extremely comprehensive limits, must have been the original genus *Staphylinus* of Linn., when even our indigenous species present the groundwork of such diversified groups! Perhaps, however, we may be now falling into the opposite extreme.

³ From *ὀξύπορος*, that crosses swiftly.

⁴ *S. dilatatus*, Fab. has been separated from the above on account of its antennæ, which form an elongated serrated club. It is said to feed on caterpillars, which it searches for on trees.

⁵ From *στενός*, narrow.

Coleoptera three distinct articles. In OZORIUS, Leach, the body is
Pentamera cylindrical, all the tibiæ broadened and dentated, the head
as long as it is wide, the thorax almost cordiform. The
mentum is large and buckler-shaped. The species come
from America and Madagascar. In COPROPHILUS,¹ Lat.,
the body is flattened, and the antennæ much longer than
the head.

4th, DEPRESSA, Lat.

In these the head is disengaged or free, as in the preceding, the labrum entire, the maxillary palpi short, and of four articulations; but the tibiæ are simple, or without teeth or exterior spines, and the tarsi exhibit five obvious articulations.

In the two following genera the palpi are filiform. OMALIUM, Grav. Thorax as wide as the elytra, wider than the head, and almost forming a transverse square; the angles, at least the anterior ones, rounded, and frequently exhibiting a raised lateral margin; the antennæ enlarging towards their extremity. LESTEVA, Lat., *Anthophagus*, Grav. (Plate CCXXII. fig. 22.) Thorax cordiform, narrowed, truncated posteriorly, almost isometrical, as wide as the head, and narrower than the elytra. In the ensuing genera the palpi are subulate. MICROPEPLUS,² Lat. (Plate CCXXII. figs. 10 and 14.) Antennæ terminating in a solid club, and lodged in fossulæ of the thorax. PROTEINUS, Lat. Antennæ granose, somewhat perfoliate, and larger at the end, but clavate, always exposed, and inserted before the eyes; the thorax is short, and the elytra cover the whole of the abdomen. ALEOCHARA, Grav. Antennæ inserted between the eyes, or near their inferior margin, and exposed at the base, with the first three joints obviously longer than the following ones, which are perfoliate, the last elongated and conical; the thorax is nearly oval, or like a square rounded at the angles.

5th, MICROCEPHALA, Lat.

Head sunk posteriorly into the thorax, nearly up to the eyes, and separated neither by a neck nor visible restriction; the thorax is in the form of a trapezium, and is widened from before backwards. The body is less elongated than in the preceding section, and approaches more to an ellipsis; the head is much narrower, contracted, and projecting forwards, and the mandibles are of moderate size, edentated, and simply curved at the point. The elytra in several cover rather more than the half of the upper surface of the abdomen. Some of the species live on flowers and mushrooms, others on dung.

In LOMECHUSA, Lat., the tibiæ have no spines; the antennæ from the fourth joint form a perfoliateous club, elongated or fusiform; the palpi are subulate; the antennæ frequently shorter than the head and thorax. In TACHINUS,³ Grav. (Plate CCXXII. fig. 23), the tibiæ are

spinous, the antennæ composed of pyriform joints, and insensibly enlarging; the palpi are filiform. TACHYPORUS⁴ resembles the preceding in the tibiæ and antennæ; but the termination of the palpi is subulate.⁵

FAMILY III.—SERRICORNES, LAT.

In this family of pentamerous Coleoptera, we find only four palpi, as in the preceding family, and those that follow. The elytra cover the abdomen, which character, with certain others, distinguishes the SERRICORNES from the BRACHELYTRA.⁶ The antennæ, with some exceptions, are equal throughout, or smaller at the extremity, dentated either like a saw or comb, or even fan-like; and in that respect are more developed in the males. The terminal article of the tarsi is often bilobed or bifid. These characters are rarely visible in the ensuing family, that of CLAVICORNES; at which, however, we shall arrive by transition so graduated, that rigorous limits are with difficulty assigned.

SECTION 1ST, STERNOXI,⁷ Lat.

Body always of a firm and solid consistence, and generally of an oval or elliptical form; the feet in part contractile; the head sunk vertically into the thorax up to the eyes; and the præsternum or median portion of the thorax elongated, dilated, or advanced as far as beneath the mouth, and usually marked on each side by a groove, in which the antennæ, always short, are lodged, and prolonged posteriorly to a point, which is received by a depression of the anterior extremity of the mesosternum. The anterior legs are distant from the anterior extremity of the thorax. This section is further divisible into two tribes.

TRIBE 1ST, BUPRESTIDES.

In these the posterior projection of the præsternum is flattened, not terminated in a laterally compressed point, and simply received into a depression or emargination of the mesosternum. The mandibles are frequently terminated in an entire point, without fissure or emargination. The posterior angles of the thorax are either not at all or but slightly prolonged. The terminal article of the palpi is generally almost cylindrical, scarcely thicker than the preceding; the others globular or ovoid. Most of the articulations of the tarsi are generally broad or dilated, and furnished with pellets beneath. These insects never leap, a character which distinguishes them decidedly from the *Elaterides*. This tribe corresponds to the old genus *Buprestis*, as constituted by Linnæus,—the *Richard* of Geoffroy,⁸ so named by the latter author on account of the

¹ From *κοπρος*, dung, and *φίλος*, a lover.

² From *μικρος*, small, and *πεπλος*, a covering; the elytra being so short as to leave a considerable part of the abdomen exposed. This genus is placed in the necrophagous family, *Nitidulidæ*, by Mr Stephens.

³ From *ταχινος*, swift, active.

⁴ From *ταχυς*, quick, and *πορος*, a passage. For the species of this family, see Gravenhorst's *Coleoptera Microptera*, Gyllenhal's *Insecta Succica*, &c. With Mr Duncan's aid, we have described the genera and species of ordinary occurrence near Edinburgh (*Ent. Ed.* pp. 308-388); but, as already mentioned, numerous undescribed *Brachelytra* inhabit Scotland.

⁵ In the genus *Atractocerus*, however, the elytra are extremely short. In *Proteinus* of the preceding family they are, on the other hand, comparatively long; thus showing the tendency to exception in each general rule.

⁶ From *στερνον*, sternum, and *οξύς*, pointed.

⁷ "This genus," it has been observed, "furnishes the most beautiful coleopterous insects which can adorn either the domain of nature or the cabinet of the naturalist. Most part of the species are clothed with such brilliant colours, that Geoffroy has thought proper to designate them all under the generic appellation of *Richard*. The origin of this name is as singular as its application is fantastical. It was originally given to the jay, in consequence of the facility with which that bird was taught to pronounce the word." (Griffith's *Animal Kingdom, Insecta*, part 2d, p. 356.) Professor Klug has stated that the Berlin Museum possesses not less than five hundred species of the Linnæan genus *Buprestis*.

oleoptera extreme richness of their external covering. Even of the entamera. European species several are extremely beautiful, and many of the foreign kinds are not only of the largest size for the class of insects, but present a brilliant surface, beset as it were with gold and emeralds, or glittering with an iridescent play of green and azure. The body is in general oval, somewhat lengthened, rather wider and obtuse before, as if truncated, and narrowed behind from the base of the abdomen. The eyes are oval, the thorax short and wide. The scutellum small or unapparent. The extremity of the elytra is frequently dentated. The legs are short.

All these insects walk very slowly, but fly exceedingly well in dry and sultry weather. When an attempt is made to seize them they drop upon the ground, with a view no doubt to conceal themselves in the subjacent herbage. The abdomen of the female is furnished at its extremity with a coriaceous or horny conical appendage, composed of three pieces (the terminal abdominal rings), and which may be regarded as a kind of ovipositor, by which she deposits her eggs in dry or decayed wood, in which the larvæ dwell. Several of the minor species occur on leaves and flowers; but the greater proportion are found in forests or depots of timber. They sometimes appear suddenly in places where they were never seen before, having been involuntarily transported in foreign timber in the nymph or larva state.

The *Buprestides* are very common in South America and many of the other sultry regions of the earth. They decrease in number as we advance northwards into the temperate climes, and altogether disappear in colder countries. Scarcely a score occur in Britain; and of these we are not aware that even one has yet been found in Scotland.

GENUS BUPRESTIS,¹ Lin. Palpi filiform, or slightly enlarged towards the extremity, terminated by an almost cylindrical article. Antennæ of equal thickness throughout, and serrated from the third or fourth joint. Penultimate article of the tarsi deeply notched. Maxillæ bilobed.

These are the characters of the genus *Buprestis*, as restricted in recent times. Some of the species have no apparent scutellum. Such is *B. fasciculata*, a species from the Cape of Good Hope. It is about an inch long, of a golden or coppery-green, densely punctured, and with little tufts of yellowish or reddish hairs. It sometimes hangs in such abundance on a shrub, as to make it appear all laden with flowers. Others are furnished with a scutellum. Of these we may name *B. gigas* from Cayenne, a species, as its name implies, of the largest size; the thorax cupreous, mingled with brilliant green, and two large spots like burnished steel; the elytra tridentate at the end, cupreous in the centre, bronze-green on the margin, with impressed points and some elevated lines and ridges. Its larva is represented on Plate CCXXII. fig. 19. On the same plate (fig. 18) we have delineated a magnificent species, *B. bicolor*, lately received from Java. It is of a deep-green colour, with a golden lustre, two cream-coloured spots on the elytra, and one on each side of the thorax. It belongs to the genus CATOXANTHA of Dejean.

Of the other genera of the tribe we shall here name only TRACHYS, Fab. (Plate CCXXII. fig. 26), APHANISTICUS, Lat., and MELASIS, Oliv.² The last-mentioned genus (probably named from μέλας, black), conducts naturally to

TRIBE 2D, ELATERIDES.

Coleoptera
Pentamera.

This numerous tribe corresponds to the undivided genus *Elater* of Linnæus, and differs from the *Buprestides* chiefly in the posterior style of the præsternum, which is prolonged to a sharpish point or spine laterally compressed. On examining the living species, the use of the last-named organ becomes obvious. The legs are very short, and when the creature falls upon its back, which it frequently does while dropping from a plant to the ground, it can only assume its natural position by springing upwards, which it is enabled to do by bringing the projecting point into sudden contact with a groove situated in front of the mesosternum. The sides of the præsternum are also distinguished by a groove, in which the antennæ, pectinated or bearded in several males, are partly lodged. The females have a species of elongated ovipositor, with two lateral pieces pointed at the end, between which is the true oviduct. The tarsi are entire.

The Elaterides occur in flowers, on various plants, and on the ground. We owe to Degeer the description of the larva of one species (*undulatus*). It is long, nearly cylindrical, provided with small antennæ, palpi, and six feet. Its body consisted of twelve scaly segments, of which the posterior was covered by a circular plate, furnished with two blunt points curving inwards; underneath was a large fleshy mammilla, which seemed to serve the office of a foot. The larvæ of *Elater striatus* are said to do much injury, by attacking the roots of wheat. The grub known in this country under the name of wire-worm is an *Elater* in the early state. It lives under ground for several years, feeding on the roots of grain and vegetables. It is partial to land newly broken up, and does great damage in gardens recently converted from pasture-land. In the year 1813, according to Mr Spence, this larva destroyed the greater proportion of the annuals sown in the botanic garden of Hull. In such cases Sir Joseph Banks recommended that slices of potatoes stuck upon skewers should be buried near the seeds, and examined and cleared of the wire-worms from time to time.

M. Leon Dufour has studied the anatomical structure of several species of this family. In the number, length, and mode of insertion of the hepatic conduits, they show a resemblance to the Carabidæ. The digestive canal is seldom more than once and a half the length of the body. Immediately succeeding an œsophagus, so short as to be included within the region of the head, there is a small smooth conical crop, which appears to have escaped the observation of Ramdhor. The chylic ventricle is bilobed in certain species. This tribe is very extensive both in exotic and European species, and is much more prevalent in temperate and even northern countries than the preceding. The *Elaterides* now consist of numerous genera. Some of the American species are remarkable for the fine phosphoric light which is observed to emanate from them during the evening twilight, and when the shades of night have fallen upon the forests. One of these had the fortune to be transported to Paris under the form of nymph or larva; and having made its escape into the streets after the assumption of the perfect state, it greatly astonished the inhabitants of the Faubourg St Antoine. Most of the genera are recognisable, in a general way, by their narrow, elongated, and somewhat flattish forms. We have above sixty species in Britain, arranged according to the modern views, under not less than twenty genera.

¹ From *Bous*, an ox, and *πησσης*, swelling, in allusion to the supposed injury produced on cattle by an insect anciently named *Buprestis*.

² For the species, the reader may consult Olivier, *Coléoptères*, t. ii.; Fabricius, *Systema Eleut.* t. ii.; and Schoenherr's *Synonymia Insectorum*. See also *Règne Animal*, t. iv. p. 446.

Coleoptera The various groups of the *Elaterides* are referred by
Pentamera. Latreille to two principal divisions.

1st, *Antennæ entirely received into the inferior cavities of the thorax.*

In some the antennæ are received on each side into a longitudinal groove, placed directly under the lateral edges of the thorax, and are always filiform, and simply serrated. The joints of the tarsi are always entire, without prolongations, and in the form of a pellet underneath. The thorax is convex or arched, at least on the sides, and dilates towards the posterior angles in the manner of a lobe, pointed or triangular. They approach the *Buprestides*. Here are placed the genera *GALBA* and *EUCNEMIS*.

In others the antennæ, sometimes clavate, are received, at least partially, either into the longitudinal grooves of the lateral borders of the præsternum, or into fossettes placed under the posterior angles of the thorax. The tarsi are frequently provided with little pellets, formed by the prolongation of the inferior parts, or the penultimate article is bifid. Here are placed the genus *ADOLECERA*, Lat. (Plate CCXXII. fig. 29), and others.

2d, *Antennæ exterior or exposed.*

In the genus *CEROPHYTUM*, Lat. (Plate CCXXII. fig. 30), the terminal joint of the palpi, especially the maxillary, is much larger than the preceding, and almost securiform. These insects are more particularly distinguished from the following by their tarsi, of which the first four articles are short, triangular, with the penultimate bifid. The antennæ of the males are ramose on the internal side, the base of the third and following articles being prolonged into a widened branch, rounded at the extremity; those of the female are serrated. In the succeeding genera the articles of the tarsi are entire and almost cylindrical. In *HEMIRHIPUS*, Lat. (Plate CCXXII. fig. 31), the mandibles and labrum are exposed, and the antennæ of the male have a flabelliform termination. The species are foreign to Europe. In *ELATER* properly so called (Plate CCXXII. fig. 27), the antennæ of the males are simply serrated. Here we place the fire-fly, or *mouche lumineuse* of the French colonists, which during the night diffuses from its thoracic spots a strong and beautiful light, sufficient to enable one to read the smallest print, particularly if several are placed together in a glass vessel. By means of this natural illumination the women of the country (the species is South American) are said to pursue their work, and ladies even use it as an ornament, placing it among their tresses during their evening promenades.¹ M. de la Cordaire, who has studied the habits of these insects in the living state, informed M. Latreille that the principal reservoir of phosphoric matter is placed below, at the junction of the thorax and abdomen.² Mr Curtis had the insect alive in London, and has recorded his observations with his accustomed accuracy.³ In the genus *CTENICERA*,⁴ Lat. the antennæ of the males are pectinated.⁵

We shall conclude by observing that the name of *wire-worm*, bestowed on several larvæ of Elaters, is more specifically applicable to the early state of *Cataphagus lineatus*⁶ of Stephens. Its history appears to be given in the *Stockholm Transactions* for 1777, by Mr Bierkander. He calls it the *root-worm*. It measures when full grown about seven lines in length. The body is very narrow, of a yellow colour, hard, shining, and composed of twelve segments, on the last of which are two indented dark-coloured specks. The head is brown, the extremity of the jaws black. The anterior segments have six scaly feet. It is said to remain five years in the larva state, from which it issues as an Elater, the *E. segetis* of Bierk. supposed to be synonymous with the *E. lineatus* of Linn. and the insect above named of Stephens. Great damage is often occasioned by the wire-worm to the turnip crops. An instance is recorded by Messrs Kirby and Spence of a field in which it had destroyed one fourth of the crop, and the owner calculated his loss at L.100. He one year sowed a field thrice with turnips, which were twice wholly, and the third time in great part, cut off by this destructive larva.⁷

SECTION 2D, MALACODERMI.⁸

The insects of this section are distinguished from the *Sternoxi* by their bodies being generally, in whole or in part, of a soft or flexible texture. From this character they derive their name. Their head is likewise inclosed posteriorly in the thorax, or at least covered by it at the base; but the præsternum is not dilated or advanced anteriorly in the manner of a chin-cloth (*mentonnière*, Lat.), nor is it usually terminated posteriorly in a point received into a cavity of the mesosternum.⁹ The Malacodermi are divided into five tribes.

TRIBE 1ST, CEBRIONITES.

So named from the genus *Cebrio* of Fabricius, with which all the others are connected. The mandibles terminate in a simple or entire point, the palpi are of equal thickness, or more slender towards the extremity. The body is rounded or convex in some, oval or oblong, but curved above, and inclined anteriorly, in others. The thorax is transversal, broader at the base, with the lateral angles sharp, or even prolonged, in many, in the form of a spine. The antennæ are generally longer than the head and thorax. The legs are not contractile. The habits of these insects are unknown. Many are found on plants, in moist places.

In *CEBRIO* (proper)¹⁰ of Lat. the præsternum terminates posteriorly in a point, received by a groove of the mesosternum. All the joints of the tarsi are entire and without pellets, and the posterior thighs are not larger than the others. The species peculiar to Europe appear in great numbers after heavy rains. Of the ten species enumerated by Dejean, seven occur in Europe, one in Africa, one in Java, and one in North America. In *CALIRHIPIS*, Lat. (Plate CCXXII. figs. 32 and 33), the præsternum is not prolonged into a point, the antennæ are closely approximated at the base, inserted on an eminence,

¹ Règne Animal, t. iv. p. 445.

² Zoological Journal, vol. iii. p. 379.

³ For the British genera and species, see the works of Messrs Curtis and Stephens. Such as have been hitherto ascertained to inhabit Scotland are described in *Entomologia Edinensis*, p. 192-9.

⁴ From *καταφαγω*, I devour.

⁵ The modern genera of Elaterides are far too numerous to admit of being even named in our present article. We refer the reader, in addition to the systematic works of Fabricius, Olivier, and Latreille, to Palisot de Beauvois's *Insectes d'Afrique et d'Amerique*. Dalman's *Analecta Entomologica*, and the beautiful monograph by Count Mannherheim entitled *Eucnemis Insectorum genus*.

⁶ From *μαλακος*, soft, and *δερμα*, skin.

⁷ The *Cebriones* may be said to constitute an exception to this negative character, and thus approximate the Elaterides; but the inferior extremity of the præsternum does not advance under the head.

⁸ Aristophanes applies the name *Κεβριον* to a species of bird.

⁹ *Ibid.* note. See also *Nouvelles Annales du Mus. d'Hist. Nat.* t. ii. p. 66.

¹⁰ From *κεραις*, a comb, and *κερας*, a horn.

oleoptera and from the third joint, in the males, form a large fan. The terminal joint of the palpi is ovoid, that of the tarsi almost as long as the others united, and presenting between its hooks a little silky and linear appendage. We have represented the head of the species (*C. Dejeanii*), which serves as the type of the genus. It occurs in Java. In RHIPICERA¹ of Lat. and Kirby² (Plate CCXXIII. fig. 1), the inferior surface of each of the first four joints of the tarsi presents two membranous and projecting lobes; the last is long. The antennæ are flabelliform in both sexes, and consist of much more than the ordinary number of eleven joints. The articulations are much fewer in those of the females. The genus consists of a few species from North and South America and New Holland. In DASCILLUS, Lat. (*Atopa* of Fab.), the antennæ are simple in both sexes, the first three joints of the tarsi reversed cordiform, without membranous prolongations; the penultimate is deeply bilobed. *D. cervinus* (Curtis, B. E. V. pl. 216), the only British species, occurs rather plentifully in the alpine districts of Scotland. In the remaining Cebrionites the mandibles are small, and project but little, if at all, beyond the labrum. The body is generally soft, and almost hemispherical or ovoid, and the palpi terminate in a point. The posterior legs of several are fitted for leaping. They live on aquatic plants. Such are ELODES³ of Lat. (*Cyphon*, Fab. Steph.), of which the hind thighs differ but little in thickness from those of the preceding genus (we have seventeen kinds in Britain), and SCYRTES, Lat. of which the species are leapers, with the posterior thighs very large, and the tibiæ terminated by two strong spurs.

TRIBE 2D, LAMPYRIDES.

This tribe is distinguished from the preceding by the enlarged termination of the palpi, at least of those of the maxillæ; by their straight, depressed, but slightly convex body; and by the thorax, sometimes semicircular, sometimes nearly square or trapezoidal, projecting over and almost concealing the head. The mandibles are generally small, and terminate in a slender, arcuated, very acute point, generally entire. The penultimate joint of the tarsi is always bilobate, and the terminal hooks have neither dentations nor appendages. The females of some are apterous, or have but short elytra. When seized, most of these insects press their feet and antennæ close to the body, and remain as motionless as if they were dead. Several curve the abdomen underneath. They correspond to the old genus *Lampyrus* of Linn., and include some species remarkable for their phosphorescent or luminous qualities.

1st, Antennæ approximated at the base, the head either prolonged anteriorly in the manner of a snout, or for the greater part, or entirely, concealed beneath the thorax. Eyes of the males large and globular. Mouth small.

Here we place the following genera, in all of which the

head is exposed:—1st, *LYCUS*,⁴ Fab. In this the snout is as long as the preceding portion of the head, or longer, and the antennæ serrated. The elytra are generally dilated, either laterally, or at their posterior extremity, the two sexes (particularly of certain African species) differing greatly in that respect; 2d, *DICTYOPTERA*, Lat. (Plate CCXXIII. fig. 2); and, 3d, *OMALISUS*,⁵ Geoffroy (ibid. fig. 4). The remaining insects of this division are distinguished from the preceding, not only by the want of a snout (it is not apparent even in the last-named genus), by their head, which in the males is almost entirely occupied by the eyes, and much concealed by the square or semicircular thorax—but more particularly by a very remarkable character, either common alike to males or females, or peculiar to the latter sex, viz. the property of phosphorescence. Hence the names of glow-worms, fire-flies, &c. bestowed upon the species which form the genus *LAMPYRIS* properly so called.⁶

In regard to the general history of these insects, we may observe, that the Greeks applied the name of *Lampyrus*, and the Latins those of *Noctiluca*, *Luciola*, &c. without any very special reference, to such insects as were observed to shine during the night with a lambent or phosphoric flame. They were long confounded with *Telephorus* and *Malachius* under the genus *Cantharis*. Geoffroy effected their separation from *Telephorus*, and placed them in the genus *Lycus*, while Linnæus also combined them with that genus and *Pyrochroa*. Fabricius was the first to restrict and define the genus with propriety.⁷ The antennæ are short, the articulations cylindrical and compressed. The head is concealed beneath the anterior margin of the thorax, which is semicircular in the indigenous species. The eyes are large. The body rather soft, oblong-oval, much depressed. The abdomen is serrated on its lateral edges. The elytra are coriaceous, and slightly flexible. The legs are compressed and simple. The females are apterous, with the rudiments of elytra at the base of the abdomen. Other characters are minutely detailed by systematic writers, which we need not here enter into. We shall, however, record some observations, both of a general and particular nature, which we were induced to make in consequence of our having kept the common British glow-worm in confinement.⁸

The beautiful light which emanates from this insect constitutes its most interesting and peculiar attribute. If several ancient nations were worshippers of the sun, and regarded "holy light" as a divine effulgence, the offspring of heaven, and the purest of the elements, we need scarcely wonder that in remote times, when natural phenomena were but slightly understood, even the more obscure manifestations of a supposed celestial principle should have excited the wonder and admiration of mankind. We consequently find many exaggerated accounts of the cause and effects of these flying and creeping lights, which, as they do not illustrate the natural history, properly so called, of the insects themselves, we shall leave for the pre-

¹ From *ορις*, a fan, and *κερας*, a horn.

² From *ελος*, a marsh, the species usually frequenting moist places.

³ The word *λαμπυρος* occurs in Aristotle, and is derived from *λαμπω*, to shine, and *πυρ*, fire. The genus in its undivided state is very extensive, containing not fewer than sixty species. We observe, however, that in the last edition of Dejean's Catalogue, so many divisions have taken place, that the genus *Lampyrus*, properly so called, is now made to consist of only nine species. It is very poorly represented in Britain, and indeed produces but few European examples. If, as Mr Stephens supposes, *L. splendida* has been erroneously introduced into the British Fauna, then *L. noctiluca*, Linn., may be regarded as the sole indigenous species. Some Brazilian species, in which the antennæ of the males consist of more than eleven joints, formed like the laminae of a feather, constitute the genus *Amydetes* of Hoffmansegg. Others, also peculiar to South America, and of which the antennæ consist of only eleven joints, form the genus *Phengodes* of that author. (Illiger's *Mag.* vi. p. 342.)

⁴ For representations of the glow-worm (*L. noctiluca*), see Plate CCXXIII. Fig. 5 is the winged male; fig. 6 the wingless female; fig. 7 the larva; fig. 10 represents a large and remarkable species, the *Lampyrus Savignii* of Kirby.

⁵ We here in part avail ourselves of what we have already stated in the *Entomologia Edinensis*, p. 202-7.

⁶ Linn. Trans. vol. xii. pl. 21, 3.

⁷ From *λυκοω*, I destroy.

⁸ Perhaps from *ομαλος*, flat.

Coleoptera sent unrecorded. But the actual phenomena are extremely interesting, on account both of their singularity and beauty, and, without the aid of fiction, are well deserving the attention of the poet and philosopher. Huet, bishop of Avranches, an eminent scholar, composed a poem, entitled *Lampyrus*; and the masterly genius of Wordsworth, which draws so much that is new and beautiful from the observance of common things, has not failed to immortalize the radiance of the "earth-born star." "And if," say Messrs Kirby and Spence, or one or other of these authors, while speaking of the British glow-worm, "living like me in a district where it is rarely met with, the first time you saw this insect chanced to be, as it was in my case, one of those delightful evenings which an English summer seldom yields, when not a breeze disturbs the balmy air, and hundreds of these radiant worms, studding their mossy couch with mild effulgence, were presented to your wondering eye in the course of a quarter of a mile,—you could not help associating with the name of glow-worm the most pleasing recollections. No wonder that an insect which chiefly exhibits itself on occasions so interesting, and whose economy is so remarkable, should have afforded exquisite images and illustrations to those poets who have cultivated natural history."¹ However beautiful the effect produced by our own species, and by the fire-flies (*L. italica*), which are still more abundant over Italy and the rest of the south of Europe, their splendour, according to Humboldt, cannot be compared in richness to those innumerable scattered and moving lights that embellish the nights of the torrid zone, and seem to repeat on earth, along the vast extent of the savannahs, the spectacle of the starry vault of heaven. These, however, belong to a different tribe of insects (Elatérides), which resemble the glow-worm merely in their luminous properties; yet we cannot resist quoting the beautiful lines by Mr Southey, in which he describes their first effect on the earliest visitors of the new world.

..... Sorrowing we beheld
The night come on; but soon did night display
More wonders than it veiled; innumerable tribes
From the wood-cover swarm'd, and darkness made
Their beauties visible: one while they streamed
A bright blue radiance upon flowers that closed
Their gorgeous colours from the eye of day;
Now motionless and dark, eluded search,
Self-shrouded; and anon, starring the sky,
Rose like a shower of fire.²

The glow-worm is now a very rare insect in the neighbourhood of Edinburgh. Mr Neill informs us that it formerly occurred between the city and the village of Canonmills; but we have not heard of its having been found there or elsewhere around our immediate suburbs for many years. Dr David Ritchie has observed it occasionally near Pathhead, and Professor Wallace has met with it in Fife. Professor Wilson informs us that he once saw it on the Queensferry road, near Comely Bank. We have ourselves taken it by Loch Lomond side, and elsewhere in Scotland. It abounds in the north of England. We once received some living specimens early in July from Borthwick, about twelve miles from Edinburgh. They laid eggs a few days after their arrival, on the sides of a glass vessel. The parents soon after died, probably from being kept in too confined a space; but the young larvæ were hatched in a few weeks, and by the end of September they measured about the third of an inch in length. These larvæ bear a strong resemblance to the female perfect insect. The body is composed of twelve segments, of which the central are the largest. The three

first segments bear each a pair of feet, and the caudal segments are slightly retractile within each other; and when the insect walks, which it does very leisurely, it bends its tail beneath it in such a way as to assist or support it in its progress. The head is very small, and is also retractile, and is usually withdrawn whenever the insect is alarmed or disturbed. These little creatures thrive well in captivity. They were kept on a piece of moist mossy turf, which was frequently renewed; but whether they sustained themselves on the dewy herbage, or by means of the minute animal substances which it contained, it was not for a time very easy to discover. The curved and extended form of the little jaws would in the first place induce one to suppose that they were carnivorous. Olivier, however, observes, in his description of the larva of the glow-worm, "elle vie cependant sur de la terre fraîche, avec de l'herbe et des feuilles des différentes plantes; mais l'on a remarqué qu'elle devient faible et languissante, quand on la laisse manquer de terre humide. Elle est très-pacifique, et paroît craintive."³ Fresh earth, or the moisture which arises from it, certainly seems necessary to their welfare, for we noticed that, when their turf became dry, and a slice of fresh apple or potato was introduced, they immediately settled on it, and inserted their heads as if drinking. We, however, soon after detected one with its jaws fixed in the head of a minute snail, which it appeared to be devouring, its own head being inserted into the aperture of the shell.

This observation appeared the more interesting, in as far as it served to connect those insects, by means of their habits, with that singular species the *Drilus flavescens*, which is known to feed voraciously on the *Helix nemoralis*, and the female of which was described by Mielzinski as the type of a distinct genus, under the name of *Cochleoc-tonus*. This latter insect is parasitical on the body of the helix, in the shell of which it dwells and undergoes its metamorphoses.

While engaged in the observance of these glow-worms, we met with a notice, in the *Annales des Sciences*, by a French gentleman of Rouen, on the same subject. In it we have ample proof of the carnivorous propensities of the creatures in question. He placed a great number of the larvæ in a vessel with fresh earth, and supplied them with various kinds of leaves. They soon however became extremely feeble, and remained so for several weeks, when he happened to put a dead slug in their jar, of which the young glow-worms were no sooner aware than they greedily seized upon it with their arched and sharp-pointed mandibles. On the ensuing day they were found to have eaten their way so far into the slug, that nothing but their tails was visible. They were perceived however occasionally to quit their prey and walk about upon the moist earth. The French naturalist was curious to observe how they would proceed with a living snail, and he therefore introduced one into his colony of insects. The animal soon began to crawl about its new domicile, but it no sooner came upon the path of a glow-worm than it was seized by the latter immediately beneath the mouth, and with such force and tenacity that it drew itself suddenly into its shell, and of course dragged its enemy along with it. The glow-worm however immediately disengaged its hold, and struggled back to the mouth of the shell, on the back of which it soon mounted, thus keeping the snail in a state of siege. Whenever it protruded even the point of its horns it was instantly seized, bitten, and obliged to withdraw within its fortress. The larva being soon joined by a companion, the two attacked the unfortunate snail, and

¹ *Introduction to Entomology*, vol. ii. p. 410.

² *Madoc*.

³ *Entomologie*, t. ii. No. 28, p. 7.

after a continued combat of several hours, they put it to death, and by next morning it was not only slain, but eaten. These and similar experiments were made from the month of November to the month of June, after which the larvæ were observed to undergo their transformations. They occupied about a week in assuming the state of nymph—they continued in that state eight days longer—and then appeared in the form of the perfect insect. When about to assume the nymph state, the skin of the upper and anterior portion of the body cracks and opens, or a lateral division takes place on either side, so as to separate the skin of the upper from that of the under portion. By alternate elongations and contractions they then work their way forwards, and contrive to effect their liberation in a few minutes from their old attire. The nymph is larger than the larva, though not quite so long. Its colour is at first pale yellow, with two reddish spots on the posterior and lateral portion of each segment of the abdomen, as well as on the posterior angles of the thorax. It wants the large acute mandibles of the larva; its antennæ are very obvious, and consist of eleven articulations. The tarsi are likewise distinctly composed each of five articulations. The last rings of the abdomen are very brilliant, especially when the insect is handled; and it was noted as remarkable that the whole body partook, though with less intensity, of that phosphoric splendour which in the perfect insect characterizes only the terminal segments of the abdomen. Before the termination of the eight days which are passed in the nymph state, all the more delicate colours had disappeared, and were finally converted into those duller hues which distinguish the insect in its matured condition. As soon as it has disengaged itself from the slough of the larva, it bends its body into an arch or semicircle, and is then a genuine nymph, although it still continues to move its head, and even its limbs and antennæ. In this intermediate condition its general form has undergone no great change, but the head, feet, and antennæ are considerably altered, and seem enlarged or swollen. At first the body manifests a slow and heavy movement, which ere long ceases, and the antennæ and feet are then applied more closely to the sides of the body. The only signs of life now consist in a movement of the abdomen, which is bent into an arch, or occasionally moved from side to side. The body is shorter than that of the larva, the head is bent beneath the first segment or thorax, the antennæ consist of numerous articulations, and the caudal segment of the body, instead of being terminated by a couple of points, is now surrounded by eight of those points, in the centre of which are two fleshy tubercles, placed in a slight depression. Olivier had previously informed us that the nymph, after quitting the skin of the larva, shone with a very lively and brilliant light of a beautiful green colour, which became more splendid for a time when the vessel which contained it was moved, and disappeared again, as if by some voluntary action of the animal, even in the nymph state, in which the vital and instinctive powers are usually almost in a state of suspension. According to Degeer, the larva is also luminous. We did not however observe any manifestation of that faculty in those in our keeping.

It has been a frequent subject of inquiry to ascertain the purposes which the light is intended to serve. In the perfect state the female continues wingless, while the male has become a swift-flying insect; and this has led to the supposition that the lambent flame, which is always most

conspicuous in the female, is intended as a “nuptial lamp,” to guide the male to her society. In this case, however, we do not so clearly see the use of it in the larva and nymph states, unless, to be sure, as a preparatory process for the formation of the animal phosphorus. Although many insects discover each other merely by the sense of smell, the fact seems nearly certain that the male or winged glow-worm ascertains his mate by aid of her luminous property; for it is a well-known and successful entomological device to place a female in a conspicuous position, and watch by her side, with a view to entrap the rarer or less visible males, which ere long make their appearance. Olivier has frequently caught the males by holding a female on the palm of his hand,—which makes it the more singular that he did not perceive the two luminous points which the former bears on the last segment of the abdomen,—“Je n’ai pas encore m’assurer, il est vrai, si le mâle de notre espèce commune a la propriété de luire.” We may add, that the eggs are also beautifully luminous for some time after they are laid.

Dufour has examined the anatomical structure of the female glow-worm. The alimentary canal measures about twice the length of the body. The œsophagus is so short as to be nearly imperceptible. It dilates immediately into a short crop. The chylic ventricle is separated from the crop by a valvular contraction. It is long, smooth, that is, unprovided with papillæ, but pursed and cylindrical in its two anterior thirds, and intestiform in the remainder. The small intestine is very short.¹

The matter from which the luminous property of the glow-worm results has been the subject of frequent experiment and observation. It is obviously under the control of the insect, which, when approached, may frequently be observed to diminish or put out its light.²

In the perfect female the luminous matter occupies chiefly the inferior part of the three last annuli of the abdomen. These differ from the rest in colour, and are usually of a yellow hue, especially on the under side. The light diffused is more or less intense, according to circumstances. The insect lives for a considerable time in a vacuum, and in various gases; but in nitrous acid, muriatic and sulphurous gases, it soon expires. When placed in hydrogen gas it has sometimes been observed to produce detonation. When the luminous portion of the body of a glow-worm is cut off, the insect continues to live, and the separated segments retain their phosphoric nature, and are luminous for some time, whether placed in vacuum, exposed to the air, or submitted to the action of different gases. By what means the living insect is able to shroud itself in darkness, and then suddenly to clothe itself as it were in a mantle of radiant light, is a subject beyond our power of investigation; but when dried the phosphorescence seems to depend on a certain degree of softness or humidity; for when apparently quite extinct, it may be reproduced by pressure, and the application of a little moisture. In the living state, however, although immersion in warm water produces a brilliant light, the application of cold water tends to its speedy extinction.

The next peculiarity in the history of the glow-worm consists in the change of its habits in regard to food, which takes place on its attaining maturity. From an insect of a predaceous nature, greedy of animal juices, it becomes entirely herbivorous, not much addicted indeed to food of any kind, but still confining itself, when it does indulge in eating, to the tender leaves of plants. It is

¹ *Ann. des Sciences Nat.* t. iii. p. 225.

² On this curious subject, however, we beg to refer the reader to the writings of Beckerheim (*Ann. de Chimie*, t. iv. p. 19), Caradon, and Treviranus, among foreign authors,—and to those of Mr Macartney (*Phil. Trans.* 1810), and Kirby and Spence (vol. ii. p. 423), among ourselves.

Coleoptera this circumstance which has no doubt led to so much con-
Pentamera. trariety of opinion on the part of entomological writers regarding its natural disposition. Most observers having attended to it chiefly after it had undergone its transformations, they naturally, and so far correctly, concluded that it was a herbivorous insect. Had they watched its progress from the egg they would have come to another conclusion, at least in regard to its earlier condition. This alteration in the habits of these creatures is in fact by no means unexampled, either among other genera of the same class, or among the more distantly related reptile tribes. The most familiar instance among the latter is the common frog, which in the early state of tadpole is herbivorous, while under the perfect form it preys on flies and other insects. In this case, to be sure, the order of change is inverted, the alteration being from a herbivorous to a carnivorous diet; while the contrary takes place in the glow-worm. But the analogy is more strictly maintained in the case of those aquatic beetles which form the family *Helophoridae*, which in the larva state are carnivorous, but become herbivorous after assuming their final transformation. The same singularity is also illustrated by many dipterous flies, which, born and bred amid the putrid moisture of animal remains, no sooner become winged insects, than they seek a purer diet in the nectarous juices of fruits and flowers.

In relation to the glow-worm, the observation is of more practical interest, because the appearance of the insect among our lawns and shrubberies is so extremely ornamental during the summer nights, that many have tried to import it to districts where it does not naturally occur. They have failed, in consequence of endeavouring to rear the young on vegetable food. Moist herbage, or a supply of damp earth, seems almost indispensable; but, in addition to these, their box must contain some minute testacea, such as the young of the ordinary species of the genus *Helix*. Perhaps the best plan is to hatch the eggs, and then place the young at liberty under an old hedge as soon as they have begun to eat freely.

2d, Antennæ decidedly remote at their base; head neither prolonged nor narrowed anteriorly in the form of a snout; the eyes of ordinary size in both sexes.

In genus *DRYLUS*, Oliv. (Plate CCXXIII. figs. 8, 9, and 12), the males are winged, and the inner side of the antennæ, from the fourth joint, is prolonged like the tooth of a comb. Those of the female are shorter, or somewhat perfoliaceous, and slightly serrated. The maxillary palpi in both sexes are thicker towards the extremity, and terminate in a point. There is a tooth on the internal side of the mandibles. The *D. flavescens* (see figs. last referred to) feeds, while in the larva state, on the *Helix nemoralis* of Linn. in the shell of which it dwells and undergoes its metamorphosis. It was on this account described by Comte Mielzinsky under the name of *Cochleoctonus*. Its history, and that of the other species, are now well known.¹

All the remaining genera of this second division of the *Lampyrides* are winged in both sexes, and the maxillary palpi are not much longer than the labial. They correspond to the family *Telephoridae* of English naturalists, and are composed chiefly of the species placed by Linnaeus under the genus *Cantharis*. Schæffer and Degeer reserve that name to the species used in medicine, and apply the term *Telephorus* (probably from *θελος φορεω*, *I carry death*) to the remainder. The true *Cantharidæ*, therefore, are constituted by the genus *Meloe*, and the well-known blister-fly *C. vesicatoria*, &c.

In the genus *TELEPHORUS* (Plate CCXXIII. fig. 11) Coleoptera
Pentamera. the palpi are terminated by a securiform article, and the thorax offers no lateral emarginations. Their bodies are long, narrow, depressed, and of a soft or somewhat flexible consistence. These insects abound in meadows during the summer season, on umbelliferous and other plants. The larvæ are characterized by a flat scaly head, furnished with two strong teeth, a pair of small antennæ, and four palpi. Their bodies are flattish beneath, divided into twelve rings resembling those of caterpillars, and covered by a membranous skin, which is soft to the touch. The general colour of these larvæ is a deep velvety black, except the front of the head, which is shining. The antennæ, palpi, and feet are of a reddish or yellowish brown. They dwell in moist earth. Olivier was of opinion that they fed on roots, but the laborious and accurate Degeer asserts that they voraciously devour a great variety of insect prey. That of *Telephorus fuscus* was observed to change into the nympha state towards the end of May. It buried itself in the earth, but presented no appearance of cocoon. The nympha was about six lines in length, with the body somewhat arched, and of a pale-reddish white. The perfect insect was developed in the month of June. Even in the last-named state, in which so many species are chiefly occupied in the indulgence of other propensities, the *Telephori*, according to Degeer, continue their accustomed appetite. He has observed a female drag a male to the ground, turn him on his back, and suck out his entrails; so that, as among the spider tribes, considerable caution is necessary on the part of an inexperienced suitor while making his advances. Mr Curtis has frequently seen *Telephori* with other insects in their mouths. He once observed *T. lividus* eating an ichneumon, and he took another of the same species with an *Empis* in its mouth. *T. fuscus* is known to prey upon its own species. There are above thirty different kinds of this genus in Britain. Dejean, under the Linnæan name of *Cantharis*, enumerates 132 species. Whatever we know of the anatomy of these creatures accords with their apparent dispositions. Dufour has ascertained that their digestive canal is absolutely straight. Their biliary vessels are four in number, in which character, as well as in that of their generative system, they present a resemblance to the genus *Lycus*.

One of the most remarkable incidents in the history of the *Telephori* is the frequency with which, in some continental countries, the species are carried into the air in great quantities by violent winds, and unexpectedly deposited in distant regions,—thus giving rise to what are called *insect showers*. Sweden and Hungary have been most productive of such phenomena. One of the most ornamental of the British species, and the only one we shall here describe, is *T. cyaneus* of Curtis. The head is black and shining, but rufous before the eyes; the thorax and abdomen are likewise rufous, the elytra are deep blue, the legs black. This insect is pretty widely, though sparingly, distributed over the southern and central counties of Scotland, and the north of England. We have specimens from the Edinburgh district, from Kinordy in Forfarshire, from Dollar in Clackmannanshire, and from Dumfries and Roxburgh shires.

The genus *SILIS* of Megerle differs from the preceding chiefly in having an emargination posteriorly on each side of the thorax. In *MALTHINUS* of Lat. (Plate CCXXIII. fig. 14) the palpi are terminated by an ovoid joint; the head is narrow behind; and the elytra, in several species, are shorter than the abdomen.

¹ See *Annales des Sciences Nat.* Jan. Juil. Aout, 1824; and *le Bulletin de la Soc. Phil.* for April of the same year.

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TRIBE 3D, MELYRIDES.

Here we find the palpi generally short and filiform; the mandibles emarginated at the point; the body usually narrow and elongated; the head only covered at base by a flat or but slightly convex thorax, generally square, or elongated and quadrilateral; the joints of the tarsi entire, and the terminal hooks unidentated or bordered with a membrane. The antennæ are usually serrated, and even pectinated, in the males of several species. Most of these insects are of active habits. They occur on the leaves and flowers of plants.

In MALACHIUS¹ of Fab. (Plate CCXXIII. fig. 13), there is a retractile and dilatable vesicle under each anterior angle of the thorax, and on each side of the base of the abdomen. Most of the species are adorned by ornamental and contrasted colours. The habits of the larvæ are but obscurely known. Olivier presumes that many of them live in wood, because he has frequently found the perfect insect in timber-yards, as if newly escaped from the nympha state. This is an extensive genus, and may be regarded as characteristic of temperate climes, although a few occur in Africa and the East Indies. Mr Stephens enumerates seventeen British species. Comte Dejean's collection contains 104 in all. Among the Melyrides with filiform antennæ, but of which the thorax and abdomen are unfurnished with retractile vesicles, Latreille places the genus DASYTES² of Paykul. The antennæ are at least as long as the head and thorax; and the body is generally narrow and elongated, sometimes linear. We have figured the male of *D. ater* (Plate CCXXIII. fig. 15). In MELYRIS properly so called (Plate CCXXIII. fig. 16), the antennæ are shorter than the head and thorax, insensibly enlarged, but without forming a club, as in *Lygia*. Their joints are also less dilated laterally, and are almost isometrical. The thorax is less convex.

In other Melyrides, such as PELOCOPHORUS of Dej. the maxillary palpi are terminated by a larger and securiform article, a character which, with certain others, approximates them to the ensuing tribe. Dejean at one time placed them among the *tetramerous* species.

TRIBE 4TH, CLERII.

Distinguished by at least two of the palpi being projecting and clavate. The mandibles are dentated. The penultimate joint of the tarsi is bilobate, the first very short or but slightly visible in several. The antennæ vary, being in some nearly filiform and serrated, in others insensibly enlarged towards the extremity. The body is usually cylindrical, the head and thorax narrower than the abdomen, and the eyes emarginate. Most of these insects occur on flowers, some of them on the trunks of trees or in dry timber. The larvæ are regarded as carnivorous.

Of some the tarsi, viewed from above or from beneath, distinctly exhibit five joints. Such is the genus TILLUS³ of Olivier, in which the mandibles are cleft or bidentated at the extremity; the antennæ sometimes serrated, from the fourth joint to the tenth inclusively, with the last ovoid, sometimes terminating suddenly from the sixth in a serrated club. The terminal joint of the labial palpi is very large and securiform; the head short and rounded, and the third and fourth joints of the tarsi dilated in the form of a reversed triangle.

Of others the tarsi, when viewed from above, appear to

consist of only four joints, the first being extremely short, or concealed beneath the second. Such is the genus CLERUS⁴ properly so called (Plate CCXXIII. fig. 17), in which the maxillary palpi are terminated by a compressed joint in the form of a reversed triangle, the last of the labial palpi, which are larger than the others, being securiform. The club of the antennæ is hardly longer than wide, and is composed of crowded joints; the third is longer than the second. The maxillæ terminate in a fringed and projecting lobe. The thorax is depressed anteriorly. The species, in the perfect state, occur on flowers. Their larvæ feed on those of certain bees. Dufour has described their internal structure. The crop is so short as to be almost entirely contained within the head. In NECROBIA,⁵ Lat. (Plate CCXXIII. fig. 19), the four palpi are terminated by an elongated, compressed, triangular joint of the same size; the second and third joints of the antennæ are almost equal, and the terminal club is elongated, and with looser articles. These insects occur chiefly in spring. They are said to live on carrion, and are richly adorned for such foul feeders. Deep blue is their prevailing colour. There are four species in Britain, of which we have as yet found only two in Scotland, viz. *N. ruficollis*, of a greenish blue, the thorax, base of the elytra, and legs rufous,—*N. violacea*, of a bright blue, shining yet pubescent, the antennæ and legs black. If the geographical notices which we have collected of the former species be correct, its distribution must be very extensive. It seems to occur both in Africa and the East Indies,—a wide circuit for an insect which we have taken behind the glass-works at Leith. "Insectum mihi carissimum," says Latreille, "illis enim infelicissimis temporibus quibus calamitatum omnium pondere obruta Gallia trepidanter gemebat, amicissime auxiliantibus Bory de Saint Vincent, Dargelas, Burdigalensibus, posteriori maxime, hoc animalculum mihi libertatis salutisque occasio miranda evasit."⁶

TRIBE 5TH, PTINIORES, Lat.

This tribe, consisting of the genus PTINUS of Linnæus, and of some others nearly allied, possesses a body of a tolerably firm consistence, in some cases almost ovoid or oval, and at others nearly cylindrical, but generally short, and rounded at either end. The head is nearly globular or orbicular, and is received almost entirely into a strongly arched or rounded thorax, resembling a hood. The antennæ of some are filiform, or diminished towards the termination, and are simple, flabelliform, pectinated, or serrated; of others they are terminated suddenly by three larger and longer joints. The mandibles are short, thick, and dentated beneath the point. The palpi are very short, and terminated by a larger article, almost ovoid, or like a reversed triangle. The tibiæ are not dentated, and the spurs at the extremities are very small. These insects are all of small size, exhibit little variety in their colouring, which is usually dark or sombre, and when touched they counterfeit death. Their motions are slow, and such as are winged seldom take to flight. In the larva state they are extremely destructive in museums.

In the genus PTINUS (Plate CCXXIII. fig. 18) properly so called, the antennæ are as long as the body, and inserted between the eyes, which are somewhat protuberant. The body is oblong. In the genus PTILINUS, Fab. (ibid. fig. 20), the antennæ, inserted before the eyes, are shorter than the body, and are pectinated or plumose from the

¹ From μαλακος, soft.

² From δασυτης, shagginess.

³ From τιλλω, to pluck or pull out.

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⁴ The word κληρος is applied by Aristotle to an insect which inhabits hives.

⁵ From νεκρος, carcass, and βιος, life.

⁶ Genera Crust. et Insect.

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third joint in the males¹—serrated in the females. They inhabit old wood, in which they perforate deep round holes. In *ANOBIUM*, Fab. the antennæ are terminated by three larger or longer joints, the terminal one being ovate. The name of *Byrrhus*, originally bestowed upon the insects of the last-named genus by Geoffroy, was transferred by Linnæus to a very different group. His genus *Ptinus* included both *Ptilinus* and *Anobium*. Fabricius was the institutor of the genus *Anobium*, so called from *αναβιον*, *resuscitated*,—the species being characterized, in common with most of their congeners, by their frequent simulation of death, and their re-assumption of activity as soon as the threatened danger is removed. In this instinctive mode of preservation Olivier accuses them of exhibiting an invincible obstinacy. “Ils se laissent entièrement bruler sans donner aucun signe de vie.” The larvæ of these insects are extremely injurious to old furniture, in which they perforate numerous round holes. Hence the genus is named *vrillette* by the French, from *vrille*, a gimlet. In the larva state they resemble small, white, soft worms, with six short minute feet. The head is scaly, and is terminated by two maxillæ in the form of strong cutting pincers, with which they gnaw the wood into the finest sawdust. When about to change into the nymph state, they line the bottom of their little cells with a few silken threads. Other species feed on flour, bread, sealing-wafers, &c. where they form grooves or galleries, according to the thickness of their working materials. The superstitious fancy of the *death-watch* has arisen partly from an insect of this genus, the *An. tessellatum*. It is supposed, however, to share this mysterious calling with the *Termes pulsatorium* of Linnæus, and probably with several others. According to Dr Shaw, it is in the advanced state of spring that the former of these insects commences its mysterious pulsations, which, he asserts, is nothing more than the signal-call of the sexes. The number of distinct strokes is generally from seven to eleven, and these are occasioned merely by its beating with its head with considerable force and quickness against the plane of its position. Where the insects are numerous, as is not unfrequently the case in old houses, these sounds may be heard during the whole day, especially in warm weather. The sound greatly resembles a moderate tapping on a table with the finger nail, and indeed by that simple process they may be induced to beat in reply when not otherwise inclined so to do. “He that could eradicate this error,” says the quaint Sir Thomas Brown, in allusion to the death-tick, “from the minds of the people, would save from many a cold sweat the meticulous heads of nurses and grandmothers.”² One of the most common species of the genus is *Anobium striatum*, of a somewhat pitchy-brown colour, the thorax obsoletely grooved, and produced towards the base into an elevated triangular ridge. This little timber borer, which is the *A. pertinax* of Fabricius, has been long famous for a most *pertinaceous* simulation of death. “All that has been related of the heroic constancy of American savages when taken and tortured by their enemies, scarcely comes up to that which these little creatures exhibit. You may maim them, pull them limb from limb, roast them alive over a slow fire,³ but you will not gain your end; not a joint will they move, nor show by the least symptom that they suffer pain. Do not think, however, that I ever tried these experiments upon them myself, or that I recommend you to do the same.”⁴ This species was observed

by Latreille to produce the sound called the *death-tick*, by striking its mandibles upon wood. On this occasion it was immediately answered from within by a precisely similar sound. We took a very rare British species, *A. abietis*, Fab. many years ago in a fir-wood near Edinburgh. *A. erythropum* of Leach is also stated by Mr Stephens to have been taken at Ravelston.

SECTION 3D, XYLOTROGI, Lat.

This final section of the *SERRICORNES* is distinguished from the two preceding by the freedom of the head, which is completely exposed and separated from the thorax by a strangulation or species of neck. It is composed entirely of the genus *Lymexylon* of Fab. as subdivided by recent writers.

In *ATRACROCERUS* of Palisot de Beauvois, the elytra are extremely short, and in the form of little scales; the antennæ are compressed and almost fusiform; the thorax is square, the abdomen depressed. This limited and very anomalous-looking genus (it has the aspect of a *Staphylinus*) has representatives in Guinea, Brazil, and Java. A species is likewise known to occur in amber. In *LYMEXYLON*,⁵ Fab. the elytra are as long or little shorter than the abdomen, the antennæ are simple, slightly if at all compressed, and almost moniliform. The thorax is nearly cylindrical. The *L. navale*, Fab. (of which *L. flavipes* of the same author is the male), is a small narrow insect of about half an inch in length, of a pale fulvous colour; the head, exterior margin, and extremity of the elytra black,—the latter colour more predominant in the males. This species is extremely common in the oak forests of the north of Europe, although unknown in Britain, and rare in the vicinity of Paris. Its larva is so long and slender as almost to resemble a *Filaria*. It multiplied so prodigiously some years ago in the dock-yards at Toulon, as to cause the destruction of great quantities of timber.⁶

FAMILY IV.—CLAVICORNES, Lat.

In this family, as in the preceding, we find four palpi, and elytra covering the upper surface of the abdomen, or its greater portion; but the antennæ are almost always thicker at the extremity, which frequently forms even a perfoliaceous or a solid club; they are longer than the maxillary palpi, and their base is exposed or scarcely covered. The legs are not fitted for swimming, and the joints of the tarsi, at least of the posterior ones, are usually entire. In the larva state they feed on animal matter. Latreille divides the tribe into two sections.

SECTION 1ST. Antennæ always composed of eleven joints, longer than the head, not forming from the third articulation a fusiform or nearly cylindrical club; the second joint not dilated in the form of an auricle. The terminal joints of the tarsi, as well as its hooks, of moderate length, or small. All the genera of this section are terrestrial. It comprises several tribes.

TRIBE 1ST, PALPATOIRES.

These, in a natural series, should be placed near the *Pselaphii* and *Brachelytrous* genera. Their antennæ are at least as long as the head, are slightly enlarged towards

¹ The generic name is no doubt derived from *πτειλον*, a feather,—in reference to the form of the antennæ.

² *Pseudodoxia Epidemica*.

³ Degeer, iv. 229.

⁴ *Introd. to Ent.* vol. ii. p. 235.

⁵ From *λυμη*, destruction, and *ξύλον*, wood.

⁶ *Règne Animal*, t. iv. p. 369.

Coleoptera Pentamera. the extremity, or are nearly filiform; their first two joints are longer than those that follow. The head is distinguished from the thorax by an ovoid strangulation. The maxillary palpi project, and are long and inflated at the extremity. The abdomen is large, oval or ovoid, and laterally embraced by the elytra. The legs are elongated, the thighs clavate, the joints of the tarsi entire. These insects are found on the ground beneath stones and other substances. They form a single genus, divided by some writers into *MASTIGUS* and *SCYDMENUS*. The latter frequent moist places.

In all the following *Clavicornes* the head is generally sunk in the thorax, and the maxillary palpi are never at the same time advanced and club-shaped.

TRIBE 2D, HISTEROIDES.

This tribe is composed of the great genus *Hister* of Linnæus. The four posterior legs are more widely separated from each other at their origin than the anterior pair. The legs are contractile, and the exterior tibiæ dentated or spinous. The antennæ are always bent or *elbowed* (geniculate), and terminated in a solid mass, or composed of close-set articulations. The body is of a very solid consistence, and the elytra so hard that even the pin of the entomologist is with difficulty made to enter, and the præsternum is often dilated in front, and the elytra truncated. The mandibles are strong, and not unfrequently unequal as to size. The palpi are almost filiform, or slightly enlarged at their extremity, and terminated by an oval or ovoid article. In respect to their habits, the dentation of their tibiæ, and some other circumstances, these insects seem to exhibit an approach to the coprophagous *LAMELLICORNES*; but both Dufour¹ and Latreille² are of opinion that well-founded anatomical considerations connect them with the *SILPHÆ*. In the species (*H. sinuatus*) dissected by the former author, the digestive canal was found to be four or five times as long as the body. The œsophagus is extremely short; the oblong enlargement which immediately succeeds it exhibits throughout its parietes some brownish lines, which seem to indicate the existence of interior appendages proper for trituration; and if so, such enlargement may be regarded as the gizzard. The chylic ventricle is very long, twisted on itself, and beset with pointed and projecting papillæ. The hepatic vessels have six distinct insertions around the chylic ventricle.³

These insects feed on putrid and stercoraceous substances, decaying vegetables, &c. and some dwell beneath the bark of trees. Their movements are slow, their colour blackish, frequently with a tinge of bronze. Such of the larvæ as are known to naturalists affect the same food as the perfect insect. Their form, however, is different, being almost linear, depressed, smooth, soft, and of a yellowish white, with the exception of the head and first segment, of which the skin is scaly and of a brown or reddish colour. These larvæ have six short legs, and are terminated by a pair of articulated appendages, and an anal prolongation or tube. The scaly shield of the first segment is longitudinally channelled.

In some the tibiæ, at least the anterior ones, are triangular and dentated, and the antennæ always free and exposed, the body square, and slightly if at all inflated. Such is the genus *HOLEPTA* of Paykul, in which the

body is much depressed, the mentum deeply emarginate, and the palpi formed of almost cylindrical joints. The species dwell beneath the bark of trees. In *HISTER*⁴ properly so called (Plate CCXXIII. fig. 22), the præsternum projects beyond the mouth, and the palpi are composed of joints, the last excepted, rather in the form of a reversed cone than cylindrical.⁵

TRIBE 3D, SILPHALES.

In these and the remaining *CLAVICORNES* the legs are inserted at an equal distance from each other, and, with the exception of the eighth tribe (*BYRRHINI*), the legs are not contractile, or at most the tarsi only can be bent upon the tibiæ, the mandibles are generally salient and flattened or not thick, and the præsternum is more dilated anteriorly.

In the *SILPHALES* we find five distinct joints in all the tarsi, and the mandibles terminate in an entire point without fissure or emargination.⁶ The antennæ terminate in a club which is generally perfoliated, and composed of four or five articulations. The internal side of the maxillæ in some is furnished with a horny tooth. The anterior tarsi are frequently dilated in the males, and the exterior margin of the elytra of the greater number is marked by a groove with an obvious border. This tribe is composed of the genus *SILPHA* of Linnæus.

In the genus *NECROPHORUS*, Fab. so named from νεκρός, a carcass, and φέρω, I carry (Plate CCXXIII. fig. 21), the antennæ, scarcely longer than the head, terminate abruptly in an almost globular club of four joints, the first of which is long, and the second much shorter than the third. The body forms nearly a parallelopiped; the thorax is widest anteriorly; all the tibiæ are strong, widened at the extremity, and terminated by strong spurs; the elytra are truncated at right angles. The maxillæ are destitute of a corneous claw.

This important and well-marked genus was first defined by Fabricius. Linnæus had placed the species of which it is composed with the *Silphæ*, while Scopoli and Geoffroy combined them with the genus *Dermestes*. The most marked peculiarity in their manners consists in their habit of interring small animals, such as mice and moles, for the purpose of depositing their eggs in their decaying carcass. To effect this operation, they remove the earth from beneath the dead body, which sinks into the hollow, and is afterwards covered with the looser soil of the excavation. Their sense of smell, like that of many other insects, is extremely delicate, and no sooner has any of the smaller quadrupeds perished, than one or more of these grave-diggers make their appearance, and in a few hours the corpse is interred. The larvæ are of a lengthened form, of a greyish-white colour, with a brown head. Their bodies are composed of twelve rings, furnished on their anterior and superior portion with a small scaly plate or shield, of a ferruginous brown colour; the shields of the last segments are provided with small elevated points. The head is hard, scaly, and furnished with strong cutting mandibles. The feet are six in number, very short, and attached to the first three segments of the body. When these larvæ have attained to their final term of increase, they descend, it is said, fully a foot beneath the surface, and, forming an oval chamber, the walls of which are strengthened by a coating of a gluey liquid, they as-

¹ *Annales des Sciences Nat.* Octob. 1824.

² *Ibid.* Juil. 1825.

³ The generic name is supposed to be derived from *Histrion*, a word of Tuscan or Etruscan root, signifying an actor, and was probably bestowed in consequence of their instinctive propensity to simulate death when handled.

⁴ For the further divisions of this tribe, see Paykul's *Monographia Histeroideum*; and Leach's *Zoological Miscellany*, vol. iii.

⁵ In *Sphærites*, dentations are sometimes found on the internal side.

⁶ *Règne Animal*, t. iv. p. 491.

Coleoptera sume the nymph state. The perfect insect makes its appearance in the course of three or four weeks. There are seven species of this genus in Britain. Dejean possesses twenty-five. They are all of considerable size, and are chiefly from Europe and North America. We have received a specimen from Persia.¹ *N. vestigator* is black, the club of the antennæ, external margin of the elytra, and two transverse bands, orange yellow. *N. humator*, the most common species in Scotland, is a shining black, with the club of the antennæ ferruginous. Neither *N. mortuorum* nor *N. respillo* (the species here figured) are very common in Scotland.

In NECRODES² of Wilkin (Plate CCXXIII. fig. 23) the antennæ are obviously longer than the head, and terminated by an elongated club of five joints, the second of which is larger than the third. Their body is oblong oval, the thorax almost orbicular, widest in the middle. The tibiæ are narrow, elongated, slightly enlarged at the end, and terminated by two ordinary spurs. The elytra are obliquely truncated. We have probably not more than one species in Britain, *N. littoralis* (the species figured), which is black, depressed, and oblong, with the thin terminal joints of the antennæ orange. It occurs on the sea-shore and the banks of rivers, beneath sea-weed, carrion, &c. and is found on the continent of Europe, along with *N. simplicipes*. The others occur in North and South America, New Holland, and Java.

In the genus SILPHA³ the body is almost shield-shaped and depressed, or but slightly elevated. The thorax is semicircular, truncated, or very obtuse before; the exterior margin of the elytra strongly recurved and guttered; the palpi filiform, with the last article almost cylindrical, and in many terminated by a point. Most of these insects feed on carrion, and thus contribute to the more speedy disappearance of putrid effluvia. Some climb upon plants, particularly the stems of wheat and other grain, where they find small *Helices*, on which they prey. Others dwell on trees, and feed on caterpillars.

The genus was originally of great extent, but has been much modified and circumscribed by Fabricius, Dejean, Latreille, Leach, and others. The species which it now contains resemble their congeners in being of an essentially carnivorous nature—preferring animal substances in a state of putrescence to fresher food. They exhale a disagreeable odour, and, when seized, a thick and dark coloured liquid exudes from their bodies. The larvæ resemble the perfect insects in their habits. They consist of twelve segments, of which the sides are terminated by sharp angles, the terminal segment being furnished with two conical appendages; the head is small, and bears a pair of tri-articulate filiform antennæ, and two strong maxillæ. Like the preceding genus, they undergo their metamorphoses under ground. The species are pretty extensively distributed over the earth, and are rather numerous. Dejean enumerates thirty-four species in his Catalogue, which, however, includes under the generic name of *Silpha* the genera *Oiceoptoma* and *Phosphuga* of Dr Leach. Of the restricted genus we have not more than eight British species. Most of these are deep black or dark brown. One of the most ornamental is *S. quadripunctata* (Plate CCXXIII. fig. 24), of which the margins of the thorax and the elytra are pale-yellow, the latter with two round black spots on each. We took this rare

Scottish insect some years ago near Curric, in the vicinity of Edinburgh. It has since been brought to us from Loch Tay by Dr Greville. It is more frequent in England, where it frequents oak woods for the purpose of preying on lepidopterous larvæ.

TRIBE 4TH, SCAPHIDITES.

In these the mandibles are cleft or bidentated at the extremity. The tarsi are composed of five very distinct and entire joints. The body is oval, narrowed at either end, arcuated or convex above, and thick in the middle. The head is low, and received posteriorly into a trapezoidal thorax, slightly bordered, broadest behind. The antennæ are generally as long at least as the head and thorax, and are terminated by an elongated mass of five articles. The terminal joint of the palpi is conical. The legs are slender and elongated. With the exception of the *Cholevæ*, the tarsi are nearly the same in both sexes.

In this tribe we place the genera SCAPHIDIUM⁴ of Olivier, and CHOLEVA of Spence;⁵ of the former, *S. maculatum* is the only British species,—the rest inhabiting North and South America, and some of the continental countries of Europe. Of the latter, Mr Spence has described eighteen British species, arranged in three sections, of which some of the constituent parts are referable to the genus *Ptomophagus*⁶ of Illiger and Knock, to *Luperus*⁷ of Frœlich, and *Catops* of Fabricius and Paykul. Only two or three of Mr Spence's species belong to the genus *Choleva* in its present restricted form.

TRIBE 5TH, NITIDULARIÆ.

The Nitidulariæ approach the Silphales in their scutiform and bordered body, but the mandibles are bifid or notched at their extremity; the tarsi seem to consist of only four joints, the first and last, in some, being only visible beneath, where they form but a slight projection,—in others the penultimate is extremely small, in the form of a knot, inclosed within the lobes of the preceding. The club of the antennæ is always perfoliate, of three or two joints, and is usually short or but slightly elongated. The palpi are short and filiform, or somewhat thickest at the extremity. The elytra in several are short or truncated. The legs are but slightly elongated, and their tibiæ frequently widened at the end; the tarsi are furnished with hairs or pellets. These insects are of various habits, according to the species. They occur on flowers, in mushrooms, beneath the bark of trees, and even on putrid meat. This tribe is composed of the genus NITIDULA, as subdivided into COLOBICUS, THYMALUS, IPS, NITIDULA (proper) (Plate CCXXIII. fig. 25), CERCUS, and BYTURUS.

In the restricted genus NITIDULA,⁸ the antennæ are short, abruptly clavate, the radical joint large, thick, and somewhat orbicular, the third above one half longer than the fourth, the three last forming a club. Nearly thirty species occur in Britain. Many others are found in Europe and America.

TRIBE 6TH, ENGIDITES.

These resemble the preceding in the emargination of the extremity of the mandibles, which however project but slightly, and that laterally, beyond the labrum. Their body is oval or elliptical, with the anterior extremity of the head a little advanced in an obtuse or truncated point.

¹ For notices of their anatomical structure, see Dufour, in *Ann. des Sciences Nat.* for October 1824 and July 1825.

² Probably from νεκρωδης, cadaverous.

³ The word *Silpha*, derived from a Hebrew root, occurs in Aristotle, and appears to have been sometimes used by that author to signify a cockroach.

⁴ From Σκαφη, a boat, and ιδεα, form.

⁵ *Linn. Trans.* vol. xi.

⁶ From πτομα, a carcass, and φαγω, I eat.

⁷ From λυπερος, troublesome.

⁸ From nitidus, shining, or bright.

Coleoptera The tarsi consist of five distinct joints, entire, and at most only slightly pilose beneath, the penultimate being somewhat shorter than the preceding joint. The antennæ terminate in a perfoliate club of three articulations. The elytra completely cover the abdomen, and the palpi are somewhat thickened at the extremity. Some very minute species live in the interior of houses, and are frequently found on window-sashes. They constitute the genus *DACNE*, divisible into, 1st, *Dacne* proper (*Engis*, Fab. *Erotylus*, Oliv.), in which the antennæ terminate abruptly in a rather large, orbicular, or ovoid and compressed club, composed of crowded articulations, of which the central one at least is much wider than long, and the third longer than that which precedes and follows; the centre of the posterior margin of the thorax is dilated behind or lobed, and the upper extremity of the mentum is advanced, and terminated in a truncated or bidentated point: 2d, *Cryptophagus*,¹ Herbst, Lat. (*Dermestes*, Linn. *Ips*, Oliv. *Antherophagus*, Knock), in which the antennæ are moniliform, with the second article as large or larger than the preceding, and terminate in a less abrupt and narrow club than in *Dacne*, and with intervals between its segments. This is a pretty extensive genus, occurring in various parts of the world, but chiefly in European countries. We have fourteen species in Britain.

In Latreille's arrangement (*Règne Animal*, t. iv. p. 508) we now come to certain tribes in which the præsternum is frequently dilated anteriorly in the manner of a chin-cloth (*mentonnière*), and which differ from the preceding in their legs being more or less contractile. The tarsi may be free, but the tibiæ, at least, are folded upon the thighs. The mandibles are short, usually thick, and dentated. The body is ovoid, thick, and furnished with deciduous scales or hairs of various colours. The antennæ are generally straight, and shorter than the head and thorax. The head is sunk into the thorax as far as the eyes. The thorax itself is but slightly if at all bordered; it is trapezoidal, and wider posteriorly, the middle of the posterior margin being frequently somewhat prolonged or lobate. The larvæ are pilose, and dwell for the greater part on the skins or carcasses of animals. They are hurtful in museums. Those in which the legs are not completely retractile, the tarsi being always free, and the tibiæ lengthened and narrow, form

TRIBE 7TH, DERMESTINI.

In *DERMESTES* proper (so called from *δερμα*, *skin*, and *σθω*, *to eat or consume*) the antennæ are shorter than the thorax, the radical joint large and ovate, the seven following short and slender, the remaining three forming an ovate compressed club, of which the two lower joints are somewhat dilated in the inner side, the terminal being smaller and rounded. They are not received in a particular groove beneath the thorax. *D. lardarius* (Plate CCXXIII. fig. 27) is black, pubescent, the elytra with a broad cinereous band across the base, in which are three brownish or black spots. In *ATTAGENUS* the club of the antennæ is proportionally very large, almost serrated, and composed of three articles, of which the first and last, especially in the males, are the largest. The body is ovoid, short, slightly convex. The terminal article of the maxillary palpi is large and ovoid. In *ANTHRENUS*² the club of the antennæ is more solid than perfoliate, and is in the form of a reversed cone, and lodged in a short cavity, hollowed beneath the anterior angles of the thorax. In the larva state these insects live on dried animal matters, par-

ticularly on the contents of entomological cabinets. In **Coleoptera** that condition they are oval, and furnished with hairs, some of which are dentated; they form aigrettes or tufts, of which the hinder are prolonged in the form of a tail. In **Pentamera.** the perfect state they are found among flowers. Other genera, such as *Limnichus* of Ziegler, *Trogoderma* and *Globicornis*, Lat., pertain to this tribe.

TRIBE 8TH, BYRRHII.

This tribe is composed principally of the genus *Byrrhus* of Linn., and differs from the preceding in its feet being entirely contractile, the tibiæ being susceptible of being bent upon the thighs, and the tarsi upon the tibiæ, so that the species, when their limbs are thus contracted, appear inanimate and without legs. The latter are usually broad and compressed. The body is short and convex.

In *NOSODENDRON*, Lat. (of which we have one British example, *N. fasciculare*), the mentum is entirely exposed, large, and buckler-shaped. In *BYRRHUS* proper the mentum is of ordinary dimensions, and as it were interlocked, at least partially, by the præsternum, of which the anterior portion is dilated. The larvæ of these insects have been studied by M. Wadouer. Their heads are large, their bodies narrow and elongated, with the two terminal segments more extended than the others; the first, or that of the prothorax, presents superiorly a large corneous plate. The genus was confounded by Degeer with *Dermestes*, and with *Cistela* by Geoffroy. The species occur in fields, woods, and sandy places. They are not unfrequent by the side of highways, and although they can fly with facility when they choose, they rarely exercise that faculty. When handled or even approached, they apply their legs and antennæ so close to the body as to exhibit the appearance of a little ball, and in that state they simulate death with great perseverance. Of eight or nine species found in Britain, we shall here name only *B. æneus*, an interesting species, lately added to the British Fauna by the Rev. James Duncan. It is oblong-ovate, brassy green above, scutellum whitish, the elytra irregularly punctured, and without striæ. It was found in an open part of a wood near Newbattle House in Mid-Lothian. It has since occurred under stones on Musselburgh Links, has been taken in Dumfriesshire, and was met with by Dr Greville in considerable numbers near the ferry of Kyle-stroem in Sutherland. There are thirty-three species in Dejean's collection.

SECTION 2d. The *CLAVICORNES* of this section, although forming a good natural group, can only be characterized by the assemblage of several features. Some which are nearest to the *PALPICORNES* have antennæ of only nine or even six joints. Others have ten or eleven joints to these organs, which are sometimes scarcely longer than the head, and from the third joint form an almost cylindrical or fusiform club, arcuated and somewhat serrated; sometimes nearly filiform, and as long as the head and thorax. In this case, as well as among most of the other genera of the same division, the tarsi are terminated by a large joint, with two strong hooks at the end. In certain genera, such as *Heterocerus* and *Georyssus*, these parts consist of only four articulations. The form of the body in this section is generally ovoid, with the head sunk up to the eyes in a trapezoidal thorax laterally bordered, and terminated posteriorly by acute angles. The præsternum is dilated poste-

¹ From *κρυπτος*, *hidden*, and *φαγος*, *eating*.

² *Anthrenus* is the ancient name of an insect which dwelt among flowers,—a kind of bee.

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Pentamera.

riorly (the Potamophili excepted), and the legs are imperfectly contractile. They usually occur in water, beneath stones by river sides, or in mud. They form two tribes.

TRIBE 1ST, ACANTHOPODA.¹

Remarkable for their broadish flattened legs, armed exteriorly with spines. The tarsi are short, of four articulations,² the hooks of ordinary size. The body is depressed, and the præsternum dilated. The antennæ are rather longer than the head, arcuated, and composed of eleven joints, of which the last six constitute an almost cylindrical and slightly serrated club, the second being short and not dilated. This tribe is composed of the single genus *HETEROCERUS*³ of Bosc (Plate CCXXIII. fig. 26).

TRIBE 2D, MACRODACTYLA.⁴

Here are included such of the Clavicornes as have simple narrow tibiæ and lengthened tarsi, all composed, except in *Georyssus*, of five articulations, the last of which is large, with strong terminal hooks. The body is thick or convex,—the thorax less rounded, and usually terminated on both sides by acute angles.

The type of this tribe is formed by the genus *Dryops* of Olivier—*Parnus*, Fab. We here place the genus *ELMIS*,⁵ of which the species, pretty frequent in Britain, occur in water, beneath stones, or on the leaves of water-lilies. In *PARNUS* proper (*Dryops*, Lat. Oliv.) the antennæ, shorter than the head, are lodged in a small cavity beneath the eyes, the second joint being compressed and much produced,—concave for the reception of the remaining joints, which form a serrated mass attached by a small peduncle near the base. *P. prolificornis* is oblong, olive brown, villose, with the clytra thickly punctured, and obscurely striated towards the sides and apex. It occurs in moist places by the sides of ponds and marshes, not unfrequent during spring. Here are also placed the genera *Potamophilus* of Germar, *Macronychus* of Müller, and *Georyssus* of Latreille.

FAMILY V.—PALPICORNES.

In this family, as in the preceding, the antennæ are terminated by a kind of club, usually perfoliate, but composed at most of only nine articulations, and inserted beneath the advanced and lateral margins of the head, and scarcely longer than it and the maxillary palpi,—frequently even shorter than these last-named organs. The mentum is large and buckler-shaped. The body in this family is generally ovoid or hemispherical, and arched or convex. The feet in most of the genera are formed for swimming, and these present either four articulations to the tarsi, or five, of which the first is much shorter than the second: the whole are entire.

TRIBE 1ST, HYDROPHILII.

Feet fit for swimming. First article of the tarsi much shorter than the others. Maxillæ entirely corneous. Of this tribe (genus *Hydrophilus* of Geoffroy) Linnæus formed only a division of his genus *Dytiscus*. Their anatomical structure however differs in many important particulars from that of the true *Dytisci*. The digestive canal, which is four or five times as long as the body, presents a strong

analogy, both in its length and texture, to that of the Lamellicornes, and differs from that of the Carnivora except as regards the biliary vessels. We perceive neither the swimming bladder nor the excremental apparatus, such as these exist among the Hydrocanthari. In the females only, the latter is replaced by secreting organs fitted for the formation of a cocoon to contain the eggs. The sexual organs of the male bear a great resemblance to those of the preceding family. These and other considerations have induced M. Latreille to place them here. The species are more convex in their general forms than the *Dytiscidæ*, and their antennæ are dissimilar; but in many of their instincts and habits of life, and in their general transformations, they bear a resemblance to that group. The largest water insect of Great Britain (*Hydrophilus piceus*), which we have failed as yet to discover in Scotland, belongs to this division. Many species are also extremely minute.

In the genus *HELOPHORUS* of Leach (from ἑλος, a marsh, and φορέω, I penetrate) the antennæ are shorter than the head, the first joint is the longest, robust, and slightly curved, the second shorter than the first, the three following minute, the last four forming the club. *H. aquaticus* (Plate CCXXIII. fig. 29) abounds in almost every pond. It is almost always found covered with mud, in such an ingenious manner that, when feeding in its little pool, it is with difficulty distinguished from the subjacent soil, either by its natural enemies, or the no less dangerous eye of the practical entomologist. *H. granularis* is more frequently found upon the wing in situations remote from water. In *HYDROCHUS* of Germar (from ὕδωρ, water, and οἰκῶ, to inhabit) the general form is narrower and more elongated, the thorax like a lengthened square, and the eyes prominent. *H. brevis*, a rather scarce species, occurs in the Edinburgh district in ditches near Craigcrook, and in the Braid marshes. As allied to the preceding genera we may here name *ENICOCERUS* of Stephens (so called from ἐνικός, singular, and κέρας, horn). The antennæ are as long as the head, the basal joint long, curved, slightly geniculate at the base, the second ovate-truncate, three or four following very minute and obscure, the last five of nearly equal thickness, penultimate cup-shaped, terminal orbicular. *E. viridiæneus*, of a brassy green, thorax with an oblique groove near each of the hinder angles, and two foveæ in front, the legs piceous. Although a newly described insect, it does not seem at all scarce in Scotland, where it occurs beneath small stones by the margins of water, or imbedded among mud and confervæ. In the genus *SPERCHÆUS*, Fab. the antennæ have only six joints, and the clypeus is emarginate. In *HYDROPHILUS*,⁶ properly so called, of Leach, the tarsi are identical in both sexes and not dilated, the pectoral spine terminates with the præsternum, and the scutellum is proportionally small. *H. caraboides* is the only British species. The genus *HYDROUS* of the last-named author⁷ (*Hydrophilus*, Lat.) is characterized by the great extension backwards of the sharp-pointed sternal spine, and by the triangular-shaped dilatation of the last article of the two anterior tarsi of the males. The scutellum is large. *H. piceus* (Plate CCXXIII. fig. 28), the only British species, is one of the largest of the European Coleoptera. It measures above an inch and a half in length, is of an oval form, a blackish-brown colour, with a polished or shining surface. The club of the antennæ is partly reddish. A

¹ From ακανθα, a thorn or spine, and ποῦς, foot.

² According to the accurate Gyllenhal, there are actually five, the first being small and oblique. (*Insecta Succica*, t. i. p. 138.)

³ From ἕτερος, different, and κέρας, horn.

⁴ From μακρός, long, and δακτυλος, finger.

⁵ The name is applied by Galen to a species of intestinal worm.

⁶ From ὕδωρ, water, and φιλος, a lover.

⁷ *Zoological Miscellany*, vol. iii. p. 94.

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Pentamera. few slight striæ are visible on the elytra, of which the posterior extremity is rounded posteriorly, and prolonged to a small tooth at the inner angle. This fine insect flies well and swims swiftly, but is inefficient as a pedestrian. When held loosely in the hand it sometimes inflicts a wound with the point of the sternum. The female constructs an ovoid cocoon, arcuated, and of a brown colour. Its exterior tissue is composed of a gummy paste, at first somewhat fluid, which soon hardening, becomes impenetrable by water. The eggs which it envelopes are symmetrically disposed, and kept in their position by a sort of whitish down. These cocoons float in the water.¹ The larva is depressed, blackish, and rugose; the head reddish brown, smooth, round, and capable of being drawn backwards. This peculiar faculty gives it the power of seizing whatever small shells or other living prey it may perceive floating on the surface. Its back serves it as a kind of table, on which it bruises its prey. The bodies of these predaceous larvæ become very flaccid as soon as they are caught. They swim with facility, and are provided beneath the anus with two fleshy appendages, which serve to maintain them at the surface of the water when they ascend to breathe.² They are called on the continent *vers-assassins*, on account of their greedy and ferocious nature. They become more herbivorous in the perfect state.

In LIMNEBIUS of Leach (from *λῆμνη*, a marsh, and *βίος*, life), the antennæ are short, slender, the club six-jointed; the maxillary palpi longer than the antennæ, with the terminal article shorter than the preceding, and cylindrical. In this tribe are likewise included the genera *Hydrobius* and *Berosus*.

TRIBE 2D, SPHÆRODIOTA.

These Palpicornes differ from the preceding in being terrestrial. Their tarsi consist of five distinct articulations, of which the first is at least as long as the following. The maxillary palpi are shorter than the antennæ, with the third joint larger, inflated, and in the form of a reversed cone. The maxillary lobes are membranous. The body in this tribe is almost hemispherical, with the præsternum prolonged to a posterior point, and the tibiæ spinous, the anterior being palmated or digitated in the larger species. The antennæ are always composed of nine articles, or simply of eight, if we regard the terminal one as an appendage of the preceding. The genera are CERCYON of Leach, and SPHÆRIDIMUM³ of Fabricius (Plate CCXXIII. fig. 30). The former is abundant in Britain, where we find about sixty species, many of which occur in Scotland.⁴ Few are as yet ascertained to inhabit extra-European countries, although one or two occur in North and South America. All the species of this tribe are of small size. They usually occur in cow-dung, and excrementitious matter. Some are found on the margins of water.

FAMILY VI.—LAMELLICORNES.*

This is the last family of the pentamerous Coleoptera, and one of the most remarkable of the order,—whether we consider the great size of many species, the singularly varied forms of their head and thorax, or the richness of the metallic colouring with which the vegetable-eating kinds are frequently adorned.

The antennæ, inserted in a deep groove beneath the lateral margin of the head, are always short, and composed generally of nine or ten articulations; they are always terminated in a club or mass, which usually consists of three joints, expanded in the form of thinnish plates or leaves, disposed in various ways,—like the spokes of a fan, the leaves of a book, the teeth of a comb, or a series of funnels placed above and within each other. The body is generally ovoid or oval, and thick. The exterior edge of the two anterior tibiæ are toothed, and the articles of the tarsi, with the exception of certain males, are entire, and without brush or pellet beneath. The anterior extremity of the head is advanced and dilated in the form of a clypeus or epistoma. The mentum is usually large, covering the ligula, or incorporated with it, and bearing the palpi. The mandibles of many are membranous, a character scarcely if at all to be observed in any other Coleoptera. The males are frequently very different from the females, being distinguished by horn-like elevations on the head and thorax, and by the greater size of the mandibles. Linnæus indeed founded the sections of his great genus *Scarabæus* in accordance with these peculiar projections, while Scopoli assumed the spines or teeth of the fore-legs as the distinguishing characteristic of his subdivisions. The latter author likewise proposed two other methods, one of which regards the number of articulations in the clava of the antennæ, and the other takes into consideration the varying manners of the insects themselves. The former of these is extremely defective, the second is chiefly deserving of consideration as exhibiting the first attempt ever made towards a natural arrangement of these insects. They are divided into *Anthophylli*, *Phyllophagi*, and *Stercorei*.

Degeer was the first to avail himself of the improvements indicated by Scopoli, while at the same time he avoided his principal imperfections. He arranged the *Scarabæi* into three families, as follows: 1st, *Scarabées de terre*; 2d, *Scarabées des arbres*; 3d, *Scarabées des fleurs*. *Oryctes* and *Trox* were no longer regarded as phyllophagous insects.

Geoffroy separated from *Scarabæus* of Linnæus the exscutellated species under the name of *Copris*, and Scopoli's genus *Lucanus* under the name of *Platycerus*. The institution of the genus *Copris* was certainly an improvement, although it was founded on such defective characters, that coprophagous insects, such as the family *Geotrupini* of Latreille, were included in the same genus with *Cetonia*, from which they might have been perceived to be distinct so soon as the necessity was admitted of carrying the investigation among the *Lamellicornes* somewhat beyond that first affinity—the form of the antennæ.

At a still later period Fabricius further improved upon the heterogeneous composition of Geoffroy's genus *Scarabæus*, by taking from it the genera *Trox*, *Melolontha*, *Cetonia*, and *Trichius*. But the re-union of Geoffroy's genus *Copris* with *Scarabæus* was a retrograde step which the entomologist of Keil afterwards corrected in a supplementary work. The connection, however, between the insects afterwards named *Geotrupes* by Latreille and the genus *Copris* of Geoffroy, was so far re-established by the formation of the Fabrician genus *Scarabæus*.

Olivier adopted the genus *Scarabæus* of Fabricius, with all his other genera except *Trichius*, and divided it into

¹ For a detailed and accurate account of the structure and transformations of this insect, see a posthumous work of the celebrated Lyonnet, lately published under the title of *Recherches sur l'Anatomie et les Métamorphoses de différentes espèces d'Insectes*.

² *Annales du Muséum d'Hist. Nat.* t. xiv. p. 441.

³ See *Ent. Ed.* p. 139.

⁴ From *lamella*, a little plate, and *cornu*, a horn, in allusion to the structure of the club of the antennæ.

⁵ From *Σφαίρονδιον*, globe-shaped.

Coleoptera the following sections: 1st, Those furnished with mandibles, but unprovided with a labium; 2d, those furnished with mandibles and a labium; 3d, those which have neither mandibles nor labium. The three groups just mentioned are characterized by Mr Macleay as strictly natural.¹

This important family, in the system of Latreille, seems to include all those insects classed by Linnæus in the old genera *Scarabæus* and *Lucanus*. The lamellicorn tribes, indeed, include a very numerous assemblage, many of which, especially such as feed on flowers and living vegetation (called *Thalerophaga* by Macleay), are remarkable alike for beauty of form and splendour of colour. Most of those, however, which feed on decomposed vegetables, or excrementitious substances, are usually of a more uniform black or brownish hue. But even the coprophagous kinds sometimes surprise us by their beauty, and present a singular contrast when disentangled from their repulsive habitations. They are all winged insects, although for the most part rather dull and heavy in their movements.

The larvæ are long, semi-cylindrical, soft, of a whitish colour, and divided into twelve rings or segments. The head, of a harder consistence, is armed with strong mandibles. The feet are six in number, and squamous or of a scaly texture. On each side of the body there are nine stigmatic openings. The posterior extremity is the most bulky; it is rounded and almost always curved inwards, in such a manner as to prevent the larva from extending itself in a straight line. Its motions are consequently slow and awkward, and when crawling on the surface it frequently rolls over or falls on one side. The nympha or intermediate state is in some instances not assumed till after the lapse of several years. Immediately preceding the assumption of that state the larva protects itself by means of a cocoon of an oval form, composed of earth and the gnawed fragments of other materials, agglutinated by a viscous secretion which exudes from its body. These larvæ seek their food in the dung of cattle, in tan pits, in gardens where rich vegetable mould occurs, and among the roots of plants. In regard to their interior structure, it has been observed that the nervous system, when studied in the different stages of life, presents a considerable dissimilarity. The ganglions are less numerous, and approximate more to each other, when the insect has reached the term of its final transformation; and the two posterior ganglia throw out numerous filaments disposed in a somewhat radiated form. In the larva the trachea is elastic, but simply tubular in the perfect insect. The structure of the eye in most of the lamellicorn beetles exhibits characters analogous to those of the Tenebrionites, the Blattæ, and other lucifugous or light-shunning species.

The alimentary canal is of great length, especially among the coprophagous kinds; and the chylific ventricle is beset with papillæ, which, according to the investigations of M. Dufour, serve as the receptacles of the alimentary fluids. The biliary vessels resemble those of the carnivorous Coleoptera in number and position, but they differ in being of greater length and much more slender. Latreille divides this important family into two tribes.

TRIBE 1ST, SCARABÆIDES.²

These correspond to the unrestricted genus *Scarabæus* of Linn. Their antennæ are terminated by a foliaceous club, generally capable of being alternately closed or expanded; or are composed of joints that fit into each other, either in the form of a reversed cone, or nearly globular. The mandibles are of identical form, or nearly so, in both sexes; but the head and thorax of the males frequently exhibit projections or peculiar forms. The antennæ in the latter sex are frequently more fully developed than in the females. The alimentary tube in these insects is generally much longer than that of the following tribe, and the œsophagus is proportionally shorter. But it is chiefly by the genital system of the males that the Scarabæides are distinguished, not only from the tribe with which they are conjoined, but from all other pentamerous Coleoptera. The larvæ have a cylindrical stomach surrounded by three ranges of small cæca, the small intestine very short, the colon extremely thick and turgid, and the rectum of moderate size. A prodigious accession of fine typical forms has been received of late years by this division of Entomology, far beyond what we are able to indicate in this work.³ We shall, however, notice the most important and remarkable genera, and illustrate many of these by means of the plates connected with this department of the Encyclopædia.

The following sections are established on the consideration of the masticating organs, the antennæ, and the habits, and have been confirmed by the anatomical researches of M. Dufour.

SECTION 1ST, COPROPHAGI.⁴

In some of these the antennæ are formed of nine, in others of only eight articulations; the three terminal ones forming the club. The labrum and mandibles are membranous and concealed. The terminal lobe of the maxillæ is also of the same consistence, broad and arcuated at the upper margin, and curved inwards. The terminal article of the maxillary palpi is always the largest of all, nearly oval or almost cylindrical; but that of the labial palpi is almost always more slender than the preceding, or very small. Behind each of these latter palpi is a membranous projection, in the form of a ligula. The mentum is emarginate. The sternum presents no particular projections, and the hooks of the tarsi are always simple. The anterior tarsi are frequently wanting in certain species, either naturally or because they are deciduous. The extent of the alimentary canal is always very great, occasionally (as in *Copris lunaris*) even ten or twelve times the length of the body. The chylific ventricle occupies the greater portion; it is beset with papillæ, conoid or in the form of nails, folded on itself, and maintained in that state of agglomeration by numerous tracheal bridles. The intestine is filiform, but terminates in an enlargement. "Les testicules des coprophages disséqués par M. Dufour, lui ont paru composés de six capsules spermatiques, orbiculaires, un peu déprimées ordinairement réunies, par des trachées, en un paquet, portées chacune sur un pédicule tubuleux, assez long, et qui aboutit à un canal déférent de peu de longueur. Il n'y a qu'une

¹ *Hor. Ent.* p. 17.

² The *Scarabæides*, as restricted by Macleay, are chiefly tropical forms, that is, the species in the warmer regions of the earth are to those from beyond the tropics nearly as five to one. Out of 450 species and upwards, in the collection of Mr Macleay senior, only nine are natives of England, and of these eight are *Onthophagi*.

³ Comte Dejean informs us that his collection now contains 2060 species of *Lamellicornes*, among which he has found himself under the necessity of establishing 76 new genera.

⁴ From *Κοπρος*, dung, and *φαγος*, eating.

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Pentamera. paire de vesicules séminales; elles sont filiformes, très longues et fort repliées."¹ Our present section corresponds to the third division of the genus *Scarabæus* of Olivier (*Copris*), with the addition of some other *Scarabæi* (*Aphodii*) of that author.

*

In some the intermediate pair of legs are much more remote from each other at the base than the rest; the labial palpi are hairy, with the terminal articulation much smaller than the others, or even indistinct; the scutellum is either null or extremely small.

Coprophagi of this division, peculiar to the eastern continent, with a rounded body, usually depressed above, or but slightly convex, similar or differing little in the sexes, and without horns; the antennæ of nine joints, terminated by a foliated club; without either scutellum or a sutural hiatus indicating its place; the four posterior tibiæ, usually furnished, as well as the tarsi, with ciliated or hairy fringes, and slender, elongated, not dilated at the extremity, or but slightly so, truncate obliquely, and terminated by a single strong-pointed spur; with the epistoma more or less dentated;—these form the genus *ATEUCHUS*² of Weber and Fabricius. (Plate CCXXIV. figs. 1 and 2.)

The above genus, however, has been since restricted to such species as have the exterior margin of the elytra straight or unemarginated, and without a sinus, near the base, leaving exposed the corresponding portion of the upper margin of the abdomen. The tibiæ and tarsi of the last four legs are furnished with long hairs; the first four articles of the tarsi are generally longer than the others. The first joint of the labial palpi is almost cylindrical, or in the form of a reversed cone. The epistoma is generally divided into three lobes or festoons, and its contour presents six teeth. The *Ateuchi* form the genus *Scarabæus* of Macleay.³ These insects deposit their ova in dung, which they form into balls, and roll along with their hind legs till they find a hole adapted to receive them, or a softish soil in which they may be buried. Two species were worshipped by the ancient Egyptians, and form a noted and conspicuous feature in the hieroglyphical system of that mysterious nation. We still find them sculptured on their monuments, in various positions, and sometimes of gigantic size. They were also formed into separate figures, as seals and amulets, composed of gold and other precious materials, and hung around the necks of the living, or buried along with their famous mummies. The insect itself in the natural state is also sometimes found in their gaudy coffins.

The *Ateuchus sacer* (Plate CCXXIV. fig. 2) occurs not only in Egypt, where it formed an object of superstitious worship, but over a great portion of the south of Europe. It is also found in the western regions of Asia. Another species, discovered in Sennaar by M. Caillaud, was, however, according to M. Latreille, the first to attract the notice of the Egyptians.⁴ It is named *A. Egyptiorum*

(ibid. fig. 1), and, instead of being black like the former, is green with a golden hue. The occiput also, instead of being bi-tuberculated, exhibits only a slight elongated eminence, which is smooth and shining.

In *GYMNOPLEURUS* of Illiger, the exterior sides of the elytra are strongly emarginate near the base. The four posterior tibiæ are in general simply ciliated, or furnished with small spines, and the last article of the tarsi is as long, if not longer, than all the preceding ones taken together. The first article of the labial palpi is dilated internally and almost triangular. There is a fossula on each side of the thorax.⁵

Other Coprophagi, nearly allied to the preceding, and likewise placed by Fabricius among the *Ateuchi*, are distinguished by the intermediate tibiæ, the extremities of which, as well as of the two hinder ones, are frequently clubbed or dilated, and present two spurs or spines. The epistoma in many has only four or two teeth. The first article of the labial palpi is always larger than the following, and dilated on the internal side. The third and last article is distinct. We shall here name only the genus *SISYPHUS*, which differs from the others in having only eight joints in the antennæ. The form of the abdomen is triangular, and the intermediate and hind legs are long and narrow, with the thighs clubbed.

In all the ensuing Coprophagi the intermediate and hind tibiæ are always dilated at their extremity, and almost in the form of a lengthened triangle; the intermediate pair terminate, like those of the preceding, in two strong spines; but the head or thorax, or both these parts, of the males, are distinguished by horns or marked projections. In several the last three articulations of the antennæ are semi-cupular, and concentrically fitted into each other. These insects are referable to the genera *Onitis* and *Copris* of Fabricius.

The genus *ONTHOPHAGUS*,⁶ Lat. (ibid. fig. 3) (which, in common with *ONITICELLUS* of Dejean, has the third joint of the labial palpi small or indistinct, and the preceding larger than the first), exhibits a short body with a thickish thorax, broader than long, and semi-orbicular or nearly orbicular, but strongly emarginate or truncated in front. The head, and frequently the thorax also, is horned in the males. The scutellum is not apparent. Of this genus we have eight or ten species in Britain. Dejean's Catalogue contains 150. Some beautiful species of small size occur in Africa and the East Indies. They are likewise met with in New Holland, where they constitute the principal portion of the coprophagous beetles, which seem rare in that vast region, a circumstance attributed by Mr Macleay to the absence of all large herbivorous mammalia, except of the marsupial kind.

Two other genera, furnished with a scutellum or a sutural hiatus, with the anterior legs often deprived of or unprovided with tarsi, and frequently long, slender, and curved in the males, are distinguished from all other Co-

¹ *Règne Animal*, t. iv. p. 531.

² Probably from α priv. and $\tau\epsilon\upsilon\chi\omicron\varsigma$, an instrument of war, the head being unarmed.

³ The genus *Scarabæus* of Macleay (*Ateuchus* of most modern authors) is proper to the ancient world. Of the forty-three species which compose its five types, as exposed in the *Horæ Entomologicae*, twenty-seven occur in Africa. The first type extends from the Atlantic Ocean to Thibet, and from Austria to the Cape of Good Hope. It contains the following species:—*S. (HELIOCANTHARUS) sacer*, *Dufresnii*, *pius*, *Bonelli*, *Hottentotus*, *impius*, *Lamarckii*, *Cuvieri*, *Sanctus*, *Palæmon*, *intricatus*, *puncticollis*, *Spencii*, *Degeri*, *Savignii*, *morbillosus*, *laticollis*, *variolosus*, *semipunctatus*. Type second contains as yet only a single species, from the north of Africa, *S. (MNE-MATIUM) Ritchii*. The third type seems confined to the south of Africa, and includes *S. (PACHYSOMA) Æsculapius* and *Hippocrates*. The existence of the fourth type is inferred upon general principles, and from an observed hiatus in the series of affinities, but has not yet been specially detected. The fifth type inhabits all that tract of country which extends from the Atlantic Ocean to the Chinese Sea, and from Paris to the Cape of Good Hope, and contains *S. (GYMNOPLEURUS) azureus*, *nitens*, *mundus*, *sinuatus*, *pilularius*, *Sturmii*, *atrouitidis*, *flagellatus*, *humanus*, *Leei*, *Bufo*, *fulgidus*, *cærulescens*, *affinis*, *cyaneus*, *Königii*, *granulatus*, *parvus*, *miliaris*, *spilotus*, *maculosus*.

⁴ *Description des Insectes recueillis par M. Caillaud*, forming part of his *Voyage en Nubie*.

⁵ For the other genera, see *Règne Animal*, t. iv. p. 405. Consult also *Hor. Ent.* p. 494.

⁶ From $\omicron\upsilon\lambda\omicron\varsigma$, dung, and $\phi\alpha\gamma\omicron\varsigma$, eating.

Coleoptera prophagi by the form of the club of the antennæ; its first joint (or the seventh of the whole, counting from the base) being sub-triangular, and receiving within it the ensuing, of which the inner margin is shaped like a horse-shoe; the third or terminal article is in the form of a reversed cupula. The thorax is large, and usually exhibits two depressions near the middle of its posterior margin. In *ONITIS*, Fab., the second article of the labial palpi is the largest of all; and the scutellum, though small and sunken, is yet visible. The anterior legs are generally long, slender, and curved in the males, and the tarsi are often absent. The thorax, with a few exceptions, is without horns. In *PHANÆUS* of Macleay (*Copris*, *Onitis*, Fab.), Plate CCXXIV. fig. 4, the first article of the labial palpi is the largest, and dilated on the inner side. A simple sutural void indicates the place of the scutellum. This genus is composed of large and beautiful species, chiefly from the equinoctial regions of the new world. The males differ greatly from the females in regard to the horn-like processes which frequently characterize the head and thorax of the former; but the respective length of the legs does not differ between the sexes, as in the preceding genus.

The genus *COPRIS*¹ (Plate CCXXIV. fig. 5), as now restricted by Latreille, contains those species only the antennæ of which are terminated by a trifoliate club; the four anterior tibiæ strongly dilated and truncated at the extremity; both scutellum and hiatus wanting; the body thick, and differing on its upper surface in the sexes; and the labial palpi composed of three distinct joints, of which the first is the largest, almost cylindrical, and not dilated on the inner side. The largest species of this numerous genus (there are eighty-four in Dejean's collection, of which, however, scarcely half a dozen are European, and only one, *C. lunaris*, occurs in England) are indigenous to the warmer countries of Asia and Africa.² Many species are likewise native to the new world.

* *

In others the legs are inserted at equal distances from each other; the scutellum is distinct; the labial palpi smooth, or but slightly haired, with the third and terminal article larger, or at least longer, than the preceding.

In the genera of this subdivision of the Coprophagi the elytra entirely envelope the contour of the abdomen, to which they form as it were an arched covering,—a character by which they approach the ensuing section. They are, however, closely related, by the structure of their legs and antennæ, to the preceding genera; although the sexual differences are less pronounced or apparent, and frequently consist merely in small tubercles instead of horns. All the species are of small size, and some of them are among the most frequent of the British Lamellicornes. They constitute the family *Aphodiidae* of the English entomologists. These insects are extensively distributed over the whole of the north temperate zone; and Mr Macleay has made out the proportion of tropical species to be to those from countries beyond the tropics as one to eight. According to the same authority, none have hitherto been brought from New Holland, although several occur at the Cape of Good Hope, which is nearly of the same south latitude. It is probable, however, that if the marine detritus of New Holland were properly searched, some insects at least approaching to *Psammоди* in habit would occur.³

Although these insects closely resemble each other in general structure, they yet differ rather widely in their modes of life. They are not all coprophagous, strictly speaking, for several prefer vegetable matter, for the most part marine, in a state of putrescence. We shall notice the two principal genera. In *APHODIUS*,⁴ Fab. (Plate CCXXIV. fig. 6), the last article of the maxillary palpi is cylindrical, and that of the labial more slender than the preceding. The maxillæ have no appendage, or corneous and dentated lobe, on the inner side. The species of this genus are slow of foot, but they fly with facility; and their appearance is interesting, as denoting the "ethereal mildness" of returning spring. They are common in cow pastures. We received the species figured on the plate referred to (*A. bipunctatus*) from the south of Russia. Above fifty species occur in Britain, and three times that number are known to naturalists. In *Psammоди*, Gyllenhal (so named from *ψαμμος*, sandy, in reference to the places of their most frequent occurrence), the last article of the palpi is almost oval, and longer and thicker than the others, and the internal lobe of the maxillæ is corneous, and divided into two dentations.

SECTION 2D, ARENICOLI.

The groups of this section have one character in common with the two genera last mentioned, that the elytra entirely cover the posterior extremity of the abdomen; but their other features are distinctive. The labrum is coriaceous, and generally projects beyond the epistoma. The mandibles are corneous, and usually curved and salient. The terminal lobe of the maxillæ is straight, and not curved inwards. The third and last article of the labial palpi is always very distinct, and always at least as long as the preceding. With few exceptions, the antennæ consist of from ten to eleven articulations. Like the preceding insects, however, these also live in dung, beneath which they dig holes in the earth. Their principal period of flight is during the evening, after sunset. When touched they counterfeit death.

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In this subdivision the labium is terminated by two lobes or projecting ligulæ; the mandibles are generally salient and curved; the labrum is exposed in whole or in part; the antennæ, in the greater number, are composed of eleven articulations. The body is black or reddish, with the elytra smooth or simply striated. The males are generally distinguished from the females by horn-like projections and other external characters. They affect more especially excrementitious substances.

In the genera *ÆGIALIA* of Lat. and *CHIRON* (Plate CCXXIV. figs. 7 and 11) of Macleay, the antennæ are only nine jointed. In the latter their terminal club is rather semipectinated than foliated, and the species are placed by some with *Passalus*.

In the subsequent genera the antennæ are considered to consist of eleven joints, although the computation varies according to the view which may be adopted of the exact structure of the articulations. The genus *LETHRUS*, Scopoli, is distinguished from all the others by the form of the antennal club, like a reversed cone, and composed of leaflets contorted into a kind of funnel, and fitted concentrically into each other; and by the mandibles,

¹ From *κοπρος*, dung.

² The fine insect which, following the nomenclature of M. Fischer of Moscow (*Entomog. de la Russ.*), we have represented as an *Ateuchus* (see Plate CCXXIV. fig. 8), is, we understand, regarded by Latreille as belonging to the genus *Copris*.

³ *Hor. Ent.* i. p. 58.

⁴ From *αφδος*, dung.

Coleoptera which are entirely dentated and serrated on their inner side, and present a corneous advancement underneath, especially in the males. *L. cephalotes* is said to be extremely injurious to cultivated grounds, where it attacks the scarcely visible buds and leaves of plants, cutting them cleanly off with its mandibles. It is hence called *Schneider* in Hungary, where it sometimes proves very hurtful to the vines. This species (there are only two or three others known) lives in holes in the earth, and fierce battles take place during the nuptial season between the males when aspiring to the favour of the gentler sex. The antennal club of the remaining Arenicoli is composed of ordinary-shaped leaflets, placed one on another like the leaves of a book. In *GEOTRUPES* of Lat. (Plate CCXXIV. figs. 9 and 10) named from *γη*, the earth, and *τρύπαω*, to bore, in reference to their excavating propensities, the club of the antennæ is oval or ovoid, and the edges of all the leaflets are perceptible even when the part is contracted. The labrum forms a transverse square, entire, or simply dentated. The mandibles are curved, greatly compressed, dentated at the extremity, and frequently sinuated on the inner side. The species are pretty numerous, and occur both in Europe and America. Some are common in Britain, especially *G. stercorarius*, a large black beetle, with brilliant metallic blue or purple reflections on the under surface, well known as "wheeling its drowsy flight" during fine evenings. We have often been amused by the different devices made use of by insects to deceive their enemies. While the Byrrhidæ, and several other tribes already alluded to, contract their limbs when alarmed, so as to give themselves the appearance of a little ball of inert matter in no way tempting to any insectivorous creature, the species above named pursues an opposite line of conduct, and sticks out its legs at full length, where it holds them perfectly still and rigid, so as to produce the same appearance as if it had been long deprived of life. It is thus supposed to deceive the cunning rook and other birds, which value it chiefly as a living prey.¹ In *BULBOCERAS*² of Kirby (Plate CCXXIV. figs. 12, 13, and 14), one of the mandibles is simple at the extremity, while the other is dentated. The genus is also distinguished from the preceding (in common with *Athyreus* and *Elephastomus* of Macleay) by having the club of the antennæ large, orbicular, or nearly globular, with its first and last leaflet, when the part is contracted, completely enveloping the tenth or intermediate, and forming for it a kind of box (see figs. 13 and 14).

In *Hybosorus* and *Acanthocerus* (placed in different families, the former in *Geotrupidæ*, the latter in *Trogidæ*, by Macleay³), the antennæ consist, as in most of the subsequent Scarabæides, of ten articulations.

* *

In this our second subdivision of the *ARENICOLI*, the antennæ, scarcely longer than the head, are composed of ten articulations, of which the first is large and hirsute. The ligula is entirely concealed by the mentum. The labrum and mandibles are but little exposed, and the latter are thick. The palpi are short, the mentum very hairy. The inner side of the maxillæ is armed with teeth. The body, of a cinereous or earthy hue, is rough or tuberculated on the upper surface. The head is inclined, and terminates in an angle or point. The thorax is short, transversal, without lateral borders, sinuated posteriorly, with the

anterior angles advanced. The abdomen is large, arched, and covered with very hard elytra. The anterior legs are advanced, and their thighs cover as it were the lower surface of the head. Coleoptera
Pentamera.

These insects form the genus *Trox*⁴ of Fabricius and Olivier. They generally occur on sandy soils, and are supposed by Latreille to feed on the roots of plants. We suspect that our knowledge is still extremely vague regarding their habits of life and modes of transformation. It is certain that they are attracted by dried bones and other cadaverous remains, but it is difficult to determine whether this is owing to the peculiar colour, or the nature of the animal substance. Pallas observes, "sub cadaveribus æstivo ardore exsiccatis cum Histeribus et Dermestibus hospitatur;" but it by no means follows from that peculiarity of position that the insect partakes of the carcass, any more than that numerous other species which seek the secure covering of a rock or mass of stone, are in the habit of devouring these inorganic matters. We may further remark that the Troges are the only petalocerous insects among which we find an apterous species,—the *T. horridus* being destitute of wings. It forms the genus *Phoberus* of Macleay, and is worthy of consideration as probably destined, when its habits are better known, to throw some light, either by agreement or opposition, on the history of its congeners, and the value of the groups into which they have been divided. These in general are supposed to delight in cadaverous substances: all insects intended to live on animal matter, partially distributed and collected in masses, are provided with wings, which convey them rapidly (with the joint guidance of the sense of smell), to those decaying objects which they instinctively desire; but the species above named being destitute of wings, a doubt naturally arises as to the probability of its feeding, like its congeners, on dried cadaverous matter. It has been stated as an illustration of this point, that the genera *Silpha*, *Hister*, *Dermestes*, and other necrophagous kinds, are winged, whilst *Pimelia*, *Brachycerus*, &c. which, like *T. horridus*, frequent sandy deserts, are apterous,—a formation supposed to accord with the fact that the particles of which their food is composed are so universally spread over these arid plains as to obviate the necessity of any rapid or extended change of place.⁵

SECTION 3D, XYLOPHILI,⁶ Lat.

In these the scutellum is always distinct, and the elytra do not cover the posterior extremity of the abdomen. In several the hooks of the tarsi are unequal. The antennæ have always ten articulations, of which the last three form a foliated mass,—the central leaflet being never entirely concealed or inclosed by the others. The labrum is not projecting, and only its anterior part is exposed. The mandibles are entirely corneous, and laterally project beyond the head. The maxillæ are corneous, or of a solid texture, straight, and usually toothed. The ligula is covered by an ovoid or triangular mentum, narrowed and truncated at the extremity, where the angles are frequently dilated. All the legs are inserted at equal distances from each other.

*

A first subdivision contains those genera in which the males are distinguished from the females by tubercles or

¹ *Ent. Edinensis*, p. 180.

² From *βολος*, a bulb, and *κρας*, a horn.

³ *Hor. Ent.* pp. 120 and 136.

⁴ *Τρογ*, from *τρύπαω*, I gnaw.

⁵ See *Horæ Ent.* p. 62; *Ent. Ed.* p. 186; and *Règne Animal*, t. iv. p. 546.

⁶ From *ξύλον*, wood, and *φιλος*, a lover.

Coleoptera horn-like projections on the head or thorax, and some-
Pentamera times by a difference in the form of the latter part. The
epistoma is small, triangular, and either pointed, truncat-
ed, or bidentated at the end. The labrum is almost
always concealed. In some the maxillæ terminate by a
simple coriaceous or crustaceous lobe, more or less hairy,
and without teeth: in others they are entirely squamous
or scaly, pointed, and provided with a small number of
teeth, accompanied by hairs. The mentum is ovoid, or
truncate-triangular. The chest exhibits no projection.
The hooks of the tarsi are generally equal. The scutel-
lum is small, or of medium size. The colours incline to
black and brown.

Of those genera in which the maxillæ are terminated
by a coriaceous or crustaceous lobe without teeth, and
simply hirsute or furnished with cilia, we shall adduce as
an example *ORYCTES*¹ of Illiger (Plate CCXXIV. fig. 15).
The legs of these differ but little in length, and the four
posterior tibiæ are thick, strongly incised or emarginate,
with an extremity greatly widened, and appearing as if
stellated in some. This genus contains some large and
striking species, such as *O. rhinoceros*, and others, from the
East Indies. There are few European species, and of these
O. nasicornis is by some regarded as indigenous in Eng-
land. It feeds on tan and rich vegetable mould. Its
larva is well known as having furnished the great Swam-
merdam with the subject of one of his many remarkable
anatomical investigations.

Of such as possess maxillæ which are usually corneous
or scaly, and more or less dentated, we shall mention the
genus *SCARABÆUS*² properly so called (Plate CCXXIV.
fig. 17). In these the body is thick and convex, and the
external side of their mandibles sinuous or dentated.
These insects occur chiefly in the equatorial regions, both
of the old world and the new. They are scarcely known
in Europe, and do not exist in Britain. *S. punctatus* is
found in Italy and the south of France, and *S. monodon*
in Hungary. Several species from South America (such
as *S. Hercules*) and the East Indies, are remarkable for
their gigantic size and extraordinary structure. *S. Atlas*,
Fab. (*Hector* of Dejean?), is a native of Java, but it also
occurs in the mainland.³ We know little of the actual
history or transformations of these fine insects, but their
habits may be inferred to resemble those of *Oryctes*, and
other congenerous tribes of the Scarabæides. The larvæ
probably dwell in the decaying portions of great timber
trees, and no doubt hasten the death and overthrow of
these sylvan monarchs. We could dilate with pleasure
on the singular aspect of these gigantic Coleoptera, did
not the nature of our general plan, and our desire to no-
tice, however briefly, most of the principal genera, pre-
clude our entering into the descriptive details of species.
We must therefore rest satisfied with a general reference

to the works of Olivier, Fabricius, Latreille, Macleay, and
the Catalogue of Dejean, part ii. p. 150.⁴ We cannot
help, however, here alluding to that principle of associa-
tion in the human mind, by which size or dimension affects
us with such different ideas in relation to different ob-
jects. Many may smile at our using the expression
“gigantic” or “magnificent” to creatures the largest of
which (of the Coleopterous kinds, e. g. *Prionus gigas*)
scarcely exceeds six inches in length;—yet true it is, that
to an entomologist accustomed only to the European
forms of insect life, the first sight of any of the great-
er Prionidæ, or of *Scarabæus Hercules*, or *Atlas*, or *Ac-
taon*, creates a feeling bordering upon awe, such as that
which an enlightened artist may be supposed to expe-
rience on first beholding the perfect proportions of some
great temple. Our ideas are perhaps equally relative in
all departments both of art and nature. An Egyptian
pyramid is thought *stupendous*, while North Berwick Law
(of about equal height with the greatest of the Coptic
monuments) is almost nameless as a Scottish mountain.
An eagle, from his size and strength, is called a “feather-
ed king,” although his body is less than that of a pig a
few months old. A mastiff or Newfoundland dog, being
among the largest of the canine kind, is called “majest-
ic,” although a sucking elephant might squeeze both of
them to death by an accidental stumble,—the said ele-
phant being at the same time regarded as a “poor crea-
ture,” because it is not a full grown example of the “wisest
of beasts.” An ancient walrus, floating among the hoary
icebergs of the arctic seas, is looked upon as one of the
most ponderous of created things; yet a Greenland sea-
man considers as insignificant, and will scarcely throw his
harpoon into the sides of a young whale, which with one
blow of its upraised tail could lash the ocean into foam,
sink a “captain’s gig,” and send the walrus with a frac-
tured skull to the bottom of the sea. The same principle
is capable of illustration, by the practice of the more en-
thusiastic disciples of Isaac Walton. Even the most ex-
perienced of anglers gazes with delight, almost with won-
der, at a river trout of three or four pounds weight. A
grilse of the same dimensions, when made to “spurn the
indignant shore,” is viewed by the salmon fisher almost
with a feeling of disappointment. We remember our friend
Sir William Jardine killing, *inter alia*, one morning in the
Tweed, a salmon of six and thirty pounds weight, in an
hour and five minutes, and yet the same skilful angler was
greatly astonished by a Loch Awe trout, which, though a
giant of its kind, was, when brought to the balance, found
wanting by several ounces, in the weight of twelve pounds.
But to return to our beetles.

The genus *PHILEURUS* of Lat. (*Geotrupes* of Fabricius)
differ from the Scarabæi in their mandibles, which are
straighter, without sinus or dentation on the outer side;

¹ ὄρυκτης, one who digs.

² The term *Scarabæus* appears to have been either applied by the Romans to coleopterous insects in general, or at least to have been used with a wide and indefinite generic application. The origin of the word is by no means clear, and its derivation from *σκάπτω*, as given by Fabricius and Olivier, has been regarded as inconsistent with the rules of etymology. Mr Macleay thinks it difficult to obtain the word at all from the Greek, and regards it rather as being of Etruscan origin, the more especially as it never occurs in other than ancient Latin authors. Let us here note that the *Scarabæi* (properly so called) of Latreille belong to the genus *Dynastes* of Macleay, which includes the “giants of the insect race.” We believe, however, that some *Prionidæ* exceed them in size.

³ The specimen in our collection was taken at Rangoon by Sir Archibald Campbell, and obligingly transmitted to us by George Swinton, Esq. We have since received Javanese specimens from Lieutenant Loudon, R. N. of Musselburgh.

⁴ Few points are more puzzling, or productive of greater delay in the progress of the student, than the cloud of synonyms by which natural history is overshadowed. This arises partly from ignorance, and partly from the (nearly allied) source of self-conceit, which induce together “confusion worse confounded,” in the very face of an expressed desire to enlighten and amend. Even the great masters of the art have sometimes erred in the imposition of their generic names. The reader will bear in mind that *Geotrupes* of Fab. forms no part of the *Geotrupidæ* of the present day, but corresponds to the genus *Scarabæus* of Latreille; while the genus which bears the latter name in the *Horæ Entomologicæ* is identical in its prevailing parts to the genus *Ateuchus* of the *Systema Eleutheratorum*. There is no doubt that Mr Macleay’s genus contains the insects to which the name of *Scarabæus* was applied by Pliny.

Coleoptera their body is also depressed, and the thorax dilated or Pentamera. rounded laterally. Such are *S. dydimus*, *vulgus*, *depressus*, of Fab.

* *

A second subdivision of the Xylophili contains those genera in which the head and thorax are of similar structure in both sexes, and not characterized by peculiar projections. The anterior margin of the labrum is almost always exposed or apparent. The maxillæ are entirely squamous, as if truncated at the termination, and furnished with five or six strong teeth on their inner edge. The mentum is proportionally shorter and broader than that of the Scarabæi, and less narrowed superiorly. The mesosternum is frequently prolonged to a horn or blunt point between or beyond the second pair of legs. The scutellum is usually large. The hooks of the tarsi are generally unequal. A small number excepted, these xylophilous Coleoptera are peculiar to the equatorial regions of the new world. They resemble in many respects our preceding subjects, and are at the same time nearly allied to the Melolonthæ, and particularly the Cetoniæ, of which they bear the external aspect, although their masticating organs differ. Fabricius and Olivier, in fact, arranged most of these insects with each other. The body of the kinds now under consideration is shorter, more rounded, and smoother than that of the preceding. They moreover differ in being frequently ornamented with brilliant colours.

In some (agreeing in this character with all the preceding Scarabæides), we do not perceive, between the posterior angles of the thorax and the exterior ones of the base of the elytra, an axillary piece filling up as it were the space comprised between these parts.

We shall first notice a genus in which the central portion of the chest presents no pointed prolongation. Such is HEXODON¹ (Plate CCXXIV. figs. 16, 20, 22, and 23), of which the body is almost orbicular, plane beneath; the head square, and received into a deep emargination of the thorax; the exterior margin of the elytra dilated and anteriorly marked by a small groove or gutter; the legs slender, and the hooks of the tarsi small and equal. But in the following genera the sternum is prolonged between the second pair of legs to a conical point. In CHRYSOPHORA of Dejean (*Melolontha chrysochlora*,² Lat.), Plate CCXXIV. figs. 18 and 19, the hind legs of the male are very large, the thighs thick, the tibiæ arcuated, and terminated at the inner angle by a very strong point. Here is also placed the *Scarabæus macropus* of Shaw.³ In RUTELA, Lat. (Plate CCXXIV. fig. 25), there is no remarkable difference in the size of the legs in the two sexes; the mentum is almost isometrical; the scutellum small or moderate; and the sternal point is short,—not reaching to the origin of the two anterior feet. The body is ovoid or oval. MACRASPIS, Macleay (Plate CCXXIV. fig. 26), differs from the preceding in the proportions of the mentum, which is obviously longer than broad; in the short and rounded form of the body; in the length of the scutellum, which at least equals a third of that of the elytra; and in the length of the sternal point, the extremity of which attains to the origin of the two anterior legs, or extends beyond it. The mandibles are almost triangular, with the extremity pointed or emarginate. The maxillæ are furnished with several teeth. One of the hooks of the tarsi, at least of the four anterior ones, is bifid, the other

entire. Here Latreille places also the genus CHASMODIA of Macleay. Coleoptera
Pentamera.

In other genera we perceive the axillary piece, before alluded to (agreeing with that seen in the same quarter in the Cetonia, and named *epimera* by M. Audouin⁴), filling up the space comprised between the posterior angles of the thorax and the exterior angles of the base of the elytra. Such is the genus OMETIS of Latreille.

SECTION 4TH, PHYLLOPHAGI.⁵

This section, as well as the ensuing, is formed from the great genus *Melolontha* of Fabricius, of which certain species are scattered also among the preceding groups. The Phyllophagi are nearly related to the concluding genera of the third section. Their mandibles, however, are covered above by the epistoma, and concealed beneath by the maxillæ,—their exterior side being alone exposed, but without either protruding or presenting the sinuosities or dentations observed in the Rutelæ and other analogous genera. The anterior edge of the labrum is exposed, and is sometimes of the form of a broad reversed triangle, sometimes (and more frequently) of a transverse lamina, emarginate in the centre. The number of the articulations of the antennæ is by no means uniform, and varies from eight to ten. The same observation applies to those of the club, which in several differs even in the sexes of the same species. The ligula is entirely covered by the mentum, or incorporated with its anterior face, and the elytra meet completely along the whole of the dorsal suture,—characters which distinguish our present species from those of the fifth or ensuing section.

*

The family of ANAPLOGNATHIDES of Mr Macleay, and some other genera nearly allied to the preceding, form the first subdivision according to M. Latreille's views. The epistoma is thickened anteriorly, and forms, either alone or with the labrum, a vertical facette in the form of a reversed triangle, the point of which rests on the mentum. This last-named portion is sometimes almost ovoid, densely pilose, with the extremity either rounded or truncated, and without emargination,—sometimes in the form of a transverse square, with the middle of the superior margin prolonged into a tooth, simple or emarginate. The maxillæ of some terminate by a coriaceous or membranous lobe, very hairy, without teeth, or with a very small number, and situate near the middle of the internal border;—those of the others are entirely corneous, resemble mandibles, and are either truncated or obtuse and entire at the end, or terminated by two or three teeth.

In the genera PACHYPUS of Dejean, and AMBLYTERES of Macleay, the mentum is almost ovoid; and in the former the antennæ of the males are composed of only eight joints, of which the last five form the club,—in the latter they consist of ten joints, of which the last three form the club.

In the other genera of this subdivision the mentum forms a transverse square, the centre of the superior margin projecting in the manner of a tooth, entire or emarginate. In the genus ANAPLOGNATHUS of Leach (peculiar to Australasia) there is a sternal projection, and the hooks of the tarsi are entire and unequal. The antennæ are composed of ten joints, and the extremity of the maxillæ is truncated, or obtuse and entire. These insects are

¹ From ἕξ, six, ὄδους, tooth, in allusion to the amount of dentations of the maxillæ. See Plate CCXXIV. fig. 16.

² Voyage de MM. Humboldt et Bonpland, ii. xv. 1, fem.; 2, male.

³ Naturalist's Miscellany, 380, iv.

⁴ From φύλλον, a leaf, and φαγος, eating.

⁵ Memoire sur le Thorax des Insectes.

Coleoptera of considerable size, and of rather brilliant aspect.¹ Here also are placed the genera *LEUCOTHYREUS* of Macleay, and *APOGONIA* and *GENIATES* of Kirby.

* *

A second subdivision of the *Phyllophagi*² of Latreille contains the *MELOLONTHIDÆ* of Macleay. In these the labrum is in the form of a transverse plate or leaflet, generally strongly emarginate beneath in its centre, so that when seen in front it exhibits the figure of a reversed or demi-truncated heart. The mentum is as long if not longer than broad, somewhat narrowed anterior to the summit, and either nearly square or heart-shaped; its superior margin is straight, or more or less emarginate or concave, in the middle, but without any tooth-like dilatation. The maxillæ are usually squamous, and armed with several (frequently five or six) teeth. This subdivision is itself capable of a further partition into two groups, the first corresponding to the genus *Melolontha* of Fabricius, as restricted by Illiger and Latreille—the other to the genus *Hoplia* of Illiger. The former continues to bear the name of

MELOLONTHIDES.

Distinguishable by the following general characteristics. The number of complete leaflets of the club exceeds three in several genera. The form of the body is usually thick and massive. The mandibles are strong, entirely or in greater part corneous, and exhibiting at most only a membranous and hirsute appendage, placed in the emargination of the inner side; the superior extremity is strongly truncated, with two or three teeth or angular projections. All the tarsi are terminated by two hooks; the first article of the two anterior being prolonged inferiorly into a hooked appendage. The labrum is usually apparent,—the maxillary teeth robust.

The insects of which this group is composed were included by Linnæus, like all those with which we have been lately engaged, in his extensive genus *Scarabæus*, and they also continued to form a portion of that genus in the works of Geoffroy, Degeer, Schæffer, and other entomologists prior to the time of Fabricius. The last-named author established the genus *Melolontha*, which in its extended signification may be regarded as synonymous with the Melolonthides of Latreille. Were we to follow the prevailing and praiseworthy example of botanists, who bestow upon a *family* the name of the *genus* by which it is most strongly characterized, our present group ought to be denominated *Sericides*, in as far as the type is not formed by *Melolontha vulgaris*, but rather by *M. brunnea* of Fabricius, which now constitutes the genus *Serica* of Macleay. But as it is at all times desirable that families should be named after well-known genera, the designation now adopted is preferable to that which might be derived from the less noted though more characteristic type. The Melolonthides are not often distinguished by

brilliant or metallic colouring. Their elytra, of which brown is a characteristic colour, are generally slightly scaly or hirsute. Throughout the entire period of their existence these insects live on vegetable substances, and their ravages are often extremely injurious. The larvæ are very long lived, and sometimes pass three or four years in that destructive state. In cold and temperate climates they are very sluggish, if not torpid, during winter, and descend somewhat deeper into the earth to avoid the effects of frost. The perfect insects feed on leaves,—the larvæ for the most part on roots.

In the genus *MELOLONTHA* properly so called (from *μηλα, an apple-tree*, and *άνθησις, inflorescence*³), see Plate CCXXIV. fig. 29, the antennæ are ten jointed, with the five or seven terminal joints in the males, and the six or four in the females, composing the club. The labrum is thick and strongly emarginate beneath. All the hooks of the tarsi are equal, and terminate in a point entire or simply uni-dentate at their base. The posterior extremity of the abdomen usually ends in a point or style, at least in the males. Of the species of which the antennal club in the male consists of seven leaflets, in the female of only six, we shall here notice the common cockchafer, *M. vulgaris* (*S. Melolontha*, Linn.). The body of this insect is of a pitchy black, with a whitish pubescence; the sides of the abdomen are marked by a range of triangular spots. The elytra are testaceous. The antennæ of the males are much larger than those of the females. (Plate CCXXIV. figs. 21 and 24.) This, though a most abundant insect in England, and over most parts of Europe, is less generally known in Scotland, and is rare in the Edinburgh district. Specimens, however, have been procured in the park of Dalkeith House, in Lanarkshire, at Lorn in Ayrshire,⁴ at Raelhills and Moffat in Dumfriesshire, and as far north as Glencoe.⁵

We may observe that the existence in the perfect state of the species above named is of very short duration. The life of an individual is supposed not to extend beyond a week, and the entire species during each successive season prevails only for the space of a single month. The male speedily perishes after the sexual union, and the female merely survives for a sufficient time to deposit her eggs in safety. As soon as the latter is fecundated, she digs a hole in the earth of about half a foot in depth, by means of her dentated fore legs. The larvæ which proceed from these eggs are soft, lengthened, of a dingy-white or yellowish colour; they have six short scaly feet, a large scaly head, two antennæ, each composed of five pieces, and nine stigmata on each side of the body. The eyes are not at first visible—being concealed under the skin, which is ere long cast off. These destructive creatures feed upon the roots of various plants. They are most voracious during the summer season. In the course of the autumn they descend into the earth, and pass the winter in a state of profound repose, neither requiring nor desiring food. As

¹ See *Hor. Ent.* p. 143; and *Linn. Trans.* vol. xii. pp. 401–5; also Leach's *Zoological Miscellany*, vol. ii. p. 44.

² Misnamed (we presume accidentally) *Xylophiles* in the second edition of the *Règne Animal*, t. iv. p. 558.

³ *Μηλολονθη*, or *Μηλανθη*, is a term of frequent occurrence in Aristotle and other ancient authors, and was first applied by Fabricius to the insects of the present genus. It is derived from the words mentioned above, because the insects it denoted either were supposed to be produced from the flowers of fruit-trees, or were accustomed to resort to them for food. This circumstance renders it probable that the *μηλολονθη* of the ancients belonged to the family Cetoniides, as the true Melolonthides are hardly ever seen on flowers; and the description of Eustathius, who says that the animal resembled a wasp, led Mr Macleay to conjecture that it might be the *Trichius fasciatus*, a vernal beetle common in Greece, which might be readily mistaken by a casual observer for one of the Hymenoptera, as it bears a considerable resemblance to some of the members of that order, both in its colouring and mode of flight. Moutfet's investigations led him to a very different conclusion—that the insect was of a metallic green, and referable to the *Buprestides*. The former opinion is greatly the more probable, and accords with the brief notices on the subject found in ancient writers, particularly Hesychius and the scholiast on Aristophanes; but these notices are too imperfect to warrant the determinate application of a word obviously used with considerable latitude of meaning, and intended in all probability to indicate a group or tribe of insects rather than any individual species. (See *Hor. Ent.* p. 78; and Moutfeti, *Theat. Insect.* xxi. 158.)

⁴ Professor Rennie, in *Insect Transformations*, 225.

⁵ *Ent. Ed.* p. 183.

Coleoptera
Pentamera. soon as the solar rays produce their genial influence in early spring, they ascend within six inches of the surface, and recommence their ravages. They change their skin every year, assume the nymphal state in the course of the third autumn after they are hatched, and appear in the perfect state during the ensuing spring or early portion of summer. The beetle, when it first escapes from its cocoon, is pale and soft, and does not venture to leave its subterranean chamber for some time. But ere long it acquires a firm consistence, and crawling to the surface, it expands its wings, and mounting into the air, is henceforward no more a subterranean dweller, but seeks its nourishment among the umbrageous branches of the loftiest trees.¹

Although the generality of insects are more destructive in the larva than in any other state, great ravages are occasionally committed even by the perfect insect. It is in relation to the present species that Mouffet records the number of beetles which at one time fell into the Severn as being sufficient to stop the wheels of the water-mills. In the year 1688 they covered the hedges and trees in a district of the county of Galway, in such infinite numbers as to hang in clusters like bees when they swarm. When on the wing they almost darkened the light of day, and produced a peculiar sound by the rustling of their wings. When feeding, the noise of their jaws might have been mistaken for the sawing of timber; and in a very short time the foliage of the trees for miles around was so totally consumed, that at midsummer the country wore the aspect of the leafless winter.² "One of the worst of these ravagers," say Messrs Kirby and Spence, "is the grub of the common cockchafer. This insect, which is found to remain in the larva state for four years, sometimes destroys whole acres of grass, as I can aver from my own observation. It undermines the richest meadows, and so loosens the turf that it will roll up as if cut with a turfing spade. These grubs did so much injury about seventy years ago to a poor farmer near Norwich, that the court of that city, out of compassion, allowed him L.25, and the man and his servant declared that he had gathered eighty bushels of the beetle."³ In the year 1785 many provinces of France were so ravaged by them that a premium was offered by the government for the best mode of destroying them. They do not confine themselves to grass, but eat also the roots of corn; and it is to feast upon this grub more particularly that the rooks follow the plow.⁴

The scarcity of this species in Scotland saves it from the fate often inflicted in the south, where *spinning a cockchafer* is a favourite amusement among school-boys. When the larger Coleoptera fall upon their backs, they have some difficulty in resuming their natural position,—and in Sweden, according to Sparmann, there is a fond belief among the simpler of the common people, that their sins will be forgiven them if they set a cockchafer upon its legs. If this creed be true, our English youths have much to answer for.⁵

Coleoptera
Pentamera. The only other species of the genus which we shall mention is *M. fullo* (Plate CCXXIV. fig. 29), one of the largest of the European Coleoptera. It is sometimes nearly an inch and three quarters long, of a brown or blackish colour, marked with many irregular white spots. The club of the antennæ in the males is remarkably large. This species occurs chiefly on downs along the maritime shores of Europe. It is sometimes captured in England. We have received it from Persia and other eastern countries.

In the genus RHISOSTROGUS of Lat. (formerly AMPHIMALLA of the same author), the species closely resemble the preceding; but the antennæ, consisting of nine or ten joints, have only three leaflets in the club. Such is a well known English insect not yet ascertained to inhabit Scotland, *R. Solstitialis*. In the genus AREODA of Leach and Macleay (Plate CCXXIV. fig. 30) the antennæ have ten articulations, the sternum is corneous, and all the hooks of the tarsi are equal in those individuals presumed to be females, and unequal in such as are regarded as males. The species are brilliantly adorned, and inhabit Brazil. All the preceding phyllophagous genera, it may be observed, with few exceptions, are furnished with ten articulations to the antennæ; but in the following Melolonthides there are only nine. In PHYLLOPERTHA of Kirby (from *φυλλον*, a leaf, and *περθεω*, to destroy), the antennæ are only nine jointed. Here we place a species which often appears in prodigious quantities among ferns on commons in many parts of Britain. It is called the Bracken-clock in the north of England—*P. horticola*. It falls into the genus *Anisoplia* of Megerle and Dejean. A larger and much rarer species is *P. Frischii*. It has been found near Montrose. In the genus SERICA⁶ of Macleay (Plate CCXXIV. figs. 27 and 28), the joints of the antennæ seem to have been differently computed.⁷ All the hooks of the tarsi are bifid. The body is ovoid, arched, with a silky aspect, and changeable reflections. Certain insects, as yet found only in New Holland, form the genus DIPHUCEPHALA⁸ of Dejean. Their tarsi are bifid, as in the preceding, but the body is narrow and elongated, and the thorax square. In EUCHLORA of Macleay (Plate CCXXV. fig. 1 and 2), the hooks of the tarsi are unequal, and there is no sternal projection; one of the hooks of the four anterior tarsi is bifid in the males, the body is arched, the epistoma short and transverse.

The second group of this subdivision, or the third and last of the Phyllophagi, is called

HOPLIDES,

and is characterized as follows. The mandibles are small and depressed, and as if divided longitudinally into two parts, of which the internal is membranous, the external corneous; the superior extremity presents no sensible dentations. The labrum is concealed or but slightly apparent. The maxillæ have frequently only small dentations. The body is short, depressed, broad, with the ely-

¹ Some very laborious and beautifully elaborated works have been recently published on the anatomical structure of the Melolonthæ. See more particularly *Considérations générales sur l'Anatomie comparée des Animaux articulés, auxquelles on a joint l'anatomie descriptive du Hanneton*, par M. Straus, 1 vol. in 4to, with plates. Paris, 1828. The illustrious and lamented Cuvier has observed of this production, that it is the only work fit to be compared to that of Lyonnet, *Sur la Chenille du Saule*. M. Dufour has also explained the digestive system of these insects, in the 3d vol. of the *Ann. des Sciences Nat.*; while the muscular economy of the wings and thorax has been described and figured by the accurate Chabrier, in his *Essai sur le Vol des Insectes*. Paris, 1823.

² *Phil. Trans.* xix.

³ *Phil. Trans.* 1741, 581.

⁴ *Introd. to Ent.* vol. i. p. 177.

⁵ We may here record that the *Melolontha hippocastani*, Fab. (Olivier, i. 3, a, b, c) was taken by the writer of this article some years ago on the banks of Windermere. It was formerly confounded with *M. vulgaris*, but is distinguished by being rather smaller, shorter, and more convex; the elytra are narrowly margined with black, and the terminal style of the abdomen is rather shorter, and has a slight constriction or neck, which makes the extremity appear broader and more obtuse. It does not seem to be known as British to the English collectors. (See *Entomologia Edinensis*, p. 190, note.)

⁶ From *σειρικον*, silk.

⁷ Antennæ articulis decem, *Hor. Ent.* 146. Je n'en compte que neuf, *Règne Animal*, iv. 562.

⁸ From *διφους*, double, and *κεφαλη*, head.

Coleoptera Pentamera. tra narrowed posteriorly at the exterior side. The last two tarsi are usually furnished with but a single hook. In such as have two hooks to all the tarsi (genus *Dicrania*), the first joint of the anterior tarsi is prolonged inferiorly, and exhibits on the internal side a strong hooked tooth.

M. Leon Dufour, as Latreille informs us, has remarked, that the digestive canal in these insects (at least in such *Hoplia* as he has examined) is much shorter than that of the Melolonthæ, and rather approaches the same part in the genus *Cetonia*. The chylic ventricle is smooth and flexuous. The small intestine is shorter than in Melolontha, and often presents an ovoid inflation at its origin. The great intestine is elongated, and destitute of valvular anfractuosités, and the rectum is distinctly marked by an obvious collar. The generative system resembles that of the Melolonthæ.

In the genus *DICRANIA* (Lepel. and Serville, in *Encyclop. Meth.*), besides the characters alluded to above, the body is very smooth, without scales, the scutellum rather large, and there are two strong spines at the extremity of the four posterior tibiae; the lower extremity of the two hindmost tibiae is dilated. These insects are natives of Brazil. In the genus *HOPLIA* of Illiger there is only a single hook to the two posterior tarsi (Plate CCXXV. fig. 4). The pairs of the others are bifid and unequal. The extremity of the intermediate and hind tibiae is as it were crowned by little spines of nearly equal length. The body is generally furnished with minute scales. The epistoma is either almost square or nearly semicircular. The thighs of the two hind legs are moderately enlarged, and the tibiae are long, straight, and without a hooked tooth at their extremity. *H. farinosa* (Plate CCXXV. fig. 3), one of the most beautiful of European Coleoptera, is a common insect in the south of France. The antennæ are nine-jointed, the body is covered with silvery scales, of a pale but bright and ethereal blue, with a greenish or golden tint beneath. This species, on which a British entomologist gazes with great delight, is common in several European countries, near the banks of brooks and rivers.

SECTION 5TH, ANTHOBII.¹

The scarabideous insects of this section also formed a portion of the undivided genus Melolontha, and are nearly allied to the concluding members of the preceding groups. Their paraglossæ, however, or divisions of the ligula, project beyond the upper extremity of the mentum, and the edges of the elytra are somewhat open, or removed from the usual line of the dorsal suture, towards their posterior extremity, which is narrowed to a point, or rounded. The antennæ consist of from nine to ten joints, of which the three last alone form the club in both sexes. The terminal lobe of the maxillæ is often almost membranous, silky, in the form of a pencil,—in others it is coriaceous and dentated along the inner edge. The labrum and mandibles are more or less solid, according as these parts are exposed or covered. These insects live among flowers and the varied foliage of shrubs and trees.

In the genus *AMPHICOMA*,² Lat. (Plate CCXXV. figs. 5 and 6) the first joint of the antennal club is concave, and encases the others. The mandibles are rounded and curved on the exterior side, without dentation on the in-

ner margin; the antennal mass is globular, the abdomen soft, and all the legs of ordinary size. The epistoma is distinctly margined. The anterior tibiae have three teeth on their outer edge. The first four articles of the tarsi are strongly ciliated in the males. These singular insects can scarcely be regarded as European, although they do occur occasionally in Greece. They are more frequent in the south of Russia, and in the western parts of the Persian dominions. Comte Dejean informs us that *A. hirta*, Fab. is the female of *A. vulpes* of the same author. *A. vulpecula*, with which we were favoured by M. Faldermann of the Imperial Botanic Gardens of St Petersburg, appears to be also a variety of the first-named insect. The only other genus of this section which we can here notice is *ANISONYX* of Lat., an example of which is given in Plate CCXXV. figs. 7 and 13.

SECTION 6TH, MELITOPHILI.³

In these the body is depressed, usually oval, brilliant, hornless, with the thorax trapeziform or almost orbicular. An axillary piece occupies, in the greater number, the space comprised between the posterior angles and the exterior of the base of the elytra. The anal termination is exposed. The sternum is frequently prolonged in the form of a point or advanced horn. The hooks of the tarsi are equal and simple. The antennæ are 10-articulate, with the last three joints forming the club, which is always foliaceous. The labrum and mandibles are concealed, lamelliform, and nearly if not entirely membranous. The maxillæ terminate in a silky lobe, in the form of a pencil, without corneous teeth. The mentum is usually ovoid, truncated superiorly, or almost square, with the middle of the superior edge more or less concave or emarginate. The ligula is not projecting.

The alimentary tube of these insects, according to M. Dufour, is shorter than in any of the scarabideous family. The chylic ventricle has usually its external tunic covered by very small superficial papillæ, or projecting points. The enlargement which terminates the small intestine is not cavernous, as in the Melolonthæ.⁴ The larvæ are said to live in decayed wood. In the perfect state they occur on flowers, and not unfrequently also on the trunks of such trees as exude any fluid.

This section, according to the views of M. Latreille, by which we have already been so long guided, is susceptible of division into three principal groups, corresponding to the genera *Trichius* of Fabricius, *Goliathus* of Lamarck, and *Cetonia* of Fabricius, but reduced and simplified by certain abstractions:

The Melitophili of the first two divisions have no strongly-marked sternal projection; the lateral portion of the mesosternum (or that named *epimera* by M. Audouin) does not generally manifest itself upwardly. The thorax does not increase from before backwards as in *Cetonia*; nor is the exterior side of the elytra abruptly narrowed or uni-sinuate a little below the humeral angle, as in those insects. A more rigorous character consists in the labial palpi being inserted in lateral grooves of the anterior face of the mentum, so that they are entirely exposed, the sides of the mentum jutting beyond them at their origin, and protecting them behind. In the first two divisions these palpi are inserted beneath the lateral margin of the mentum, or in the margins themselves, in such manner

¹ From *ανθος*, a flower, and *βιος*, life.

² From *αμφι*, about, or on both sides, and *κομη*, hair, in allusion to the frequent covering with which the species are invested.

³ From *μελι*, honey, or *μελιτω*, to make honey, and *φιλος*, a lover.

⁴ For other details, especially for such as illustrate the generative system, see *Annales des Sciences Nat.* t. iii. p. 235, and t. iv. p. 178

Coleoptera that the first articulations, when viewed from before, do not appear.

1st, TRICHIDES.

In these the mentum is either almost isometrical, or rather longer than broad, and leaves the maxillæ exposed. They correspond, as we have said, to the genus *TRICHIUS* of Fabricius (Plate CCXXV. figs. 8 and 9), of which we may mention as an example *T. fasciatus*, probably the only British species. It is black, with scattered yellow hairs, the elytra yellowish, with three transverse black bands, interrupted at the suture. It is very rare in Scotland, but is, however, recorded by Mr Curtis as occurring "on the flowers of the thyme, near Loch Rannoch, in July." It was also noticed some years ago by Dr Greville in Glen Tilt, and we saw it taken by Mr Giles Munby, on the southern border of Sutherland, early in the month of August 1833. The dimensions of the female considerably exceed those of the male. The genus, as now restricted, is not very extensive. Dejean enumerates twelve species, several of which are from North America.

2d, GOLIATHIDES,

May be distinguished from the preceding by the mentum, which is much longer and wider, and covers the maxillæ. In some the mentum is concave in the centre. The anterior extremity of the epistoma is neither toothed nor horned. Such is the genus *CREMASTOCHEILUS* of Knock (Plate CCXXV. fig. 10), in which the thorax forms nearly a transverse square; the maxillæ are terminated by a strong tooth, hooked or falciform, with setæ or little spines in place of an inner lobe; the last article of the palpi is very long and cylindrical; the mentum in the form of a widened heart, or of a reversed triangle rounded at the upper angles, without sensible emargination. In others the mentum is in the form of a greatly widened heart, but without a discoidal cavity, its superior edge being emarginate or sinuous. The anterior extremity of the epistoma in the males is divided into two lobes, in the form of obtuse or truncated horns. The thorax is almost orbicular. Such is the extraordinary genus *GOLIATHUS* of Lamarck (*Cetonia* of Fab. and Olivier), Plate CCXXV. figs. 14 and 16, which contains some of the largest and most striking of coleopterous insects. One of the species which we have represented appears to exhibit some variation in its markings.¹ The same species seems figured by Drury (*Illustrations*, vol. i. pl. 31), who says it was brought from Africa, where it was found "floating dead in the river Gaboon, opposite Prince's Island, near the equinoctial line." The only specimen with which we are now acquainted is that preserved in the Hunterian Museum, Glasgow. Mr Kirby has described two smaller species from Brazil.² Other kinds form the genus *INCA* of modern writers.³

3d, CETONIDES.

In this group the sternum is more or less prolonged to an obtuse point, between the intermediate pair of legs; the axillary piece before mentioned is always visible above, and occupies the entire space which separates the posterior angles of the thorax from the base of the elytra;

the thorax is usually enlarged posteriorly, and has the form of a triangle truncated anteriorly or at its point. The mentum is never transversal; its superior margin is more or less emarginate in the middle. The terminal lobe of the maxillæ is silky or pencil-shaped. The body is almost ovoid, and depressed. The membranaceous texture of the mandibles and maxillæ of these insects demonstrates, as Mr Macleay has observed, that in the perfect state they live on vegetable juices. Thus *C. morio*, Fab. and doubtless many others, especially of the darker coloured kinds, regale themselves on the sap of wounded trees,—while *C. aurata* and its brilliant allies are only found on flowers.⁴ The Cetoniides, though in general gay and ornamental insects, yield in metallic splendour to several species of the genera *Rutela*, *Glaphyrus*, and *Anaplo-nathus*. "Nothing, however, can exceed the beauty and lustre of the polish, or the admirable variety of ornament, with which their elytra are adorned. The larvæ live in the fattest vegetable soils; but notwithstanding the excellent observations of Degeer, much remains to be performed towards the elucidation of this part of their history."⁵

Sufficient data have not yet been collected for the proper elucidation of their geographical distribution, but it appears that many more species exist within than without the tropics. In some the thorax is prolonged posteriorly in an angular form, so that the scutellum disappears. These form the genus *GYMNETIS* of Macleay (Plate CCXXV. fig. 12). Several species occur in America. In others from New Holland and the East Indies the clypeus is bifid, or armed, in the males, with a couple of horns, and the body is proportionally narrow and elongated, with the abdomen obviously decreasing in size posteriorly. It is even almost triangular in some. The club of the antennæ is elongated. These constitute the genus *MACRONOTA* of Wiedemann (Plate CCXXV. fig. 15). "Mais toutes ces coupes n'acquerront de la solidité que lorsqu'on aura fait un étude particulière des nombreuses espèces du genre *Cetonia* de Fabricius."⁶

The European Cetoniæ are provided with a scutellum of ordinary size. *C. aurata* (commonly called the rose-beetle) is well known in many parts of England. It is nearly an inch long, of a brilliant golden green above, with coppery red reflections beneath, and some whitish markings on the elytra. It has been taken in Morayshire by the Misses Dick Lauder, and is also known to have occurred in Dumfriesshire. It is still, however, to be regarded as *inter rariores* of the Scottish species. Dejean's Catalogue contains 125 Cetoniæ, of which the greater part are foreign to Europe. They occur over all the warmer regions of the earth. Java produces several of great beauty, of which *C. Macleayi* is described, and figured by Mr Kirby in his *Century of Insects*.⁷ The one which we have represented, *C. Baxii* (Plate CCXXV. fig. 11), is highly prized by collectors.

TRIBE 2D, LUCANIDES.

In this second tribe or principal division of the lamellicorn Coleoptera, which derives its name from the genus *Lucanus* of Linnæus, the club of the antennæ is composed of leaflets or dentations disposed perpendicularly to its

¹ See Olivier, *Coleoptères*, No. 6, pl. 5, fig. 33, et pl. 9, fig. 33. We are indebted to Mr Joseph Dalton Hooker for an accurate drawing of the valuable specimen in the Glasgow Museum. We did not receive it till the figure above referred to had been copied by our engraver from Olivier's work.

² Linn. Trans. vol. xii. p. 407.

³ Hor. Ent. p. 74.

⁴ Encyclopédie Méthodique, art. Scarabéides. See also Dejean's Catalogue, p. 168.

⁵ Ibid. p. 75.

⁶ Règne Animal, t. iv. p. 574. We observe a work *On the Family of the Cetoniides*, recently announced in France as preparing for publication, and from which, we doubt not, the entomologist will derive advantage.

⁷ Linn. Trans. vol. xii.

^{Coleoptera}
^{Pentamera.} axis, like the teeth of a comb. These organs always consist of ten joints, of which the first is usually much longer than the others. The mandibles are always corneous, generally projecting, and of larger size as well as of different form in the males. The maxillæ in most terminate in a narrow lobe, lengthened and silky; in others they are entirely corneous and dentated. The ligula in the greater number is formed of two small silky pencils, more or less projecting beyond the mentum, which is almost semicircular or square. The anterior legs are generally elongated, with the tibiæ dentated all along their outer edge. The tarsi are terminated by two hooks, equal, simple, with a small appendage, ending in two setæ, between them.¹ These insects compose two sections which correspond to the genera *Lucanus* and *Passalus* of Olivier.

*

In the first the antennæ are greatly bent or geniculate, smooth, or but slightly hirsute; the labrum small, or confounded with the epistoma; the maxillæ terminated by a membranous or coriaceous lobe, very silky, pencil-shaped, without teeth, or with one at most; the ligula either entirely concealed, or incorporated with the mentum, or divided into two narrow elongated silky lobes, more or less projecting beyond the mentum. The scutellum is placed between the elytra.

In some genera the antennal club consists only of from three to four joints or leaflets. Such are *SYNODENDRON*² of Fab. (Plate CCXXV. fig. 20), *ÆSALUS* of Fab., *LAMPYRA* of Lat. (ibid. figs. 17 and 22), *RYSSONOTUS*, Macleay (*Luc. nebulosus* of Kirby), *PHILODOTUS*, Macleay (ibid. fig. 19), and *LUCANUS* properly so called (ibid. fig. 18). To the last belongs *L. cervus* (Plate CCXX. figs. 1, 2, 3), the largest and most formidable looking of the British Coleoptera. It inhabits the interior of oaks and beeches for several years before assuming its final transformation, and is by some regarded as the *Cossus* of the ancients, a vermiform larva, long regarded as a delicious food, but not now coveted by the refined epicures of modern days.³ In other genera of this section the club of the antennæ, as in *SYNDESUS* of Macleay, is composed of the seven terminal articulations.⁴

* *

The *Lucanides* of the second section have the antennæ simply bent, or but slightly geniculate and hairy; the labrum is always exposed, crustaceous, and transversal; the mandibles strong and much dentated, but without any remarkable disproportion of size between the sexes; the maxillæ are entirely corneous, with two strong teeth at least; the ligula, likewise corneous or very hard, is placed in the superior emargination of the mentum, and terminated by three points. The abdomen is supported on a kind of pedicle, bearing the scutellum above it, and separated from the thorax by a neck or obvious interval. These insects form the genus *PASSALUS* of Fabricius (Plate CCXXV. figs. 21 and 23), which has undergone subdivision in recent times. In *PAXILLUS* of Macleay, for example (fig. 23), the club of the antennæ is composed of five joints, the labrum is very short, the maxillæ have but two teeth, one terminal, the other on the inner side.⁵ Mr Macleay restricts *Passalus* to such species as have only three articulations to the club of the antennæ, as shown

by fig. 21. The last-named author here places the genus *Chiron*, which Latreille classes with the coprophagous tribe. All these insects are foreign to Europe, and we believe also to Africa. They are characteristic chiefly of South America, but are also known in New Holland, Java, and the eastern countries of Asia. Madame Merian informs us that the larva of the species figured in her work feeds on the roots of the sweet potato. The perfect insect is well known in sugar-houses.

Coleoptera
Heteromera.

HETEROMERA.

Five Articulations to the first four Tarsi, and four to the hindmost pair.

All the groups of this, the second primary section of the coleopterous order, feed on vegetable substances. Latreille comprises them under four great families, of which the first two exhibit, by reason of an excrementitious apparatus discovered by M. Dufour, an analogy to some of the pentamerous Coleoptera. Their chylic ventricle is also frequently beset by papillæ. In several of these insects we find the vestiges of another secreting apparatus, of which we have few examples among the Coleoptera, that denominated the *salivary apparatus*. The hepatic vessels, as in the preceding or pentamerous section, with few exceptions, amount to six in number, and have two intestines, distant from each other; at one extremity, according to Dufour, they are inserted by six insulated ends around the collar which terminates the chylic ventricle; at the other they open into the origin of the cæcum by trunks varying in number in different families and genera.

The first general division of the section may be made to contain the first three families. The elytra are generally of a firm and hard consistence, the hooks of the tarsi almost always simple, the head ovoid or oval, susceptible of being sunk posteriorly in the thorax, or sometimes narrowed behind, but not abruptly, and without any neck at the base. Many of these insects are "darklings," that is, lucifugous or light-shunning.

FAMILY I.—MELASOMA.

This group consists of black or ash-coloured species, without mixture or variety of colour, from which circumstance they derive their name.⁶ They are for the most part apterous, with the elytra as it were soldered together. The antennæ are partly or entirely granose, almost of the same size throughout, or a little enlarged at their extremity, inserted under the projecting margin of the head, with the third articulation generally elongated. The mandibles are bifid or emarginate at the extremity, and there is a corneous tooth or hook on the inner side of the maxillæ. All the articulations of the tarsi are entire, and the eyes are oblong and but slightly elevated—a character which, according to M. Marcel de Serres, indicates nocturnal habits. Almost all these insects dwell upon the ground, either in sandy soils or under stones, and they are not unfre-

¹ See our elementary plate (CCXX.) figs. 1, 2, and 3.

² As we have given figures on the plates above referred to, of most of the genera just named, we abstain from entering into the details of their respective characters.

³ For a description of the singular genus *CHIASOGNATHUS* of Stephens, see the *Cambridge Philosophical Transactions* for 1831.

⁴ The insect which we have figured under the name of *Passallus pentaphyllus*, is, we believe, synonymous with *Paxillus Leachii* of Macleay, *Hor. Ent.* p. 106.

⁵ From *μίλας*, black, and *σῶμα*, body.

⁶ From *σύν*, with, and *Δενδρον*, wood.

optera frequent in cellars, stables, the ground floors of houses, and other dark and sombre situations. According to M. Dufour,¹ the insertion of the biliary vessels takes place on the under surface of the cæcum, by means of a single tubular trunk resulting from the junction of two strong short branches, themselves composed of the reunion of three biliary vessels. The bile is yellow, sometimes brown, or even violet coloured. The alimentary tube² is long; in the first tribe, that of the Pimeliariæ, three times the length of the body. The œsophagus is long, and leads to a crop, smooth or glabrous externally, more developed among the last-named insects, where it forms an ovoid sac lodged in the pectus; it is furnished interiorly with folds or longitudinal fleshy columns, terminating in some species, such as *Erodii* and *Pimeliæ*, beside the chylic ventricle, at a valve formed of four principal corneous, oval, and connivent parts. The chylic ventricle is elongated, flexuous or doubled, generally beset with small papillæ or projecting points, and terminates in a small collar, callous within, which receives the first insertion of the biliary vessels. In the genera *Blaps* and *Asida* there is a salivary apparatus, consisting of two floating vessels or tubes, sometimes, as in the latter, perfectly simple, sometimes, as in the former, irregularly branched. The same structure no doubt will be found to occur in others of the family. The texture of the tunics of the alimentary canal has been studied with great care and assiduity by M. Marcel de Serres.³ The adipose tissue is more abundant in these Heteromera than in the ensuing; and it is probably this provision which enables them, even when transfixed and fastened down by a pin, to live for six months without food—a fact witnessed (we presume accidentally) by Latreille in a species of *Akis*.

Our present family, which corresponds to the ancient unrestricted genus *Tenebrio* of the Linnæan system, is subdivided according to the absence or presence of the wings.

TRIBE 1ST, PIMELIARIÆ.⁴

Apterous, the elytra generally fixed or soldered. Palpi almost filiform, or terminated by an article not greatly dilated, and not forming a distinct triangular or securiform mass.

In the genus *PIMELIA* properly so called,⁵ the body is more or less ovoid and oval, with the thorax narrower even at the base than the abdomen, generally convex, without sharp prolongations at the posterior angles, or posterior projection at the præsternum. These insects are proper to the basin of the Mediterranean, to the western and southern parts of Asia, and to Africa.

In the three following genera the body is ovoid, short, arched or gibbous above, with the thorax short, as broad posteriorly as the base of the elytra, and terminated on each side by a sharp angle. The præsternum is dilated posteriorly in the manner of a lamina or point, with its posterior extremity resting on the mesosternum. In *ERODIUS*, Lat. the last two joints of the antennæ are united, and form a little button-shaped mass. The anterior tibiæ have a strong tooth near the middle of the exterior side, and another on the same side at the end. The mentum is incased (*encadré*) inferiorly, and covers the base of the maxillæ. *E. gibbus*, which is black, the elytra with thin raised lines, occurs in Portugal. In *ZOPHOSIS*,⁶ Lat. the

antennæ are almost filiform, or enlarge insensibly towards the end. The anterior tibiæ want the teeth. *Z. testudinarius* is black, the elytra chagrined, and covered on the sides with a whitish powder. It occurs at the Cape. In *NYCTELIA*, Lat. (Plate CCXXV. fig. 24), the third article of the antennæ is much larger than the preceding, and the following, as well as the ninth and tenth, are almost globular. The base of the maxillæ is exposed. The species are proper to South America.

In the genus *HEGETER*, Lat. the thorax assumes the form of a trapezium, almost as broad at the posterior margin as the base of the elytra, against which it is applied throughout its breadth. The terminal article of the antennæ is rather less than the preceding. In *TENTYRIA* of Lat. (*Akis*, Fab.) the thorax is almost orbicular, sometimes narrower than the abdomen, sometimes of the same breadth, but rounded at the posterior angles, and leaving an hiatus between them and the base of the elytra. The terminal article of the antennæ is as large as the preceding. These, as well as the following genera, are peculiar to the warm and western countries of the ancient continent.

The genus *AKIS*⁷ of Fab. (Plate CCXXV. fig. 25) is now restricted to those species in which the thorax is wider than the head, strongly emarginate before, short, its posterior margin widely truncate, and the lateral edges turned up. The antennæ consist of eleven distinct articulations. In *EURYCHORA*,⁸ Thunberg, the body is oval, with acute and ciliated edges, the thorax semicircular, and receiving the head in an anterior notch, the abdomen almost heart-shaped, and the antennæ composed of linear articulations, compressed or angular, of which the third is the longest, and the eleventh indistinct.

The following genera of this tribe differ from the preceding in the mentum, of a square form, not being either emarginate or widened at its upper margin. In *TAGENIA* of Lat. (*Akis*, Fab.) the thorax is narrow, and either cylindrical, or in the form of an elongated heart, truncate at both ends. The antennæ are almost perfoliate, with the third articulation scarcely longer than the following ones, and the eleventh or last extremely small, and closely united with the preceding. The head is elongated posteriorly, and borne upon a kind of neck or knob. In *SCAURUS*,⁹ Fab. the thorax is at least as broad as the abdomen, almost isometrical. The anterior thighs are strongly inflated, and frequently dentated in the males. The tibiæ are long and narrow. The terminal article of the antennæ is ovoid-conic, and elongated. The species are peculiar to the western countries of the ancient continent, and are confined to its warmer parts. In *SCOTOBIVS* of Germar, the terminal article of the antennæ is scarcely longer than the preceding, and in the form of a reversed top. The thorax is perceptibly broader than long, and much arched in its lateral margins. These insects are peculiar to South America.

Other insects of this tribe, agreeing with those just named in the entireness of the mentum, are remarkable for the lateral dilatations or tooth-like projections of the thorax. The eyes are more projecting than in the others, and the antennæ are pubescent. The elytra are very unequal. Such is the genus *SEPIDIUM*¹⁰ of Fab. of which the species are found in the southern countries of Europe, and in Africa.

¹ *Ann. des Sciences Nat.* v. p. 276.

² *Ibid.* iii. p. 478.

³ *Observ. sur les usages des diverses parties du tube intestinal des Insectes.* *Ann. du Mus.*

⁴ From *Πιμελιæ*, fut.

⁵ For the new generic divisions of *Pimelia* of Fabricius, see *Règne Animal*, v. p. 5-7.

⁶ From *Ζοφωσις*, obscurity.

⁷ From *ἀκίς*, a javelin.

⁸ From *ἑυρυχωρός*, wide.

⁹ From *σκαυρός*, having projecting claws.

¹⁰ From *σηπιδιον*, putridity.

Coleoptera
Hetero-
mera.

Among the last to which we shall here allude, is the genus *TRACHYNOTUS*, Lat. (Plate CCXXV. fig. 26), which differs from the preceding in the joints of the antennæ: these are mostly cylindrical, or in the form of an elongated and reversed cone, the last three or four being alone rounded, and either ovoid, turbinated, or hemispherical. The eyes are almost round or oval, entire, or but slightly emarginate, and elevated. The last article of the antennæ is sensibly longer and thicker than the preceding.

In the genus *MOLURIS*, Lat. *Psammodes*, Kirby (Plate CCXXV. fig. 27), the eyes are narrow and elongated, and scarcely elevated. The thorax is convex, nearly orbicular, emarginate in front, truncated posteriorly, and without angular dilatations on the sides. These insects, in common with those immediately preceding, occur at the Cape.

TRIBE 2D, BLAPSIDES, Lat.

This tribe receives its name from the genus *Blaps* of Fabricius. The maxillary palpi are terminated by an obviously dilated article, triangular or hatchet-shaped. Among other anatomical observations made by M. Dufour in relation to these insects, he states that they are provided with a double excrementitious secreting apparatus, totally different in structure from that of the pentamerous tribes. It consists of two tolerably large oblong bladders, placed altogether beneath the viscera of digestion and generation, closely approximated to each other, with extremely thin parietes, and surrounded by vascular folds, adherent, more or less pursed or turgid, and of which it is difficult to ascertain the precise point of insertion, from the impossibility of unrolling them. The same may be said of the canals destined to the emission of the secreted fluids. They are concealed by a kind of membranous diaphragm, which is applied, by means of a fleshy pannicle, to the last ventral segment. The fluid flows out laterally, and not from the extremity of the terminal segment: it is of a brownish colour, extremely acrid and irritating, of a peculiar and penetrating odour, and is capable of being thrown to a distance of six or eight inches.

Those in which the body is generally oblong, with the abdomen laterally embraced by the elytra, and in which these parts are frequently narrowed towards the end, and terminate in a tail-like point, form Latreille's first division. The tarsi are nearly alike in both sexes, and without any remarkable dilatation. In the genus *ACANTHOMERA*, Lat. (Plate CCXXVI. fig. 2), the thorax is almost orbicular, transversal; the abdomen nearly globular; the third article of the antennæ cylindrical, and longer than the ensuing. In *BLAPS*¹ proper (Plate CCXXVI. fig. 27) the thorax is almost square, and plane or but slightly convex. The abdomen is oval, transversely truncate at the base, more or less elongated. The elytra, for the most part, are narrowed or prolonged to a point, especially in the males. The third article of the antennæ is cylindrical, and much longer than the ensuing; the last is short and ovoid. As an example of this genus (of which there are three British species), we may name a well-known insect, *B. mortisaga* (ibid.) nearly an inch long, of a somewhat shining black, the ends of the elytra forming an obtuse point. It occurs occasionally in pantries, store-rooms, and other parts of houses, especially such as are dirty or neglected. A

species called *Blaps sulcata* is said by Fabricius to be eaten by the Turkish women in Egypt, to make them fat. They cook it with butter. On the same authority, it is asserted to be used as a cure for headach and the sting of the scorpion. In *SCOTINUS* of Kirby (Plate CCXXVI. fig. 9),² the thorax is emarginate and dilated at the anterior corners, and the terminal joints of the antennæ are thickened, the two last being confounded together.

Then follow certain Blapsides with an oval and slightly elongated body, and farther distinguished by a sexual difference in the tarsi, the first or the two anterior pair being most dilated in the males, and their inferior surface usually silky, or furnished with a brush. These insects frequent sandy places. Their two anterior tibiae are generally wider, dilated triangularly at the extremity, and adapted for digging. Here are placed the genera *Pedinus*, *Blaptinus*, &c. of Latreille, Dejean, and other authors.³

TRIBE 3D, TENEBRIONITES, Lat.

These differ from the last in being provided with wings. Their body is usually oval or oblong, depressed or but slightly raised, with the thorax square or trapezoidal, and as wide as the abdomen at its posterior extremity. The palpi are larger at their extremity; the last joint of the maxillary palpi has the form of a reversed triangle, or is hatchet-shaped: the mentum is but slightly widened, and leaves the base of the maxillæ exposed. The genus *Tenebrio*, as originally arranged by Fabricius, together with *Opatrum* and *Orthocerus*, serve in this tribe as the types of as many divisions.

1st, Those in which the body is oval, with the thorax nearly trapezoidal, arcuated laterally, or forming a semi-oval truncated anteriorly, wider than the abdomen, at least at its posterior margin, but slightly, if at all, bordered; the maxillary palpi terminated by a securiform joint, or nearly resembling that form; the antennæ insensibly enlarged. Here are placed the genera *CRYPTICUS* of Lat. and *OPATRUM*, Fabricius.

2d, Those in which the body is narrow and elongated, almost of equal breadth posteriorly, or wider, with the thorax nearly square, and at least almost as long as it is broad; the antennæ forming a thickish club, or abruptly dilated at the extremity. Such are, among others, the genera *CORTICUS* of Dejean (Plate CCXXVI. fig. 13), *ORTHOCERUS*, Lat. (ibid. fig. 25), and *CHIROSCELIS* of Lamarck (ibid. fig. 32).

3d, Those of which the body is equally narrow and elongated, with the thorax nearly square, but of which the antennæ are of the ordinary thickness, and not abruptly terminated by a mass or club. In *UPIS*, Lat. (Plate CCXXVI. fig. 5), the thorax forms a lengthened square; the body is narrow, though not linear; the penultimate joints of the antennæ are lenticular and transversal. In *TENEBRIO*⁴ properly so called (ibid. fig. 23), the thorax differs from that of *Upis* in being broader than long. *T. molitor* (the species figured) is a well-known insect, which appears in the evening in the least frequented parts of houses. It is likewise found in flour-mills, bakehouses, and among old walls. Its larva, commonly called the meal-worm (ibid. fig. 29), is long, cylindrical, of an ochry yellow, scaly in its texture, and smooth. It lives among bran and flour, and forms a favourite and judicious food

¹ From *βλαζ*, slow.

² Owing to the accidental omission, by the engraver, of several figures, which were afterwards inserted in the vacant spaces, some of the subjects of Plate CCXXVI. are by no means in systematic order; but the references in the text will be found correct.

³ See *Règne Animal*, t. iv. p. 456.

⁴ The name refers to the habits of the species, and signifies one that shuns the light.

Coleoptera for nightingales in the domestic state. It sometimes occurs in the interior of the human body. How it gets there nobody seems to know, but the fact is certain. We have three or four species of the genus in Britain. In a singular genus, named *HETEROTARSUS*¹ by Latreille (Plate CCXXVI. fig. 30), the penultimate joint of the tarsi is extremely small, in the form of a little knob, and received into a longitudinal groove of that which precedes it, which is itself more dilated, and almost cordiform (ibid. figs. 34 and 36). The only species with which we are acquainted comes from Senegal. It has all the characters of a *Tenebrio*, with the exception of its remarkable tarsi. At first sight the two anterior seem to consist but of four joints, and the two others of three. See the figures last referred to.

FAMILY II.—TAXICORNES, Lat.

In this family the small corneous tooth on the inner side of the maxillæ, mentioned in our generalities of the preceding tribes, is wanting. All the species are winged. Their body is generally square, their thorax trapezoidal or semicircular, and either concealing or receiving the head. The antennæ, usually inserted beneath a marginal projection of the sides of the head, are short, more or less perfoliate or granose, and either enlarge insensibly or terminate in a club. The legs are not adapted for running, and all the articles of the tarsi are entire, and terminated by simple hooks; the anterior tibiæ are often broad and triangular. Several males have the head furnished with horns. The greater proportion of these Heteromera occur on tree fungi, or beneath the bark; some live on the ground under stones. M. Dufour has observed an excrementitial secreting apparatus in several genera, and salivary vessels are known to exist in the genus *Diaperis*. The chylific ventricle is beset with little hair-like papillæ.

In some the head is exposed, and never entirely received into a deep anterior notch of the thorax. The latter portion is sometimes trapezoidal or square, sometimes almost cylindrical; its margins, as well as those of the elytra, do not extend perceptibly beyond the body. This division forms

TRIBE 1ST, DIAPERALES, Lat.

In the genus *DIAPERIS* properly so called² (Plate CCXXVI. fig. 1), the maxillary palpi terminate in an article scarcely thicker than the preceding, and nearly cylindrical; the anterior tibiæ, scarcely, if at all, larger than the following, are narrow, almost linear, and feebly dilated at their extremity. Among the ovoid and convex species, with the central portion of the thorax lobate posteriorly, we may name the insect here figured, *D. boleti*. Its body measures about three or four lines in length; it is of a shining black, with three bands of fulvous yellow, transverse and dentated, upon the elytra. It is a well-known British species, not yet observed in Scotland. In *LEIODES* of Lat. (*Anisotoma* of Fab.) the body is short and convex, and the antennæ terminate in an oval mass of five joints, of which the second is the least. Mr Stephens enumerates above thirty British species, of which *L. arenaria* was lately discovered near Cramond Bridge, Edinburgh.³ In this tribe are contained several other genera of minute insects, such as *Tetratoma*, Herbst, *Eledona*, Lat. &c.

TRIBE 2D, COSSYPHENES, Lat.

These are analogous in form to the genus *Peltis* of Fab. and to several Nitidulæ and Cassidæ. They are ovoid or sub-hemispherical, and overlapped in their contour by the dilated sides of the thorax and elytra. The head is in some entirely concealed beneath the thorax,—in others it is received or incased in its anterior emargination. The last joint of the maxillary palpi is larger than the preceding ones, and hatchet-shaped. This tribe corresponds to the unrestricted genus *COSSYPHUS* of Olivier and Fabricius.

In the genus *COSSYPHUS* properly so called (Plate CCXXVI. fig. 3), the thorax is almost semicircular, exhibits no anterior emargination, and entirely covers and conceals the head. The antennæ are short, terminate abruptly in an oval mass of four articles, chiefly transversal: the second of the whole number and the following ones are almost identical. These insects inhabit the East Indies, the south of Europe, and the north of Africa. In *HELÆUS* of Lat. and Kirby, the head is received into a deep emargination, or median aperture of the thorax, and is exposed at least superiorly. The antennæ terminate gradually in a narrow elongated club. These insects are peculiar to New Holland. Some other species, proper to South America, of which the body is almost hemispherical, very convex, and of a soft or slightly solid consistence, form the genus *NILIO* of Lat. At first sight they remind one of *Coccinellæ*, and of various species of *Erotyli*.

FAMILY III.—STENELYTRA,⁴ Lat.

This family of heteromorous Coleoptera differs from the preceding one chiefly in the antennæ, which are neither granose nor perfoliated. In the greater number the extremity is not thickened. The body is generally oblong, arcuated above, and the legs elongated, as in many other insects. The males, except in their antennæ and general dimensions, resemble the females. Our present species generally are of much more active habits than those we have just left. Many conceal themselves beneath the bark of trees, while most of the others are met with on flowers and foliage. Linnæus referred most of them to his genus *Tenebrio*, and distributed the remainder among the incongruous groups of *Necydalis*, *Chrysomela*, *Cerambyx*, and *Cantharis*. In the first edition of the *Règne Animal*, Latreille combined them under a single genus, that of *Helops*; but a more intimate knowledge of their structure, interior as well as exterior, has since induced him to partition them into five tribes, referable to a corresponding number of the older genera, viz. *Helops*, *Cistela*, *Dirceæ*, of Fab. and *Edemera* and *Mycterus* of Olivier. In *Edemera* the head is more or less narrowed, and prolonged anteriorly in the form of a muzzle, and the penultimate article of the tarsi is always bilobed,—a character which seems to connect these insects with the weevils, or rhyncophorous Coleoptera. In respect to the digestive canal, and some other considerations, *Helops* and *Cistela* approach the Tenebriones; but in *Cistela* the chylific ventricle is smooth, and the mandibles entire, and the species affect flowers and leaves, a habit by which they are distinguished from *Helops*. Most of the *Dirceæ* possess the faculty of leaping, and the penultimate article of the tarsi, or at least of some of them, is bifid. Some live in mushrooms, others in old wood. They connect on one side with He-

Coleoptera
Hetero-
mera.

¹ From ἕτερος, different, and χερς, a part of the foot or hand.

² From διαπερῶ, to pierce through.

³ *Entomologia Edinensis*, p. 145. We also possess an undescribed species, from the same locality, named in our cabinet *L. fuscicollis*.

⁴ From στενός, narrow, and ελυτρον, sheath, in reference to the form of the elytra.

Coleoptera Heteromera. lops, and on the other with *Cedemera*, and still more with that sub-genus of the same tribe named *Nothus* by Ziegler. These are the principles by which Latreille has been recently directed in his arrangement of the present family.

A certain number (including the first four tribes) have the antennæ approximate to the eyes, and the head not prolonged into a trunk, but terminated at most by a short muzzle.

TRIBE 1ST, HELOPII.

Antennæ covered at their insertion by the margins of the head, almost filiform, or a little larger towards the extremity, generally composed of nearly cylindrical articles attenuated towards the base, and of which the penultimate are frequently a little shorter, in the form of a reversed cone,—the terminal being for the most part nearly ovoid, and the third always lengthened. The extremity of the mandibles is bifid; the last joint of the maxillary palpi is of larger size, and hatchet-shaped, or in the form of a reversed triangle. The eyes are oblong, reniform, or emarginate. None of the legs are adapted for leaping; the penultimate joint of the tarsi, or at least of the hindmost ones, is almost always entire, or not deeply bilobed; the terminal hooks are simple, or without fissure or dentation. The body is for the most part areuated above, and always of a firm and solid consistence. Such of the larvæ as are known are filiform, smooth, shining, with very short feet, like those of the Tenebriones. They occur in old wood. It is also beneath the bark of ancient trees that we find the perfect insects. The tribe corresponds in great part to the genus *Helops* of Fabricius.

Some have the body almost elliptical, strongly areuated above, or very convex, with the antennæ at the utmost as long as the thorax, compressed and dilated towards their extremity, like the teeth of a saw; the thorax transversal, plane above, either trapezoidal and widening posteriorly, or almost square; the elytra frequently terminated by a point or tooth. The posterior extremity of the præsternum forms a little salient point, which is received by a forked notch of the mesosternum. Here are placed the genera *EPITRAGUS* and *CNODALON* of Lat. and *CAMPsia* of Lepelletier and Serville.

In all the other Helopii, the mesosternum exhibits no marked emargination, and the posterior extremity of the præsternum is not prolonged to a point. Here are placed the genera *SPHENISCUS* of Kirby, *ACANTHOPUS* of Megerle and Dejean, *AMARYGMUS* of Dalman, *SPHEROTUS* and *ADELUM* of Kirby, and *HELOPS* properly so called. In the last named, most of the joints of the antennæ are nearly in the form of a reversed cone, or cylindrical and attenuated at the base. The thorax is transverse, or scarcely as long as broad, either square, or trapezoidal, or heart-shaped, abruptly narrowed posteriorly, terminated by pointed angles, and always applied exactly to the base of the elytra. Here also are placed the genera *LÆNA* of Megerle, *STENOTRACHELUS*, *STRONGYLUM* of Kirby, and *PYTHO* of Latreille.¹

TRIBE 2D, CISTELIDES.

This is very closely allied to the preceding, but the insertion of the antennæ is not covered. The mandibles terminate in an entire point, or are unemarginate. The hooks of the tarsi are dentated beneath like the teeth of a comb. Several of these insects live on flowers. Their

digestive canal is shorter than that of the Helopii, and the chylific ventricle exhibits no papillæ. They correspond to the genus *Cistela* of Fabricius.

In some all the articles of the tarsi are entire. The last joint of the maxillary palpi is simply a little larger, obconical or triangular. In *LYSTRONICHUS*, Lat., the thorax is thick, narrower than the abdomen, almost orbicular or heart-shaped. The antennæ are thickened towards the extremity. The thighs are clubbed. In *CISTELA* properly so called, the thorax is depressed, trapezoidal, of the breadth of the abdomen at its posterior margin, or scarcely narrower. The antennæ are filiform, or slightly enlarged at the extremity, and the head is advanced in the manner of a muzzle. In others, such as the genus *Allecula*, Fab., the penultimate article of the tarsi is bilobed, and the last joint of the maxillary palpi much dilated, in the form of a hatchet. The body is generally more oblong.

TRIBE 3D, SERROPALPIDES.

The most remarkable distinction of this tribe, and that from which it derives its name, is the frequent serration of the maxillary palpi, which are likewise large and inclined. The antennæ are inserted in an emargination of the eyes, exposed as in the preceding tribe, and often short and filiform. The mandibles are emarginate or bifid at the extremity, and the hooks of the tarsi are simple. The body is almost cylindrical in some, oval in others, with the head inclined and the thorax trapezoidal. The anterior extremity of the head is not advanced, and the posterior thighs are not inflated. The penultimate article of the tarsi, or at least of the four anterior, is frequently bilobed; and in those in which it is entire the posterior legs at least are adapted for leaping; they are thin, long, compressed, the tarsi small, almost setaceous, with the first article elongated. The anterior are always short and dilated. The genus *Dirœa* of Fabricius forms the type of the tribe. It contains the genera *ORCHESIA*, Lat., *EUSTROPHUS*, Illiger, *HALLOMENUS*, Paykul, *DIRCÆA* (proper), Fab., *MELANDRYA*, Fab., *HYPULUS*, Paykul, *SERROPALPUS*, Hellw., and *CONOPALPUS*, Gyll.

TRIBE 4TH, CÆDEMERITES.²

This tribe is allied to the preceding by several characters, such as the exposed insertion of the antennæ near the eyes, the bifid extremity of the mandibles, the bilobation of the penultimate article of the tarsi, and the hatchet shape of the terminal joint of the maxillary palpi; but they exhibit other characters, which authorize their separation. The body is elongated, narrow, almost linear, with the head and thorax scarcely so broad as the abdomen; the antennæ are longer than those parts, serrated in some (such as *Calopus*), filiform or setaceous, and composed of long and nearly cylindrical articles, in others. The anterior extremity of the head is more or less prolonged in the form of a small muzzle, and rather restricted behind, with the eyes proportionally more elevated than among the preceding tribes. The thorax is at least as long as wide, and a little narrowed behind. The elytra are linear, or narrowed posteriorly, and are frequently flexible. Latreille regards the species as allied to *Telephorus* and *Zonitis*. M. Dufour has recognised in the Cædemerites the existence of salivary vessels, of a simple nature, flexuous and floating, as well as of a paunch formed by a lateral crop, furnished with a neck or pedicle.

¹ For the details of these and other genera of the tribe which we have been unable to do more than name, we must refer the reader to Latreille's *Genera Crustac. et Insect.*; the *Encyclop. Méthod.*; Linn. *Trans.* vol. xii.; Dalman's *Analecta Entomol.*; Dejean's *Catalogue*, and Fischer's *Entomog. de la Russie*.

² From *αἰδῶ*, I swell, and *μῆκος*, thigh.

They are the only Coleoptera in which that character has been observed. These insects, of which the transformations are unknown, are found on flowers and trees. They are all comprised in the old genus *Ædemera* of Olivier.

In some the antennæ are always short, inserted in a notch of the eyes, and simple; the posterior thighs are inflated, at least in one of the sexes; the thorax as broad as the base of the abdomen; and the hooks of the tarsi bifid. Such is the genus *NOTHUS* of Ziegler, in which the maxillary palpi are terminated by a large elongated hatchet-shaped article. The posterior legs in one of the sexes are very large, and furnished beneath with a strong tooth and two little spurs, near the lower extremity of the tibiae. The head is not prolonged anteriorly.

In others the antennæ are always longer than the head and thorax, the legs usually of nearly equal size, the thorax narrower than the base of the abdomen, slightly narrowed posteriorly, and the hooks of the tarsi entire. Such are *CALOPUS*, Fab. *SPAREDRUS*, Megerle, *DYTILUS*, Fisch. and *ÆDEMERAS* properly so called (Plate CCXXVI. fig. 4).

TRIBE 5TH, RHYNCHOSTOMA.¹

In this, which forms the concluding tribe of the Stenelytra, are grouped certain insects, some of which are evidently allied to the preceding, while others in a natural system might be regarded as belonging to the *Rhynchophori*. The head is obviously prolonged anteriorly in the form of an elongated muzzle, or of a flattened trunk, bearing the antennæ at its base, and in advance of the eyes, which are always entire or without emargination.

Sometimes the antennæ are filiform, and the muzzle not enlarged at the base; the thorax is narrowed in front in form of a truncated cone or of a trapezium; the ligula is emarginate, and the terminal joint of the tarsi bilobed. These insects occur on flowers, a habitat indicated by the silky prolongation of the terminal lobe of the maxillæ. Such are the genera *STENOSTOMA*, Fab. and *MYCTERUS*, Clairville.

Sometimes the antennæ are terminated by an elongated mass, formed by from three to five terminal joints; the muzzle is very flat, with a projecting angle on each side, anterior to the extremity; the thorax is in the form of a truncated heart, narrowed posteriorly; the ligula and all the joints of the tarsi are entire. These insects dwell beneath the bark of trees, and seem allied to the *Anthrubi* of Fabricius. They form the genus *RHINOSIMUS* of Lat. and Oliv. Those of which the club of the antennæ consists of only three articles, fall under the genus *SALPINGUS* of Illiger. We have several British species.

The second general division of heteromorous Coleoptera forms

FAMILY IV.—TRACHELIDES.

The head is triangular or heart-shaped, borne upon a kind of neck or abrupt pedicle; the body is usually soft; the elytra flexible, without striæ, sometimes very short, in others slightly inclined. The maxillæ are not unguiculated. The joints of the tarsi are often entire, and the hooks of the posterior ones bifid. The majority of these insects live in the perfect state on various plants, of which they devour the foliage, or suck the nectarous juices. Many, when seized, bend their heads, contract their limbs, and simulate death. Others are extremely active. Latreille divides them into six tribes.

TRIBE 1ST, LAGRIARIÆ.

These have the body elongated, and narrower in front; the thorax either almost cylindrical or square, or ovoid and truncated. The antennæ, inserted near a notch on the eyes, are simple, filiform, or insensibly increasing towards the extremity, generally and at least partially granose, with the terminal article longer than the preceding in the males. The palpi are thickened at their extremity, and the terminal joint of the maxillary is larger, and in the form of a reversed triangle. The thighs are oval and clubbed; the tibiae elongated, narrow, with at least the two anterior arched. The penultimate article of the tarsi is bilobed, and the hooks of the last are neither incised nor dentated. The tribe is formed of the genus *LAGRIA* of Fabricius, subdivided in accordance with certain characters detailed in the *Règne Animal*, t. v. p. 52.

TRIBE 2D, PYROCHROIDES,

Approach the preceding in regard to the tarsi and the elongation and restriction of the anterior part of the body,—but the latter is flattened, with the thorax almost orbicular or trapezoidal. The antennæ, at least in the males, are pectinated or plumose—*en panache*; the maxillary palpi are somewhat toothed or serrated, and terminate in an elongated and almost hatchet-shaped article; the labial palpi are filiform. The abdomen is elongated, entirely covered by the elytra, and rounded at the end. These insects are found in woods in spring. The larvæ dwell beneath the bark of trees.

In the genus *DENDROIDES*, Lat. the antennæ of the males are almost as long as the body, and give off long bearded filaments; in the same sex the eyes are large, and approximated behind. The thorax is trapezoidal, or in the form of a truncated cone; and the body, as well as the legs, is proportionally more elongated. In the genus *PYROCHROA* properly so called² (Plate CCXXVI. fig. 6), the antennæ are shorter and simply pectinated, the eyes distant, and the thorax almost orbicular and transversal.

TRIBE 3D, MORDELLONÆ.

These do not present, either in relation to the form of the tarsi and their hooks, or to that of the antennæ, any constant character in common, but they are easily distinguished from the other Heteromera of the same family by the general conformation of their body. It is elevated, and arcuated; the head is low, the thorax trapezoidal or semicircular, and the elytra either very short, or narrowed, and terminated by a point, as well as the abdomen. Several of these insects approach the Pyrochroides in respect to their antennæ;—others in their maxillæ, the hooks of the tarsi, and their parasitical habits, resemble *Nemognathus* and *Sitaris*, two genera of an ensuing tribe;—but they differ from all of these in their extreme agility, and the firm and solid consistence of their teguments. They formed the old genus *Mordella* of Linn.

Some have the palpi almost of the same thickness throughout. The antennæ of the males are strongly pectinated or fan-like. The extremity of the mandibles offers no emargination. The articles of the tarsi are always entire, and the hooks of the hindmost are dentated or bifid. The middle of the posterior margin of the thorax is always much prolonged backwards, like a scutellum. The eyes are unemarginate. The larvæ of certain species (*Rhipiphori*) live in the nests of wasps.

The genus *RIPIPHORUS* of Bosc (Plate CCXXVI. fig. 7)

¹ From *εὐρυς*, *broad*, and *στόμα*, *mouth*.

² From *πυρ*, *fire*, and *ωχρεος*, *yellow*.

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has the wings extended, and reaching beyond the elytra, which equal the length of the abdomen. The hooks of the tarsi are bifid. The antennæ, inserted near the inner edge of the eyes, are pectinated on both sides in the males,—serrated, or with only a single range of short teeth, in the females. The terminal lobe of the maxillæ is very long, linear, and projecting; and the ligula is also elongated, and deeply bifid. Some naturalists having found in the nest of the common wasp several living specimens of *R. paradoxus*, it has been inferred that they live there in the larva state. M. Farines, however, has observed that the larva of *R. bimaculatus* lives and undergoes its transformations in the roots of *Eryngium campestre*.¹ Here are placed the genera PELOCOTOMA of Fischer, and MYODITES of Lat.

Others have the wings always covered by the elytra, which are prolonged nearly to the extremity of the abdomen, and terminate in a point. The posterior margin of the thorax is slightly if at all lobed. The abdomen of the females is terminated by a pointed tail. The eyes are sometimes emarginate. The maxillary palpi are terminated by a large article, in the form of a hatchet or reversed triangle. The extremity of the mandibles is notched or bifid. The antennæ, even in the males, are merely serrated. In MORDELLA properly so called (Plate CCXXVI. fig. 8), the antennæ, of equal size throughout, are slightly serrated in the males. All the articles of the tarsi are entire, and the hooks of the last present beneath one or two small indentations. M. Dufour has observed in a species of this genus two floating salivary vessels, longer than the body. The hepatic vessels have no cæcal insertion,—an exceptive character in the present section. The genus ANASPIS,² Geoff. is distinguished from the preceding by the antennæ, which are simple, and gradually enlarged, by the emargination of the eyes, and by the four anterior tarsi, of which the penultimate article is bilobed. The hooks of the last are entire and without sensible dentations.

TRIBE 4TH, ANTHICIDES.

Here the antennæ are simple, or slightly serrate, filiform, or a little thicker towards the end, and most of the articles are in the form of a reversed cone, and nearly alike, except the last (and sometimes also the two preceding), which is larger and oval. The maxillary palpi are terminated by a securiform club. The penultimate joint of the tarsi is bilobed. The body is narrow anteriorly, with the eyes entire or slightly emarginate. The thorax is sometimes in the form of a reversed oval, narrowed and truncated posteriorly, sometimes divided into two knots, in others semicircular. Certain species are found on plants of different kinds, but the majority occur upon the ground. They run with great swiftness, and their larvæ have been supposed to be parasitical. They compose the genus NOTOXUS³ of Geoffroy, which Latreille divides into SERAPTIA, STEROPIS, and NOTOXUS properly so called.⁴

The two concluding tribes of this family, and of the heteromerous section, exhibit certain characters in common, such as the termination of the mandibles in a simple point, the palpi filiform or simply a little longer at their extremity, but never either clubbed or securiform, the abdomen soft, the elytra flexible, and in most instances blistering or vesicatorial, and, with few exceptions, the articles of the tarsi entire, and the hooks of these parts

generally bifid. They are all herbivorous in the perfect state, but many are parasitical, while larvæ, in the dwellings of other tribes.

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TRIBE 5TH, HORIALES.

These differ from the ensuing, or Cantharidiæ, in their hooks, which are dentated, and each accompanied by a serrated appendage. The antennæ are filiform, not longer than the thorax; the labrum is small, the mandibles strong and projecting, the palpi filiform, the thorax square, and the two posterior legs very robust, at least in one of the sexes. The tribe is composed of the genus HORIA of Fabricius (Plate CCXXVI. fig. 10). These insects inhabit the intratropical regions of India and America. The lamented Lansdown Guilding has published figures and a short history of *H. maculata*.⁵ It deposits its eggs in the nest of a wood-gnawing bee (*Xylocopa teredo*), and the larvæ, when hatched, are supposed to devour the food deposited in the ligneous chambers for a very different purpose by the parent bee. "Forsan," says Mr Guilding, "dum larva cibum apibus præparatum avide consumit, hospes fame perit." It is often so.

TRIBE 6TH, CANTHARIDIÆ.

This tribe is distinguished from the preceding by the hooks of the tarsi, which are deeply divided, and appear as if double. The head is generally large, broader, and rounded posteriorly. The thorax is usually narrowed behind, and approaches the form of a truncated heart; in some it is almost orbicular. The elytra are often somewhat inclined laterally, or tectiform, and rounded. These insects counterfeit death when seized, and several of them exude a yellow caustic liquor, of a penetrating odour, from the joints of their antennæ; but no peculiar apparatus for the production of that secretion has yet been ascertained. Many kinds are highly serviceable in the formation of blistering applications. They were all included originally in the old genus MELOE of Linnæus, now greatly subdivided. The anatomical observations of M. Dufour, and the extremely interesting researches of M. Bretonneau of Tours, on the vesicatorial properties of this tribe of insects, have enabled Latreille to arrange them in what he regards as a natural order,—not greatly differing, however, from that which he had previously adopted. M. Bretonneau has ascertained that the genus *Sitaris* is not vesicatorial,—and M. Dufour has found that these same Heteromera possess only four biliary vessels instead of six, the amount by which other insects of the tribe are characterized. That genus also resembles *Zonitis* in its general organization, while the latter is itself closely allied to *Cantharis*. The series of groups adopted by Latreille is also in harmony with the progressive changes in the form of the antennæ.

In some these organs are composed in both sexes of only nine articulations, of which the last is large, and in the form of an ovoid head; those of the males, as well as their maxillary palpi, being very irregular. The body is depressed. Such is the genus CEROCOMA of Geoff. The species make their appearance during the summer solstice, and frequently in great numbers on the same spot. They frequent the flowers of the wild chamomile, milfoil, &c. *Meloe Schœfferi* of Linn. of a bluish green, with the antennæ and legs wax yellow, may be mentioned as an example.

In all the others the palpi are identical and regular in

¹ *Annales des Sciences Nat.* viii. 224; and *Nouv. Dict. d'Hist. Nat.* second edition, art. *Ripiphore*.

² From α priv. and $\sigma\sigma\pi\iota\varsigma$, scutellum.

³ From $\nu\omicron\tau\omicron\varsigma$, back, and $\omicron\zeta\upsilon\varsigma$, pointed.

⁴ See *Règne Animal*, t. v. p. 58; and *Mém. des Nat. de Moscou*, i. 166.

⁵ *Linn. Trans.* vol. xiv. part ii. p. 315.

Coleoptera both sexes. The antennæ have generally eleven articulations, and when they offer one or two less they terminate regularly in a club. The body is thickish, and the elytra somewhat inclined.

In some the antennæ, always regular and granose in both sexes, sometimes appear to be composed of only from nine to ten joints, and are not longer than half the body; they occasionally terminate in an arcuated club, or are obviously enlarged at the extremity; while in others they form from the second joint a short cylindrical or almost fusiform stem. They constitute the genus *Mylabris* of Fabricius. Such of them as have the two or three last joints of the antennæ united, at least in the females, and forming an abrupt, thick, ovoid, or button-shaped club, the extremity of which does not extend beyond the thorax, and in which the total joints are only from nine to ten, form the genus *HYCLEUS* of Lat. Such, again, as have the antennæ proportionally longer, and offering in both sexes eleven distinct and well-divided articulations, gradually enlarging, or terminating by degrees in an elongated club, of which the terminal joint, very distinguishable from the preceding, is large and ovoid, belong to the genus *MYLABRIS* properly so called (Plate CCXXVI. fig. 11). The species we have here represented is the *M. chitorii*. It is more than half an inch long, black, pilose, with an almost round yellowish spot on the base of each elytron, and two transverse and indented bands of the same colour, one near the centre, and the other nearer the extremity. The antennæ are black. This insect, unknown in Britain, is occasionally found as far north as the vicinity of Paris, but it is much more common in the south of France, and other meridional parts of Europe. Its blistering qualities are quite as active and efficient as those of the true *Cantharis* or Spanish fly; and in Italy it is employed for the same purposes, mixed up with the latter, or even used alone. *M. pustulatus* is used by the Chinese.

In the other Heteromera of this tribe the antennæ, always composed of eleven very distinct joints, are almost of equal thickness throughout, or rather more slender towards the extremity, and frequently much longer than the head and thorax. They are irregular in several males. In *MELOE* properly so called (Plate CCXXVI. fig. 12), the antennæ are composed of short and rounded joints, the intermediate of which are the largest, and sometimes so disposed that these parts in the males exhibit an emargination or crescent-like form. The wings are wanting, and the elytra, oval or triangular, with a portion of the inner margins crossing each other, only partially cover the abdomen, especially that of the females, which, as often happens, is extremely voluminous. According to Dufour, the crop of these insects may be considered as a true gizzard, being furnished internally with callous and anastomosing plicæ, and separated from the stomach or chylic ventricle by a valve formed of four principal pieces, each of which results from two hollow cylinders placed back to back, and tridentated posteriorly.

All the species of the genus *Meloe* are awkward and mis-shapen, and of sluggish movements. They are found either crawling slowly and heavily along the surface of the

earth, or on plants of humble growth. They feed on leaves, and when handled, an oily fluid of a yellow or reddish colour flows from the joints of their legs. Latreille suspects that these insects are the *Buprestides* of the ancients, to which were attributed such destructive effects on cattle, when inadvertently swallowed by the latter. The genus seems characteristic of the European continent and islands. Eight or nine species occur in Britain; and of the twenty-one species enumerated by Dejean, the whole are European. Mr Kirby however possesses a specimen taken in North America by Professor Peck. They are all characterized by dark or sombre colours. They are most frequent in spring and autumn, and occur in fields and pathways, preferring, it is said, a sunny situation and a sandy soil. In some districts of Spain they are employed along with *Cantharides*, or in their room. They are also used by farriers.¹ The females, when filled with eggs, become greatly dilated, and in that condition much exceed the males in size. An individual of the former sex observed by Goëdard, and fed by him with the leaves of anemone and ranunculus, laid 2212 eggs between the 12th of May and the 12th of June, besides about as many more which were thrown aside uncounted. It effected this laying at two separate periods, placing the extremity of its abdomen in a hole which it had formed in the earth, and depositing the eggs in packets. These are of a yellowish colour, and resemble grains of sand pressed together. The larvæ are long, cylindrical, garnished with scattered hairs, composed of eleven nearly equal segments, besides the head, which is oval, and provided with two eyes, and a pair of longish antennæ. They have six legs, of rather large size compared with the length of the body, which is terminated by two long bristle-like appendices. Their larvæ are supposed by some ingenious observers to be parasitical on the bodies of winged insects. Degeer having remarked that a strong resemblance existed between the larvæ of *Meloe*, and a small insect which he found adhering to *Eristalis intricarius*, he placed two domestic flies among the former, and found that they were speedily adhered to by the larvæ, which stuck to them pertinaciously, and caused their death in two or three days. Bees are also subject to their attacks; and MM. Lepelletier and Serville are said to have recently confirmed the observations of Degeer, by breeding these parasites from the eggs of *Meloe*. "On the other hand," says Mr Curtis, "Mr Kirby is disposed to think that his *Pediculus Melittæ* (P. *Apis*, Linn.?) is not the larva of *Meloe*; and M. Leon Dufour has even formed them into a genus under the name of *Triangularis andrenetarum*; and a figure of one is given in the thirteenth volume of the *Annales des Sciences Naturelles*."² M. Latreille seems to adopt the opinion of their parasitical nature; and the facts, so far as known, are well stated by M. Walckenaer, in his *Memoires pour servir à l'Histoire Naturelle des Halictes*.³ The digestive system of the genus *Meloe*, with other anatomical details, has been illustrated by M. Dufour;⁴ and we are indebted for a monograph of the British species to Dr Leach.⁵

All the ensuing genera of the tribe are provided with

¹ In regard to these insects we may further observe, that Dr Leach was informed by Mr Hunneman that the species called *M. variegatus* is highly prized in Germany as a medicine, being considered as a specific in hydrophobia. For this purpose it is taken by slipping a hair round its neck, and suspending it till dry; the oily secretion first thrown out being preserved, as in that the chief virtue is supposed to exist. Mr Hunneman adds more particularly, that the late king of Prussia, Frederick the Great, purchased the nostrum from the discoverer for a valuable consideration, as a specific against the bite of a mad dog. According to the recipe, twenty-five of these insects that have been preserved in honey, are, with two drachms of powdered black ebony, one drachm of Virginia snake-root, one ditto of lead filings, and twenty grains of fungus sorbi, to be reduced to a very fine substance; the whole, with two ounces of theriaca of Venice (and, if necessary, a little elder root), to be formed into an electuary! (See *Linn. Trans.* xi. p. 245.)

² *Brit. Ent.* vol. vi. fol. 279.

³ See also *Introduction to Entomology*, vol. iv. p. 225.

⁴ *Ann. des Sciences Nat.* t. iii. p. 486.

⁵ *Linn. Trans.* xi. p. 35 and 242.

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wings, and elytra, of the ordinary structure, covering longitudinally the back of the abdomen. In the genus *CANTHARIS*, Geoff. (Plate CCXXVI. fig. 14), all the joints of the tarsi are entire, the thorax almost ovoid, a little elongated, and restricted anteriorly, truncated posteriorly. The second joint of the antennæ is much shorter than the following, and the last of the maxillary palpi is sensibly larger than the preceding. The head is a little broader than the thorax. The antennæ of the males are sometimes irregular, and even semi-pectinated. The name of *Cantharis* is extremely ancient, and has been received in a variety of acceptations. Aristotle did not apply it to any particular insect, but to various Coleoptera.¹ Linnaeus made use of the term to designate a great genus of the same order, which, however, did not include the true *Cantharis*, which he placed in *Meloe*. Geoffroy substituted the name *Cicindela*, already otherwise employed, for that of *Cantharis*, and placed in the latter the genuine Spanish fly. Fabricius placed it in his genus *Lytta*, which corresponds to *Cantharis* of Geoffroy. The latter, however, amidst all these revolutions of names, appears to have maintained its ground, and to have been the most generally adopted.

The *Cantharides* properly so called have an elongated and almost cylindrical form. The history of the most noted species, *C. vesicatoria*, commonly called the Spanish fly (fig. 14), is still somewhat doubtful, so far as concerns our knowledge of its transformations. Neither Degeer nor Geoffroy ever saw the larva. Those who suppose themselves to have seen it say that it feeds on various roots, and is metamorphosed in the earth,—an observation which accords with the usually sudden appearance of the perfect insect, the unexpected apparition of which has sometimes given rise to the belief that they migrated from more southern regions. It is described by Olivier as consisting, in its early state, of thirteen segments, soft, of a yellowish-white, with six short scaly feet,—the head rounded and flattish, and furnished with two short filiform antennæ. The mouth consists of a pair of tolerably solid maxillæ and four palpi. The medicinal uses of this now celebrated beetle are universally known, but its connection with the sanitary art is not traceable to a remote antiquity; for the *Cantharis* of the ancients was certainly not the same as the Spanish fly, and is even supposed to have belonged to a different genus. According to the testimony of Pliny and Dioscorides, who affirm that the best *Cantharides* are such as are marked with transverse yellow bands, it becomes evident that their species was the *Mylabris chircorii* already mentioned, which in China is used for epispastic preparations down to the present day. The insect of the European laboratories, *C. vesicatoria*, is of a beautiful golden green, with black antennæ. The males are less than the females, and there exists in general a great variety of size among different individuals. These insects are very common in France,² Italy, and Spain. The greater proportion employed in commerce come from the last-named country, and hence their common name. Their collection requires precaution on the part of those who are employed in that office, both with a view to guard against injurious accidents, and for the proper preservation of the objects themselves. They are killed by means of vapour of vinegar, and completely dried after they are dead. The following is the plan of procedure: In the course of the month of June the natives

place extended cloths or sheets beneath the trees on which the *Cantharides* occur, and make them tumble down by beating all the branches. When they have obtained a considerable quantity, they either put them into a hair sieve, which they place over the vapour of vinegar, or into a fine cloth, which they dip repeatedly in a vessel containing diluted vinegar. They are then allowed to dry under the shade of some loft or granary, being placed on hurdles covered with cloth or paper, and stirred occasionally with a stick, or with the hand protected by a stout glove. When thoroughly dry they are packed into vessels of wood or glass, which are afterwards carefully and tightly closed. These little processes being properly attended to, the insects retain their blistering qualities for a length of time.

The chemical analysis of *Cantharides* has been made by numerous experimentalists, who appear, however, to have confined their researches rather too exclusively to the Spanish fly. Had they studied with equal assiduity the genera *Meloe* and *Mylabris*, and even *Carabus*, *Coccinella*, and several *Tenebriones*, they would have discovered in these also an analogous or identical principle, less active perhaps in its nature, but for that very reason susceptible of being employed with greater advantage in special cases. Thouvenet, Fourcroy, Beaulieu, Orfila, and especially Robiquet, have arrived at some remarkable results. The latter has demonstrated the existence of a particular substance, on which he has bestowed the name of *Cantharadine*, and which may be characterized as white, crystalline, insoluble in water, soluble in boiling alcohol, in ether, and in oils. It is the seat of the vesicatorial or blistering property, which does not therefore reside in the green oil, nor in the black insoluble matter, nor in the yellow matter soluble in alcohol and in water,—the other ingredients of which analysis has demonstrated the presence. This discovery, though important in a scientific point of view, has produced no alteration in the practice, which proceeds effectually enough upon the old experience, that when the substance of the insect is reduced to powder, mixed up with some fatty matter, and applied to the surface of the body, it immediately proceeds to action, and detaches the outer skin from the dermis with great rapidity. It is also used for several other purposes.³ Naturalists are acquainted with many other species of *Cantharis* besides the Spanish fly. Of these we may mention *C. Syriaca* of Olivier, which occurs in Syria and the south of Europe, and the *C. dubia* of the same author, found in the southern provinces of France, Italy, the Levant, and Siberia. In the United States a species, described by Fabricius under the name of *vittata*, is employed for medicinal purposes. It is found in great abundance among potatoes.

The remaining genera of the tribe are *ZONITIS*, Fab. *NEMOGNATHUS*, Lat. *GNATHIUM*, Kirby, and *SITARIS*, Lat.

TETRAMERA.

Four Articulations to all the Tarsi.

The numerous and important groups which constitute this, the third primary section of the coleopterous order, are all vegetable feeders. The larvæ have very short

¹ *Hist. Animal*, lib. iv. cap. 7.

² Latreille observes that they appear in France about the period of the summer solstice, and that they occur more particularly on the ash and lilac, on the leaves of which they feed. They diffuse around them a peculiar and highly penetrating odour.

³ See *Annales des Sciences Nat.* ix. p. 31; and *Diction. Class. d'Hist. Nat.* iii. p. 156.

oleoptera feet, and in many even these seem wanting, or are replaced by mammillæ. The perfect insects occur among flowers and plants. Latreille divides them into seven families. The larvæ of the first four or five most commonly live concealed in the interior of plants, and are generally destitute of feet, or have these organs extremely small; many attack the hard or ligneous portion of their dwelling. These Coleoptera are the largest of their section.

FAMILY I.—RHYNCHOPHORA.¹

This numerous and widely extended family, so remarkable for the beauty of its South American species, is easily recognised by its more or less extended muzzle, terminated by a mouth, of which the parts, from their peculiar structure and position, are not easily determined without the aid of microscopical examination and dissection. The abdomen is generally of a bulky form, the antennæ geniculate and clavate, and the penultimate joint of the tarsi almost always bilobate. In many tribes the posterior thighs are dentated. The body of the larvæ is oblong, and resembles a small white worm, exceedingly soft. The head is squamous or scaly, and the feet are either wanting or mammillæform. They live by gnawing the various parts of plants. Many dwell exclusively in the interior of fruits and seeds, and do great damage to the farmer, grain-dealer, and horticulturist. Some, such as the *Brachyceri*, are supposed to live beneath the ground, and to feed on roots.

The muzzle in this richly adorned family differs essentially from the *rostrum* of the hemipterous species. It is in fact merely a prolongation of the head, and not composed of the parts of the mouth, as in the last-named order. This prolongation, however, exerts an influence over the alimentary tube, the œsophagus being thereby somewhat prolonged, and—as we find to be the case in the truly suetorial tribes—there is also a provision of salivary glands.

We have little detailed information regarding the internal structure of the Curculionidæ. Two species (*Attelabus betuleti* and *Cryptorhynchus lapathi*) have been ex-

mined and described by Ramdhor.² In both of these the Coleoptera alimentary canal was moderately long, the stomach par-Tetramera-tially shaggy, and the small intestine inversely claviform. In other respects, however, they differed materially. There was no crop or gizzard in the former, the stomach was fringed on each side, except at its upper extremity, with a series of small cæca or shags, and there were three pair of bile-vessels; in the latter the gullet was dilated into a crop, which included a gizzard of singular and exquisite construction; for, though so minute as scarcely to exceed a large pin's head in size, it was found to be provided internally with more than four hundred pairs of teeth, moved by an infinitely greater number of muscles. A transverse section of this gizzard represented two concentric stars, with nine rays each, the object of this structure being the comminution of the timber which the insect has to perforate, and probably devour. The stomach was very slender, but dilated in the middle into a spherical vesicle; and only two pairs of bile vessels were observable.³

It may well be supposed, that in a family consisting of not much less than three thousand ascertained species, many diversities occur both in habit and external structure. The antennæ are sometimes straight, but more frequently have an angular bend. They are inserted either towards the extremity of the muzzle when that organ is short, or nearer the centre, or even towards the base, in the long snouted species. The number of the articulations of the antennæ varies in certain genera from six to ten; but eleven is the more usual number, or even twelve, if we count the false or terminal article. The body is generally narrowest in front, with a large abdomen covered by very hard elytra. The tarsi are very frequently garnished beneath with short hairs. None of the species are carnivorous in any degree; but even in the perfect state they are sometimes extremely noxious, when they happen, as they sometimes do, to occur in great abundance. They tap the buds and leaves of trees, and of several cultivated vegetables, and feed upon their juices.

TRIBE 1ST, BRUCHELÆ, Lat.

Labrum apparent, anterior elongation of the head short, broad, depressed, and in the form of a snout. Palpi very

¹ Since the publication of the first edition of the *Règne Animal*, considerable attention has been bestowed on this difficult family. Messrs Germar and Schœnherr, more particularly, have devoted their time to its elucidation; and the latter author (in his *Curculionidum Dispositio Methodica*, Leipsic, 1826) gives a hundred and ninety-four genera, exclusive of sub-genera. He divides the Curculionidæ, in accordance with the straightness or geniculation of their antennæ, into two great sections, the *Recticornes* or *Orthocera*, and *Fracticornes* or *Gonatocera*. The recent observations of M. Leon Dufour on the internal structure of these insects seem to strengthen the propriety of that classification. The species of the latter section are furnished with salivary vessels, which are wanting in those of the former. In Latreille's recent reconstruction of Schœnherr's arrangement, the Recticornes compose four tribes—the *Bruchelæ*, the *Anthribides*, the *Attelabides*, and the *Brentides*. In the first two the labrum and palpi are very visible; these palpi are filiform or larger at the extremity; they are small and conical in the two other tribes, as in all the following Rhynchophora. The Fracticornes form a fifth tribe, viz. the *Curculionites*. These are divided into the *Brevirostres* and the *Longirostres*, terms which bear relation to the place of insertion of the antennæ. In the former these organs are attached to the extremity of the muzzle, or on a line with the base of the mandibles,—while they are placed further back, or nearer the head, in the latter. The genera of the *Brevirostres* are arranged in three subtribes, viz. *Pachyrhynchides*, *Brachycerides*, and *Liparides*,—corresponding to the genera *Curculio*, *Brachycerus*, and *Liparus* of Olivier; the last sub-tribe comprising also some *Lixi* of that author. The relative size and form of the mentum, the mandibles, the presence or absence of wings, the direction of the lateral sulci of the proboscis, in which the first joint of the antennæ is partly lodged, the length of that joint, and the proportions and forms of the thorax—these and other secondary considerations furnish the characters of the various groups. The *Curculionites Longirostres* are divided into two principal sections, in accordance with their habits, and the composition of their antennæ. These consist, in the *Phyllophagi*, of not fewer than ten joints, the last three of which, at least, form the terminal club. But among the *Spermatophagi* the antennæ never consist of more than nine joints, of which the last or the last two form the club. The legs of the *Phyllophagi* are sometimes contiguous and sometimes remote. Those in which they approach each other are divided into four tribes:—the *Lixides* (*Lixus*, Fab.), the *Rhynchonides* (*Rhynchænus*, Oliv.), the *Cionides* (*Cionus*, Clairv.), and the *Orchestides* (*Orchestes*, Illig.). The *Spermatophagi*, again, form three principal sections or sub-tribes:—the *Calandrides* (*Calandra*, Clairv., Fab.), the *Cossonides* (*Cossonus*, Clairv.), and the *Dryophthorides* (*Dryophthorus*, Schœn., *Bulbifer*, Dej.). These latter lead to the *Hylesini*, Fab., and other *Xylophagi*. (See *Règne Animal*, t. v. p. 69.) A great proportion of the European Curculionidæ are most accurately described by Gyllenhal in his *Insecta Succica*. Mr Kirby's paper on the genus *Apion* (Linn. Trans. vol. iv.) is also deservedly esteemed. The reader will find a critical and expository treatise on this family by Latreille, under the term RHYNCHOPHORES, of the *Dict. Class. d'Hist. Nat.* t. xiv. p. 584. He may also consult Germar's *Insectorum Species Novæ*, and the continuation of Illiger's *Magazin für Insectenkunde*. The British species are described, with their usual skill, by Messrs Curtis and Stephens. The latter, in the second edition of his *Nomenclature*, enumerates above 500 indigenous species. The Scottish kinds are described in our *Entomologia Edinensis*. We see, from our recent correspondence, that about 3000 species of this great family are now known to naturalists.

² *Abbildungen zur Anatomie der Insecten*.

³ *Introduction to Entomology*, vol. iv. p. 107.

Coleoptera visible, filiform, or larger at the extremity. These insects compose the old genus *Bruchus*, Linn. They are subdivided as follows.

Those species of which the antennæ are clavate, or very obviously enlarged at their extremity, with the eyes unemarginate, and which appear to have five articulations to the four anterior tarsi, form the genus *RHINOSIMUS*, which Latreille, in accordance with its tarsal characters, formerly placed among the Heteromera, but which other natural affinities connect more closely with the following genus. Those of which the antennæ and eyes resemble the last, but which present only four tarsal articulations, compose the genus *ANTHRIBUS*¹ of Geoffroy and Fab. (Plate CCXXVI. fig. 16), to which Latreille adds the *Rhinomacrus* of Olivier. These insects are generally found on old wood, although some occur on flowers. In the genus *BRUCHUS* properly so called² (Plate CCXXVI. fig. 17), the antennæ are filiform, frequently serrated or pectinated. The eyes are emarginate. The anus is exposed, and the hind legs are frequently very large. These species deposit their eggs in the yet tender germs of our leguminous plants, of our most valuable grains or palms, coffee, &c., where the excluded larvæ occasion infinite damage. The perfect insect detaches a portion of the epidermis in the form of a cap, and, on issuing, produces those circular holes so often seen on peas and beans. Such is a small species called *B. pisi* (see the figure last referred to), an insect which has been known to occasion great injury in North America. A very large species, the *B. Bactris* of Linn. occurs in Cayenne, where it feeds on the fruit of *Cocos guinensis*. It is named *Coumana* by the natives. The genus *RHÆBUS* of Fischer is distinguished from the preceding by flexible elytra and bifid hooks to the tarsi. The genus *XYLOPHILUS* of Bonelli is characterized by clavate palpi.

In the other tribes there is no apparent labrum. The palpi are very small, inconspicuous to the naked eye, and of a conical form. The anterior prolongation of the head represents a beak or trunk.

Sometimes the antennæ are straight or not geniculate (*Orthoceri*), inserted on the rostrum, and consist of nine or ten joints.

Those in which the three or four last joints are united into a club form

TRIBE 2D, ATTELABIDES, Lat.

They gnaw the leaves and tender parts of plants. Most of the females roll up these leaves into a tube or trumpet, in which they deposit their eggs,—thus forming a proper nidus for their offspring. The different proportions of the trunk, the mode of its insertion, the nature of the tibiæ, and the form of the abdomen, have given rise to the formation of several genera, such as *APODERUS*,³ *ATTELABUS*,⁴ *RHYNCHITES*,⁵ and *APION*.⁶ The first is very strongly marked. The head is narrowed behind, or presents a neck-like prolongation, and unites with the thorax by means of a rotule. The muzzle is short, thick, enlarged at the end, a character common to the Attelabi properly so called; but in them, as well as in the other two ge-

nera, the head enters into the thorax up to the eyes, and the snout is elongated in the form of a proboscis. In *Rhynchites* the latter is somewhat widened at the end, and the abdomen is nearly square. In *Apion*, of which Mr Stevens enumerates ninety-one species as indigenous to Britain, the snout is not widened at the end, and frequently terminates in a point. The abdomen is large or inflated.⁷ Here also are placed the genera *RHINOTIA* and *EURNINUS* of Kirby,⁸ and *TUBICENUS* of Dejean (*Auletes*, Schœn.⁹).

Those in which the antennæ are filiform, or in which the terminal article alone forms the club,—in which the muzzle, often longer in the males than in the females, and differently terminated, is always borne in advance,—of which the proportions of the body are usually much lengthened, and in which the penultimate article of the tarsi is bilobed, form

TRIBE 3D, BRENTIDES, Lat.¹⁰

In the genus *BRENTUS* properly so called (Plate CCXXVI. fig. 15), the body is linear, and the antennæ filiform or slightly enlarged towards the extremity, and composed of eleven articulations. There is only one species of *Brentus* found in Europe, the *B. italicus*, which lives beneath the bark of trees, and generally, according to Savi the younger, of Pisa, in the same domicile with a certain species of ant. They are numerous in South America, and occur there also beneath the bark of trees. The genus *ULOCERUS*, Schœn. resembles the preceding in general form, but the antennæ have only nine articulations, the last of which forms a little club. The last of this tribe is constituted by the genus *CYLAS*, Lat. in which there are ten articulations to the antennæ, the last of which forms an oval club. The thorax seems divided into two knots, of which the posterior, forming the pedicle, is the smallest. The abdomen is oval.

Sometimes the antennæ are distinctly geniculate (*Gonatoceri*), the first articulation being much longer than the following. These form the genus *Curculio* of Linn. or

TRIBE 4TH, CURCULIONITES, Lat.

These seem naturally divisible into two lesser groups, according as the antennæ are inserted near the extremity of the proboscis (*Brevirostres* or *Brachyrhynchi*), or further back, either towards the centre, or near the base (*Longirostres*, or *Mecorhynchi*); “mais il n'est pas facile,” says Latreille, “de bien déterminer leurs limites, et plusieurs genres sont très-ambigus sous ce rapport.”¹¹

A. *Brevirostres*.

In the genus *BRACHYCERUS*,¹² Fab. all the joints of the tarsi are entire, and without brush or pellet beneath. The antennæ are short, not much bent, and present externally only nine joints, the last of which forms the club. These insects are destitute of wings, and their body is very scabrous or uneven. They are characteristic of Southern Europe and of Africa, live on the ground, in sandy soils, and appear very early in the spring. The women of Ethiopia use one species as a sort of amulet, passing a string through its body, and hanging it around their necks.¹³

¹ From *ανθος*, flower, and *τελέω*, I destroy.

² From *απο*, used to augment the sense of the word with which it is used, and *δειξ*, the neck, which is much prolonged.

³ From *απτεω*, to leap, and *λαβει*, seizure. The name was originally applied by Aristotle to an orthopterous insect.

⁴ From *ῥονχος*, rostrum.

⁵ From *ἄπιον*, a pear, which the insects somewhat resemble in form.

⁶ See Kirby in *Linn. Trans.* vol. ix.

⁷ *Ibid.* vol. xii.

⁸ *Curcul. Disp. Method.* 46.

⁹ From *βρύκω*, I gnaw.

¹⁰ Gen. *BRENTUS*, Fab. *CURCULIO*, Linn.

¹¹ *Dict. Class. d'Hist. Nat.* t. xiv. p. 594.

¹² From *βραχυς*, short, and *κερας*, horn.

¹³ Caillaud, *Voyage au Fleuve Blanc*.

Coleoptera ramera. In the genus *CURCULIO*, Fab. almost the whole of the under parts of the tarsi are furnished with short stiff hairs forming pellets, and the penultimate article is deeply divided into two. The antennæ are composed of eleven articulations, or even of twelve, if we count the false one by which they are sometimes terminated. The last form the club. This splendid and extremely numerous genus, although greatly restricted by Fabricius, compared with its vast extent in the system of Linnæus, has been still more circumscribed by authors of the present day. An enormous accession of species having been discovered and described, these have been arranged by Germar, Schœnherr, Megerle, Dejean, and others, into a corresponding variety of generic groups, partly for the sake of convenience, and partly (though not entirely) because the nature of the subjects required such systematic modifications. Latreille's observations have led him to form these Curculiones into two principal divisions.

1st, Those in which the mentum, more or less widened superiorly, and more or less orbicular, occupies the entire breadth of the cavity of the mouth, and wholly or nearly conceals the maxillæ,—and in which the mandibles have no very sensible dentations, or merely exhibit a slight sinus underneath the point. The generic groups are as follows. In *CYCLOMUS* the tarsi (as in genus *Brachycerus*) are unprovided with brushes, and the penultimate articulation is entire, or very slightly notched, without distinct lobes. In this genus Latreille would comprise those named *Cryptops*, *Deracanthus*, *Amycterus*, and *Cyclomus* of Schœnherr. The tarsi of all the others are furnished with brushes beneath, and the penultimate joint is deeply bilobate. Some are apterous. In *CURCULIO* properly so called (Plate CCXXVI. fig. 18), the lateral sulci of the proboscis are oblique and directed inferiorly. The anterior legs differ little in their proportions from the following ones. The genus, even thus restricted, comprises an immense number of groups, raised by Germar and Schœnherr to the rank of genera, “dont les caractères,” says Latreille, “sont peu importants et souvent très-équivoques.”¹ He thinks that at most only those should be detached of which the antennæ are proportionally longer. Among such as have short antennæ, the thorax longitudinal, and forming a truncated cone, the shoulders salient, and of which recent writers have formed the genera *Entimus*, *Chlorima*, and others, we find many noted South American species, of considerable size and exquisite beauty, and which, considered all in all, may be regarded as the most splendid examples of the coleopterous order. Such, for example, is *C. imperialis*, commonly called the diamond-beetle, which (may the scientific reader pardon the digression), inclosed in its little box, and covered by a microscope, has so often exhibited to the wondering gaze of youth hues more gorgeous than are ever seen in after days, when no glass, however potent, can dispel the mists which gather around whatever seemed the brightest and most beautiful of earthly things. The species just named is of a brilliant golden green, with two black longitudinal bands upon the

thorax. There are several ranges of impressed or hollow spots upon the elytra, of a beautiful and sparkling green, with intervals of black, presenting the appearance of innumerable emeralds incased in gold and ebony. Such also is *C. regalis*, an insect still of great value, of which in former days a single specimen once sold in Paris for L.23 sterling. It is a good deal less than the diamond-beetle, of a bluish green, with extremely brilliant gold and copper bands upon the elytra. It is found in St Domingo and the island of Cuba. Many others, of almost equal beauty, will occur to the recollection of those who have inspected an extensive collection of foreign insects, and the specific names of *fastuosus*, *sumptuosus*, *nobilis*, and *splendens*, sufficiently attest the unfeigned admiration of the lovers of nature, of that bright attire which distinguishes these favoured creatures.² The genus *LEPTOCERUS*³ differs from the preceding in having the two anterior legs larger than the following, with the thighs thick, the tibiæ arcuated, and the tarsi often dilated and ciliated. The antennæ are usually long and slender. The thorax is almost globular or triangular, and is scarcely exceeded in width by the abdomen. These insects are very abundant in Brazil, and several analogous species are found in the Isles of France and Bourbon. Some inhabit Africa. Another genus, that of *PHYLLOBIUS*,⁴ comprehends likewise winged species, but in which the grooves of the sides of the proboscis are straight, short, and consist only of a simple fossette. Several of these are extremely common in Britain. Along with the preceding, Latreille combines the genera *Macrorhynchus*, *Mylocerus*, *Cyphicerus*, *Ambliorhinus*, and *Phytoscapus*, of Schœnherr.

Those Breviostres in which the penultimate joint of the tarsi is bilobate, but which are apterous, and always destitute of a scutellum, form other sub-genera, such as *Othiorhynchus*, *Omius*, *Pachyrhynchus*, *Psalidium*, *Thylacites*, *Syzygops*, and others.

2d, Those in which the mentum is narrowed, and, not occupying the whole of the cavity of the mouth, leaves the jaws exposed on either side. The mandibles, too, are evidently dentated. The club of the antennæ is frequently formed of the last five or six joints.

Some have scarcely more than two teeth to the mandibles. The labial palpi are distinct. The club of the antennæ, rather abrupt, does not commence, except from the eighth or ninth articulation, and is not elongated and fusiform. The body, though frequently oblong, is not of a uniform figure. Several are apterous, with the tarsi unfurnished with pellets, and their penultimate article feebly bilobed. Such is the genus *MYNIOPS* of Schœnherr, with which Latreille combines *Rhytirrhinus* of that author. Several, likewise apterous, have, like most of the Rhynchophori, the under surface of the tarsi furnished with pellets, and the penultimate article deeply bilobed. They compose the genus *LIPARUS*, Lat. which comprises several genera of Schœnherr. Such as are winged form two additional genera,—that of *HYPERA*, Germar, in which the tibiæ have either no hook at their extremity, or but a very small one, and that of *HYLOBIUS*,⁵ in which the

¹ *Règne Animal*, t. v. p. 78.

² Even among our native Curculionidæ there are many species, though of small size, yet of exquisite beauty. The genera *Polydrusus* of Germar, and *Phyllobius* of Schœnherr, frequent the foliage of trees and of herbaceous plants. They excel most of the indigenous Coleoptera in brilliancy of colouring,—produced by a covering of minute scales, the body itself being dull and opaque. These scales vary in shape, being often rounded and adpressed to the surface, at other times narrower, and having the appearance of hair. The prevailing colours are green or silvery-green, golden, and coppery, of various shades and different degrees of resplendency,—a considerable range of variation being observable even among individuals of the same species. Green, however, is by far the most common colour, and is no doubt intended to contribute to the preservation of the insect by assimilating it to the objects by which it is usually surrounded. (See *Entomologia Edinensis*, p. 253.)

³ From *λεπτός*, slender, and *κερας*, horn.

⁵ From *ύλη*, wood, and *βιος*, life.

⁴ From *φύλλον*, a leaf, and *βιος*, life.

Coleoptera hook at the internal extremity is very marked. Among Tetramera the former, *H. tamarisci* (the type of the genus *Coniatus* of Schœnherr) rivals in its colours the most beautiful of the exotic species; among the latter we may name a well-known Scottish insect, *H. abietis*, Linn. (*Cur. pini* of Marsham¹).

Others have from three to four teeth upon the mandibles, the mentum abruptly narrowed near its upper extremity, and truncated, the palpi very small or imperceptible. The antennæ terminate gradually in an elongated fusiform club. The body has in most an analogous form. Olivier placed these insects in the genus *LIXUS*, from which, in fact, they do not greatly differ. They compose the genus *CLEONUS*, as constituted by Latreille.

B. Longirostres.

In this, the second group of the tribe Curculionites, the antennæ are inserted beyond the origin of the mandibles, and often near the centre of the proboscis, which is usually elongated. It comprises, with the exception of a few species, the genera *Lixus*, *Rhynchænus*, and *Calandra* of Fabricius. In the two former the antennæ are composed of at least ten articulations; they frequently consist of from eleven to twelve, of which at least the last three form the club.

The genus *LIXUS* of Fab. (Plate CCXXVI. fig. 19) almost resembles *Cleonus* in the organs of manducation, the elongated fusiform club of the antennæ, the long and narrow form of the body, and the curvature of the tibiae. *L. paraplecticus* (the species figured) is nearly linear. Its larva lives in the stem of *Phellandrium aquaticum*, and is alleged by Linnæus to occasion *paraplegia* among horses. The disease, as well as the plant, is called *Staikra* by the Swedes. The transformations of the insect are described by Degeer. Another species, *L. odontalgicus*, is a reputed cure for toothach.

The genus *RYNCHÆNUS* of Fab. does not present an equal uniformity of character among its constituent parts, and has therefore been numerously subdivided. We shall mention a few of the modern groups.

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In some the legs are contiguous at the base, and there is no sternal groove for the reception of the proboscis. Of these a certain number never leap; their antennæ are composed of eleven or twelve joints, and their body is furnished with wings. Such are the genera *TAMNOPHILUS*,² *BAGOUS* (small insects found in marshes), *BRACHYPUS*,³ *BALANINUS*⁴ (remarkable for the great length of the proboscis), *RYNCHÆNUS* properly so called, and *SYBINES*. Along with these may be placed *MYORHINUS* of Schœnherr, and other genera, distinguished from the preceding by being apterous. In the genus *CIONUS* the antennæ consist of from nine to ten joints. The body is usually very short, and almost globular. The ensuing differ from those above named in having very thick poste-

rrior thighs, which give the faculty of leaping. Those in which the antennæ are inserted on the proboscis form the genus *ORCHESTES*⁵ of Illiger (Plate CCXXVI. fig. 20); those in which they originate between the eyes, that of *RAMPHUS*⁶ of Clairville.

* *

In other Fabrician Rhynchæni the legs are remote at the base, and the sternum frequently exhibits a more or less extended cavity for the reception of the muzzle, and even sometimes for that of the antennæ. Those in which that sternal groove does not exist are formed by Latreille into two sub-genera, *AMERHINUS* and *BARIDIUS*. Those in which it does exist have been formed by Schœnherr into a great many genera, reduced to the following by Latreille, viz. *CAMPTORHYNCHUS*, *CENTRINUS*, *ZYGOPS*, *CEUTORHYNCHUS*, *HYDATIUS*, *OROBITIS*, *CRYPTORHYNCHUS*, and *TYLODE*.⁷

The last of the Longirostres have generally nine articles at most to the antennæ, of which only the last or the last two form the club, which is characterized by a coriaceous epidermis and spongy extremity. These insects live, at least in their larva state, on grain and ligneous substances. They form the great genus *Calandra*, now subdivided into the six following smaller groups.

The first two are apterous, the penultimate joint of the tarsi is bilobed, the antennæ are geniculate and inserted at a short distance from the middle of the trunk. In the first, genus *ANCHONUS* of Schœnherr, the antennæ exhibit nine articulations anterior to the short ovoid club, which is formed by the tenth, and perhaps by two others intimately united with it. In the second, *ORTHOCHÆTES* of Germar,⁸ it is the eighth joint which seems to form the club, although it is probably also of a compound structure. The four following are provided with wings. In the first three the tarsi, in accordance with the almost universal and implied character of the great *tetramerous* section of which they form a part, are all composed of four articulations, of which the penultimate is bilobed. In *RUINA*, Lat. (*Lixus*, Fab.), the antennæ are strongly geniculate, and inserted near the middle of a straight projecting proboscis,—their eighth joint forming a greatly elongated and almost cylindrical club. The anterior legs are longer than the others, at least in the males. Of this genus we may mention as an example a well-known and singular-looking insect, found in Cayenne and Brazil, called *R. barbirostris*, on account of a thick yellowish-brown beard which envelopes the proboscis of the male, and gives it somewhat the appearance of a bottle-brush. The female wants this kind of garniture on her snout, and she was consequently mistaken by Illiger for a separate species, and named *R. verrirostris*. In the genus *CALANDRA* properly so called, the antennæ, likewise strongly geniculate, are inserted near the base of the proboscis,—the eighth joint forming an ovoid or triangular club. The insects of this

¹ It frequents the Scotch fir, and is common in the Edinburgh district, as well as throughout Scotland. It seems to occur pretty frequently over our southern borders, is more sparingly distributed in Cumberland and the adjoining counties, and, becoming gradually scarcer as we advance, is regarded as a rare insect in the southern parts of England. The imperfect description of this species given by Linnæus, who appears, in some of his works, to confound it with another insect, has rendered it rather difficult to identify his *Cur. Abietis*, and its synonyms have consequently become perplexed. From an inaccurately named specimen in the Linnæan cabinet, Marsham was led to believe that it was the *Cur. pini* of that illustrious observer, and he accordingly described it under that name in his *Entomologia Britannica*. Neither Paykul nor Fabricius appear to have formed accurate views of its characters,—the latter, in his *Species Insectorum*, regarding it as a sexual variety of an insect which in fact belongs to a different genus. The larva inhabits the wood of the Scotch fir, often proving very destructive to young plantations of that tree. The manners of the perfect insect are well described by Linnæus in his peculiar style: "Tarde incedit, arcte apprehendit, tenaciter adhæret, ore frustra cutem mordere tentat captivus."

² From *ταμνω*, or *τίμνω*, to cut asunder, and *φίλος*, a lover.

³ From *βραχυς*, short, and *πους*, foot.

⁴ From *βαλανίος*, produced from an acorn.

⁵ From *δοχιστής*, a leaper.

⁶ From *ραμφος*, the beak of a bird.

⁷ For their characters, see *Règne Animal*, t. v. p. 86-7.

⁸ *Insectorum Species Novæ*, p. 302.

Coleoptera
Tetramera. genus are but too well known for their destructive attacks upon grain, and are included with many others under the vague name of *weevil*. The most noted and injurious species *C. granaria* (*Cur. granarius*, Linn.), is fortunately rare in Scotland, and probably in most other northern countries. But in France and other continental territories it is extremely injurious. This little creature measures about a couple of lines in length, and is generally of a pitchy red, smooth, the thorax deeply punctured. The elytra are rather narrower than the base of the thorax, and do not cover the extremity of the abdomen. They are marked with deep striæ, punctured in the bottom. The legs are ferruginous. It is not in the perfect state that this destroyer commits its ravages. The season for the deposition of the eggs, and the periods of transformation, vary to a certain extent with the temperature of particular seasons; but generally in the south of France, as we are informed by M. Audouin, the female commences her maternal labours about the month of April, and continues them till the autumn. She first buries herself in a heap of grain, to the depth of some inches, and then commences to pierce their envelope, probably by means of a little dart concealed beneath the lower portion of the proboscis. The envelope is then raised, and a small hole bored, either in an oblique direction, or parallel with the surface of the grain. A single hole is made in each grain, and a single egg is laid in each hole, after which the opening is closed by a glutinous matter, so nearly resembling the colour of the grain, that it is extremely difficult to discover which is in a sound state, or which contains the germ of an insidious foe. The injured grains may, however, be detected by their floating when immersed in water, as well as by their feeling lighter when fingered by a practised hand. The egg thus laid is soon hatched, and gives birth to a very minute, white, soft, elongated worm, composed of nine segments, with a rounded corneous head, furnished with two strong mandibles, by means of which it daily enlarges its dwelling, fills its own stomach, and empties the purse of the farmer or grain-merchant. Having attained the term of its increase, it is transformed into a nymph, remains in that state for eight or ten days, and is transformed into a perfect insect, which, piercing the envelope of the grain, ere long produces in its turn a numerous progeny. The influence of temperature, so general on insect life, is effective on this noted *Charanson de blé*; but from forty to forty-five days may be stated as an average term between the union of the sexes and the reproduction of the perfect insect. When the old and unphilosophical belief prevailed of the spontaneous generation of the lower tribes of animal life, it was thought sufficient to say that these weevils were "engendered in the grain by humidity." At an after period it was thought by some who called themselves "observers"—(men of the same class with those who settle all natural phenomena by a paragraph in a newspaper, which they sign "Scrutator"),—that the perfect insect laid her eggs in the green ear, from whence, when the fields were ripe for harvest, they were transported to the stores of the granary. The accurate and inimitable Leeuwenhoeck (*Continuatio Epistoliarum*, p. 56) dispelled these errors, and taught us the truth of nature, of which he was ever so great an interpreter. As each larva consumes only a single grain, we may form some idea of their power of increase, from the

vast quantity sometimes destroyed. According to the calculation of Degeer, a single pair will produce (among themselves and their descendants), in the course of a season, *twenty-three thousand six hundred* individuals; so that, we may add, a few hundred weevils flying through the grating of a granary, and settling among its treasured heaps, might in the course of four or five months devour or destroy between *one and two hundred millions* of grains. Various modes have been suggested by economists and men of science to stay the progress of these destroyers. We are not sure that any of them have been found very efficacious. The most approved is the following: When the principal body of grain is suspected, let a small heap be placed apart in a corner, and the rest repeatedly stirred about and disturbed. The weevils, which love repose and a quiet life, will leave their usual domicils, and seek about for more peaceful dwellings. An instinct, which the foresight of man in this instance renders unavailing, induces them to settle on the smaller heap, and the shovelling of the main body being continued for some days, a vast number may be thus got quit of. Boiling water is then thrown upon the congregated insects, which have sought refuge in what they deemed a place of safety. As this process destroys only the perfect insects, and not the eggs or larva, neither of which care about being stirred up with any pole, however long, it must be employed during the earliest heats of spring, and before the laying of the eggs. It is said to succeed best when (whatever the principal store consists of) the decoy heap is formed of barley, which, it seems, is a favourite food of weevils. Reduction of temperature by ventilation has also been recommended, as tending to diminish their productive powers; and M. Clement thinks that dryness produced by lime may prove useful, by its tendency to destroy the eggs.¹ Of the larger kinds of Calandra we may mention *C. palmarum*, an insect known to all who have looked into collections of foreign Coleoptera, among which it is extremely common. It is a large species, measuring about an inch and a half in length. It occurs in South America. The larva (figured by Mad. Merian²) is named *ver palmiste* by the colonists. It lives in the heart of palm trees, and undergoes its transformations in a cocoon formed of the fibres of those lofty and plume-supporting plants.³ It is fried and eaten as a great delicacy, both by Indians and Creoles. "C'est probablement," says M. Audouin, "qu'en ait dit Linné, cette même larve, et non celle du Cossus, dont les Romains étaient si friands, et qu'ils nourrissaient avec de la farine." We cannot well see how this could be, unless the new world was known to the Romans, or Italy to the palmist worm. We believe, however, that the Cossus of the ancients was indeed the larva of a beetle (probably of one of the long-horned kinds), and not of a lepidopterous nocturnal insect, or *Cossus ligniperda*, commonly so called.

Our two remaining genera are *Cossonus* of Clairville and *Dryophthorus* of Schœnherr (*Bulbifer*, Dejean). In the former the antennæ, scarcely longer than the head and muzzle, have eight joints anterior to the club. They are thick, and inserted towards the middle of the muzzle. In the latter the antennæ have only six joints, of which the last forms the club. In regard to the tarsi the genus presents an anomalous character, and one which, if strictly applied to the definition of the section, would exclude

¹ See *Dict. Class. d'Hist. Nat.* t. iii. p. 28; and *Journal de Physique*, t. lxxxix. p. 358.

² *Insectes de Surinam*, pl. 48.

³ The palm which this insect most affects seems to be one of small size. According to Madame Merian, it grows to the height of a man, and is cut off when it begins to be tender, is cooked like a cauliflower, and tastes better than an artichoke. In its centre live innumerable quantities of larvæ, which at first are as small as a maggot in a nut, but afterwards grow to a very large size, and feed on the marrow of the tree. They are laid on the coals to roast, and are regarded as a "most pleasant food."

Coleoptera it from the tetramerous families. They present five articulations, none of which are bilobed.

FAMILY II.—XYLOPHAGI.¹

These exhibit a head formed in the ordinary way, without any obvious muzzle, or trunk-like projection. The antennæ are thicker at their extremity, or perfoliated from their base, always short, and consisting in a great number of less than eleven articulations. The joints of the tarsi are usually entire, but with the penultimate enlarged and heart-shaped in some, in which case the antennæ always terminate in a club, either solid and ovoid, or trifoliate, with the palpi small and conical. These insects mostly live and feed in wood, from which habit they derive their family name; and their larvæ are often destructive to timber, in consequence of the ramified perforations which they form in all directions beneath the bark. They frequently so abound in forests of fir and pine, as to render in a few years an immense number of trees entirely useless for all the purposes of human art. Others are extremely injurious abroad to the olive plantations, while several feed on mushrooms. Latreille divides them into three sections.

1st, Those of which the antennæ have at most ten joints, and are sometimes terminated by a strong club (generally solid, in others composed of three elongated leaves), sometimes form from their base a cylindrical and perfoliated club; the palpi conical. The anterior tibiæ of the greater number are dentated, and armed with a strong hook; and the tarsi, of which the penultimate article is frequently bilobed or heart-shaped, are capable of being bent or folded on them.

Some have very small palpi, the body convex and rounded above, or almost ovoid, with the head globular, sunk into the thorax, and the antennæ terminated by a solid or a tri-lamellar club, preceded by at least five joints. These Xylophagi compose the old genus *SCOLYTUS*² of Geoffroy, which Linnæus did not distinguish from *Dermestes*. They now form the genera *HYLURGUS*, Lat., *HYLESINUS*,³ Fab., *SCOLYTUS* proper (Plate CCXXVI. fig. 22) of Lat., *CAMP-TOCERUS*, Dejean, *PLIOTRIBUS* and *TOMICUS*, Lat., and *PLATYPUS*, Herbst.⁴ Of many of these each female deposits numerous eggs, and 80,000 wood-eating larvæ have been calculated to inhabit a single tree.

Others have the palpi large and obvious, and of unequal length. Their body is depressed, narrowed in front; their antennæ are sometimes apparently only bi-articulate, with the last joint very large, flattened, almost triangular or ovoid, and sometimes consist of ten joints, entirely perfoliate. The labrum is large. The elytra are truncated,

and the tarsi short, with all the articles entire. These insects are all exotic, and compose the genus *PAUSSUS* of Linn.⁵ It has been greatly increased in recent times, and is now divided into several genera.⁶

2d, Those of which the antennæ consist of only ten articulations, and of which the palpi, at least the maxillary ones, do not taper gradually to a point, but are of equal thickness throughout, or dilated at the extremity. The joints of the tarsi are always entire. The constituent groups form two principal genera, according to the mode in which the antennæ are terminated. Thus, in *BOSTRICHUS* the three terminal joints form a perfoliated club. These insects however form four lesser genera, viz. *BOSTRICHUS* proper (e. g. *Dermestes capueinus*, Linn.) Plate CCXXVI. fig. 24, *PSOA*, Fab., *CIS*, Lat., and *NEMOSOMA*, Desmarts. The second principal genus, called *MONOTOMA*, is distinguished by the solid and button-like form of the tenth articulation of the antennæ, and is likewise further divisible into four minor genera, — *SYNCHITA*, Helw., *CERYLON*, Lat., *RHYZOPHAGUS*, Herbst, and *MONOTOMA* proper.

3d, The Xylophagi of the third division have eleven very distinct articles to the antennæ; the palpi vary, being filiform or thickened at the extremity in some, more slender at their termination in others. All the joints of the tarsi are entire. Among the *LYCTI* the club of the antennæ consists but of two joints. They form the genera *LYCTUS*⁷ proper, *DIODESMA*, Meg., *BITOMA*, Herbst. Among others the last three or four joints of the antennæ form the club, or the last alone is larger than the preceding ones. In the *MYCETOPHAGI*, Fab. the mandibles are covered, or project but little. In Latreille's arrangement they form the following seven genera:—*COLYDIUM* and *MYCETOPHAGUS* (proper),⁸ Fab., *TRIPHYLLUS*, Meg., *MERYX*, Lat., *DASYCERUS*,⁹ Brongniart (Plate CCXXVI. figs. 26 and 28),¹⁰ *SYLVANUS*, Lat., and *LATRIDIUS*, Herbst. The species of the last-named genus are exceedingly minute, none of them exceeding a line and a half in length, and several being scarcely half that size. They occur in houses, vaults, cellars, &c. and are not unfrequently found beneath the bark of trees. From their habits they are called lurking beetles (*Lauerkäfer*) by the Germans. Their generic name (from *Lateo*?) has probably the same signification. The larvæ are somewhat egg-shaped and elongate, consisting of twelve segments of a dirty white colour, the antennæ and legs clear as water, with a black line along the back, and a tuft of hairs on the sides of each segment. They live for a longer or shorter period in this condition, according to the state of the temperature and supply of food; the usual time is from four to six weeks. They then change into nymphs of a transparent white, with brownish-yellow eyes, from which, in about fourteen days,

¹ From ξύλον, wood, and φαγος, eating.

² From σκολίση, tortuosity.

³ From ὕλη, wood, and σίνω, I injure.

⁴ For their characters see *Règne Animal*, t. v. p. 91-2, and the works there referred to.

⁵ The genus *Paussus* did not exist in the twelfth edition of the *Systema Naturæ*, but was published by Linnæus in a separate dissertation in 1775. Only a single species appears to have been known at that period (Mr Westwood now describes above twenty), and another was added in 1796 by Dr Adam Afzelius, then residing at Sierra Leon (*Linn. Trans.* vol. iv.). The etymology of the name is supposed by Afzelius to be from the Greek παύσις, signifying a pause, cessation, or rest; for Linnæus, now old, infirm, and sinking under the weight of age and labour, saw no probability of continuing any longer his career of glory. "He might therefore," adds Dr Shaw, "be supposed to say, 'Hic meta laborum,' as it proved in reality, at least in regard to insects—Pausus being the last he ever described." (*Gen. Zoology*, vol. vi. p. 43.) It was literally, in the language of Young, "An awful pause, prophetic of his end."

⁶ See an elaborate and learned Essay *On the Paussidae, a family of Coleopterous Insects*, by Mr J. O. Westwood, *Linn. Trans.* vol. xvi. p. 607.

⁷ From λυγρός, smooth or polished.

⁸ From μυκετός, moss, and φαγος, eating.

⁹ From δασύς, hairy, and κέρας, horn.

¹⁰ We have figured the type of the genus, *D. sulcatus*, on the plate above referred to. This singular little insect was discovered by M. Alex. Brongniart on a fungus in the forest of Montmorency. It is extremely small, and it is difficult to count the articulations of the tarsi, even with the aid of a good microscope. These parts consist, however, of only three articulations (see fig. 31), which would remove the genus from the tetramerous section, were it not allied to the above genera by other natural characters. The first two joints of the antennæ (see fig. 21) are globular, the following ones very small, capillary and pilose, and the last three or four also pilose and globular.

leoptera emerge the perfect insects.¹ We have about a dozen species in Britain.² In the TROGOSITÆ,³ Olivier and Fab. (*Platycerus*, Geoffroy), the mandibles are entirely exposed, salient and robust. The body is generally elongated, narrow, and depressed. In some of these the antennæ are shorter than the thorax, or at most of equal length, and terminate in a compressed club, a little toothed or serrated, and formed by the three or four last articulations. The ligula is entire. In TROGOSITA proper the mandibles are shorter than the head, and crossed. The maxillæ have but a single lobe. *T. mauritanica* (*Tenebrio mauritanicus*, Linn.), about four lines in length, blackish above, light brown beneath, with striate elytra, occurs in nuts, bread, and beneath the bark of trees. The larva, known in Provence under the name *Cadelle*, attacks grain. Here follow the genera PROSTOMIS of Lat. and Passandra of Dalman.

FAMILY III.—PLATYSOMA.⁴

This group of tetramerous Colcoptera approaches the preceding so far as relates to the internal structure, the tarsi, and the habits; but the antennæ are of equal thickness throughout, or more slender towards their termination. The mandibles are always projecting; the ligula is bifid or emarginate; the palpi are short, and the body depressed and lengthened, with the thorax nearly square. These insects are found beneath the bark of trees, and are reduced by Latreille to the CUCUJI of Fabricius, which he distinguishes as CUCUJUS proper (Plate CCXXVI. fig. 21), DENDROPHAGUS, Gyll. and ULEOIOA, Lat.

FAMILY IV.—LONGICORNES.

The insects of this family, which in the system of Linnaeus formed the genera *Cerambyx*, *Leptura*, and *Necydalis*, have the under surface of the first three articles of the tarsi garnished with brushes, the second and third being heart-shaped, the fourth deeply bilobed, with a little swelling or nodule resembling an articulation at its base.⁵ The ligula, borne upon a short and transverse mentum, is generally membranous, heart-shaped, emarginate or bifid,—in others corneous, and forming the segment of a very short and transverse circle. The antennæ are filiform or setaceous, generally at least as long as the body, sometimes simple in both sexes, sometimes serrated, pectinated or flabelliform, in the males. The eyes of a great number are reniform, and surround the antennæ at their base. The thorax is in the form of a trapezium, narrowed anteriorly in such as have the eyes rounded, entire, or slightly emarginate; in which case also the legs are long and slender, and the tarsi lengthened. M. Leon Dufour has remarked that the Longicornes, in regard both to the alimentary tube and the disposition of the hepatic vessels, generally resemble the Mclasoma, and, contrary to the opinion of M. Marcel de Serres, he denies the existence of a gizzard. The alimentary canal, usually beset with papillæ, is preceded by a crop, which is smaller and less distinctly marked in *Lamia* and *Leptura*, the concluding genera.

The larvæ of almost all the Longicornes live in the interior or beneath the bark of trees. They are either apodal, or provided with very inconspicuous legs. Their body

is soft, whitish, largest anteriorly, with a squamous head, furnished with strong mandibles, but without any other projecting parts. They are extremely destructive to the larger forest trees, piercing them to a considerable depth in all directions. A certain number gnaw the roots of plants. The abdomen of the female, in the perfect state, is terminated by a tubular and cornuous oviduct. Several species produce a sharpish sound by rubbing a portion of the thorax against the pedicle which attaches the base of the abdomen. Lister calls this sound *querulous*, while Dumeril compares it to the braying of an ass. It is on account of this peculiarity that *Prionus coriarius* is known in Germany by the name of the *Fiddler*. Of this numerous and graceful family some are nocturnal, and frequent old woods and the trunks of ancient trees; others occur on flowers and among flowering shrubs and hedges, and are richly gilded and adorned with various colours;—while all are remarkable for their elongated bodies, their lengthened limbs, and their long and delicately formed antennæ. Several of the species are among the very largest of the coleopterous tribes. The deficiency of wood in our northern quarter of the island is a circumstance unfavourable to the frequent occurrence among us of these lovers of “forest scenery.” Even of the English species commonly so called, a few of the finest are probably not original inhabitants of Britain, but have rather been accidentally imported in the larva state in foreign timber, and have afterwards, when excluded in the perfect form, contrived to wing their way, and colonize among our native woods. Their characteristic position is in countries adjoining the equator (especially in South America), and they seem to diminish both in size and number in proportion to their distance from the torrid zone. Britain in general, and more especially Scotland, are considerably to the north of the limit where these insects cease to be common; and in other respects our island presents few local peculiarities at all adapted to their increase. Yet the indefatigable Mr Stephens enumerates about one hundred indigenous species of Longicornes, including, however, certain genera, such as *Trogosita* and *Cucujus*, which Latreille and others do not admit among the long-horned tribes.

According to the system by which we are at present guided, the Longicornes are divisible in the first place into two sections.

A.

Eyes either emarginate or crescent-shaped, or elongated and narrow. Head sunk into the thorax as far as the eyes, without any neck-like restriction,—and vertical in many.

a.

In some the articulation of the palpi is in certain cases nearly in the form of a cone, or reversed triangle; in others nearly cylindrical, and truncated at the extremity. The terminal lobe of the maxillæ is straight (not curved upon the inner one at its extremity); the head generally projected or simply inclined, and when, by a rare exception (as in *Dorcadus*), its position is vertical, its breadth then nearly equals that of the body, and the antennæ are distant at their base, and spiny. The thorax, often unequal or square, is rarely cylindrical. They are subdivisible into two lesser tribes as follows:

TRIBE 1ST, PRIONII.

Distinguished by the labrum being absent, or extremely small and indistinct; the mandibles strong, or even very

¹ For a more detailed account, see Germar's *Magazin der Entomologie*, vol. ii.

² Stephens' *Nomenclature*, col. 32.

³ From πλατος, breadth or flatness, and σώμα, body.

⁴ Latreille remarks, that in regard to the above character, the *Parandra* perfectly resemble the Longicornes; and that hence, if we consider the little nodule as a genuine joint, both our present family and that which follows might be regarded as pertaining to the great pentamerous section.

⁵ From τρώγω, I gnaw, and σίτος, corn.

Coleoptera large among the males, and the internal lobe of the maxillæ small or imperceptible. The antennæ are inserted near the base of the mandibles, or of the emargination of the eyes, but are not surrounded by them at their origin. The thorax is most frequently trapezoidal or square, and notched or dentated on the sides.

In the genus PARANDRA of Lat. the antennæ are simple, almost granose, compressed, of the same size throughout, and at most as long as the thorax; and the ligula is corneous, in the form of a short segment of a circle, transverse, and without emargination. The body is depressed, and paralleliped, with the thorax square, rounded at the posterior angles, and without any teeth or spines. These tribes are peculiar to America. In SPONDYLIS, Fab. (*Attelabus*, Linn.) the antennæ and maxillary lobes resemble those of the preceding; but the ligula, as in all the ensuing Longicornes, is membranous. The thorax is almost globular, without margins, and unarmed with teeth or spines. The species, which are few in number, inhabit Europe, and their larvæ occur in trees of the pine tribe. In the genus PRIONUS¹ of authors (Plate CCXXVI. fig. 33), the antennæ are longer than the head and thorax,—serrated or pectinated in some,—simple, attenuated towards the extremity, and with elongated articulations, in others. The terminal lobe of the maxillæ is at least as long as the first two articulations of the palpi. The body is generally depressed, with the body square or trapezoidal, and either toothed or spiny, or presenting a lateral projecting angle. These insects are said to take wing only during the night or evening. When reposing they occur on trees. Some exotic species are remarkable for their great size, and their projecting mandibles. “C’est dans ce genre,” observes M. Guérin, “qui sont les plus grands Coléoptères connus, puisque certaines espèces Américaines atteignent plus de six pouces de longueur.”² The larvæ of *P. cervicornis*, which dwell in the wood of the Gossampinus, are used as articles of food. We have only four or five species of this genus in Europe, of which *P. coriarius* is the sole British species. It is one of our largest insects, measuring about fifteen lines in length. The larva lives in the decaying trunks of oaks and birch trees. It undergoes its metamorphosis under ground. *P. giganteus* is above half a foot in length. It fortunately inhabits Cayenne.

TRIBE 2D, CERAMBYCINI.

In these the labrum is very apparent, and extends across the entire width of the anterior extremity of the head; the two maxillary lobes are very distinct and projecting; the mandibles are of ordinary size, and similar, or differing but slightly, in the two sexes. The eyes are always emarginate, and surround, at least in part, the base of the antennæ, which are usually the length of, or longer than, the body. The thighs, at least the anterior four, are commonly in the form of an ovoid club, restricted to a pedicle at the base.

Latreille commences with such as have the last articulation of the palpi always obviously thicker than the preceding ones, and in the form of a triangle or reversed cone. The head is not sensibly narrowed, and prolonged anteriorly in the form of a muzzle; the thorax is not widened from before backwards, and does not present the figure of a trapezium or of a truncated cone; the elytra are neither very short and squamiform, nor abruptly nar-

rowed a little beyond their base, and subulate at the extremity. These may be termed the *regular Cerambycini*, in contradistinction to those of a more anomalous nature, by which we shall be afterwards conducted to another tribe. They compose the genera *Cerambyx*, *Clytus*, and *Callidium* of Fabricius, and a portion of his *Stenocori*; and consist of the great Linnæan genus *Cerambyx*, with the addition of some *Leptura* of the Swedish naturalist. Certain modern entomologists have greatly augmented the number of generic groups; but Latreille regards the characters assigned for their distinction as by no means sufficiently precise. We shall here notice the principal genera, as admitted in the *Règne Animal*.

A considerable amount of species, all from South America, have the body proportionally shorter and broader than those that follow, and are remarkable for the extent of the thorax, which nearly equals half the length of the abdomen. The anterior legs at least are distant at their base. The scutellum is large in several species. The antennæ are often pectinated, serrated, or spiny. Those of this division, of which the thorax, nearly semi-orbicular and always very large, is smooth or merely chagrined, with a single tooth on either side at the posterior angles,—of which the posterior extremity of the præsternum is plane, truncated, without emargination, or emarginate, and placed upon the mesosternum,—of which the scutellum is always very large, and the legs distant at their origin—form the two following genera:—LISSONOTUS of Dalman (Plate CCXXVI. fig. 35), in which the antennæ are strongly compressed, serrated or semi-pectinated, and long, with the posterior extremity of the præsternum unemarginate:—MEGADERUS of Dejean, in which the antennæ are simple and shorter than the body, and the posterior extremity of the præsternum emarginate, and receiving the opposing end of the mesosternum. Those, again, of which the thorax is extremely unequal, tubercular, or with many dentations, and the præsternum carinated or terminated posteriorly in a point, form the following four genera,—DORCACERUS,³ Dejean, TRACHYDERES, Dalman (Plate CCXXVI. fig. 37), LOPHONOCERUS,⁴ Lat. (Plate CCXXVII. fig. 1), and CTENODES, Olivier and Klug.⁵

In other groups of species, the thorax, sometimes square or cylindrical, sometimes orbicular or nearly globular, is very much shorter than the elytra, at least in those in which it is extended in breadth, and the præsternum presents neither a carina nor pointed prolongation at its posterior extremity. The scutellum is always small, and the legs are approximate at their origin. Several, remarkable for their beautiful metallic colouring, and the agreeable odour which they exhale, exhibit rather an anomalous character in regard to the relative proportions of the palpi,—the maxillary being smaller than the labial, and even shorter than the terminal lobe of the maxillæ, which frequently projects. The body is depressed, with the anterior of the head narrow and pointed. The hinder tibiæ are often much compressed. They form the genus CAL- LICHROMA⁶ of Latreille (*Cerambyx*, Fab. Dejean). A species well known in England, but which we have not traced farther north than Westmoreland, and remarkable for its strong odour of roses, is the *Cal. moschata* (*Cer. moschatus* of Linn. and of the English naturalists). It measures about an inch in length. South America, and the equatorial regions of the ancient continent, furnish several species. Other Longicornes of this division, but in

¹ From *πριον*, a saw.

² *Dict. Class. d'Hist. Nat.* t. xiv. p. 282.

³ For the characters by which these genera are distinguished from each other, see *Règne Animal*, t. v. pp. 111–12.

⁴ From *καλος*, beautiful, and *χρωμα*, colour.

⁵ From *δορκας*, a goat or antelope, and *κερας*, horn.

⁶ From *λοφος*, a tuft, and *κερας*, horn.

Coleoptera which the maxillary palpi are as usual at least as long as the labial, and surpass the extremity of the maxillæ, are distinguished from such as follow, by the antennæ, particularly of the males, having twelve distinct articulations instead of eleven. These parts are always long, setaceous, and not unfrequently spiny or bearded. The thorax is toothed or spiny on the sides. These are united by Latreille under the genus ACANTHOPTERA¹ (*Callichroma*, *Purpuricen*, *Stenocorus*, Dej. Dalm.). Certain species with the thorax nearly square or cylindrical, and the elytra generally terminated by one or two spines, enter into the genus *Stenochorus* of Dalman. Others, more characteristic of the western countries of the ancient continent, form the genus *Purpuricen* of Ziegler and Dejean. An elegant insect of a pale ashy blue, with three black spots on each elytron, and several joints of the antennæ furnished with tufts of hair, is the *Acanth. alpinus* of Lat. recently removed from the genus *Callichroma*. It smells strongly of musk. We took it among the Alps of Switzerland, and have since received a specimen captured in a timber-yard in Paris.

The following Cerambycini have only eleven articulations to the antennæ.

In some these organs, at least in the males, are long and setaceous; the terminal article of the palpi is in the form of a reversed cone; the thorax is either square or a little dilated in the middle, or oblong and almost cylindrical; it is often rugose or tuberculated laterally. They compose the genus CERAMBYX properly so called² (Plate CCXXVII. fig. 2). Of these, certain species form the genus *Hamaticerus* of recent writers. Such is *C. heros* of Fab. an inhabitant of the temperate and warmer regions of Europe. It is one of the largest Coleoptera of the European continent. The larva forms deep excavations in the wood of the oak, and has been deemed by some the *Cossus* of the ancients. As it is not now the custom to eat grubs, that disputed question still remains obscure. Latreille places in this niche of the entomological system various *Callichromæ* (so called) of Dejean, with a smooth or but slightly unequal thorax. Most of them belong to South America. They are in general beautifully ornamented by the hand of nature, though their size is small. Some are singularly distinguished by one or more little globular tufts of hair upon the antennæ, and even the hind legs of certain species are similarly adorned. The thighs of these insects (some of which were arranged by Fabricius and Olivier among the *Saperdæ*) resemble a club-like mass, supported upon a more lengthened pedicle. The antennæ consist of long and slender articulations. In the genus GNOMA of Dejean the thorax is long and cylindrical. The palpi are almost filiform, and the inner side of the mandibles presents a tooth. The species occur in America.

In the extensive genus CALLIDIUM³ of Olivier, the antennæ are in general scarcely longer than the body, and are rather filiform than setaceous. The thorax, always unarmed, is sometimes nearly globular or orbicular, sometimes more narrow, nearly cylindrical, and simply dilated and rounded in the centre. The palpi, always very short, are terminated by an article rather thicker and broader than the preceding ones, and in the form of a reversed triangle. These insects now form the genera CERTALLUM of Megerle and Dejean, CLITUS of Fabricius, and CALLIDIUM properly so called. Of the second and last we have several British species.

Latreille concludes our present tribe of insects with cer-

tain species, which, in regard to the palpi, the form of the head, thorax, and elytra, and their general proportions, offer some remarkable and anomalous characters. He commences with such as present a thorax analogous to that of the preceding, especially the genus *Certallum*. It is as broad as the head, and as the base of the elytra, or scarcely narrower, and is either almost cylindrical, or rounded, or nearly orbicular; in both cases wider near the middle. The terminal articulation of the palpi is sometimes attenuated near the end, and terminated in a point, sometimes thicker and truncated, and obconical. All the thighs are clubbed, and supported by an abrupt, slender, and lengthened pedicle. The elytra of the greater number are either very short, or abruptly narrowed at a little distance from their base, and then subulate.

In the genera OBRIUM of Megerle, and RHINOTRAGUS of Dalman, the elytra do not exhibit those peculiar forms; but in *Necydalis*, Linn. those parts are either very short and scale-like, or prolonged, as usual, as far as the extremity of the abdomen, and abruptly contracted a little beyond their origin, then greatly narrowed, and terminated in a point. They do not resemble the *ÆDEMERÆ*, with which they were arranged by Fabricius, except in the form of the elytra. They are divisible into two minor groups. For example, those with subulate elytra form the genus STENOPTERUS⁴ of Illiger (Plate CCXXVII. fig. 5), while such as have them short and squamiform continue to bear the name of NECYDALIS (ibid. fig. 3).

Certain insects, for the most part proper to the African islands, to New Holland, New Ireland, and New Zealand, present some ambiguous characters; and, according to Latreille, ought perhaps, in a natural order, to be placed between the Lamariæ and the Lepturetæ. In the mean time, however, he concludes with them the tribe Cerambycini. The palpi are almost filiform, with the terminal articulation nearly cylindrical, slightly attenuated towards the base. The thorax is usually smooth, or but slightly uneven, without acute tubercles, is widened posteriorly, or presents the form of a trapezium or of a truncated cone. The abdomen is almost in the form of a reversed triangle in the greater number, and the elytra are truncated at the extremity. They form four genera, viz. DISTICHOCE-RA, Kirby, TMESISTERNUS, Lat., TRAGOCERUS, Dejean, and LEPTOCERA of the last-named author.

b.

In other Longicornes, forming

TRIBE 3D, LAMARIÆ,

The head is vertical and the palpi filiform, or scarcely larger at their extremity, and terminated by an article more or less ovoid, and tapering to a point. The exterior lobe of the maxillæ is a little narrowed at the extremity, and curved upon the inner division. The antennæ are most frequently setaceous and simple, and the thorax, exclusive of the lateral tubercles or spines, is nearly of an equal width throughout. Some species are apterous,—a character not exhibited by any other division of the family.

Our present tribe, in the system of Latreille, is composed of the genera *Lamia* and *Saperda* of Fabricius, of some of the *Stenocóri* of that author, of the *Colobothæ* of Dejean, and of several of his *Cerambyces*.

The genus ACROCINUS of Illiger is constituted by an insect of a very striking and extraordinary aspect, the *Cerambyx longimanus* of Linn. The genus is distinguished

¹ From *ακανθα*, a spine, and *πτερον*, a wing.

² From *κερας*, horn, and *βους*, an ox.

³ From *καλος*, beautiful, and *ιδεα*, form.

⁴ From *στενος*, narrow, and *πτερον*, wing.

Coleoptera from all the Longicornes by the thorax being provided on each side with a moveable tubercle, terminated by a point or spine. The body is flattened, with the thorax transversal; the antennæ are long and slender; the anterior legs much longer than the others, especially in the males; and the elytra are truncated at the end, and terminated by two teeth, of which the exterior is the strongest. The singular species above named, of which the colours present an agreeable mixture of grey, red, and black, is known to the French colonists by the name of the *Harlequin* of Cayenne. It is a very large insect. The *Prionus accentifer* of Olivier pertains to the same genus.

All the other Lamariæ are referable to the great genus *LAMIA* (Plate CCXXVII. fig. 4), which, however, has been extensively subdivided in modern times. A great number of species, chiefly from South America, of which the legs are robust and the tarsi much dilated, fall under the genus *ACANTHOCINUS* of Megerle and Dejean. Not more than three species are known in Europe. Of these we received *A. ædilis* (called the *Carpenter* in France), from a wood near Inverness; and Sir Thomas Dick Lauder informs us that he likewise took it in a forest of that northern county. Specimens from the neighbourhood of Kirkaldy are preserved in the collection of Sir Patrick Walker. The species is remarkable for the great extent of the antennæ, which in the males are four times the length of the body. It is characteristic of northern countries, and most of the British examples have occurred in Scotland. "Habitat frequens," says Linnæus, writing in reference to Sweden, "in linteribus et arborum truncis decorticatis, dum ex his domos struunt ruricolæ, hinc pueris nostris dicitur *Timberman* omnibus notissima species: vulgus hunc lædere religiose apud nos ducit."¹ Others of an analogous form, but of which the antennæ are garnished with hairs, compose the genus *POGONOCHERUS*² of the same authors. Britain produces four species, of which two occur in Scotland. Certain apterous kinds compose the genus *DORCADION*³ of Dalman. These insects are proper to Europe and the neighbouring countries of Asia. Their antennæ are generally shorter than the body, with their articulations in the form of a reversed cone, which gives them a knotted aspect. A species common on the continent of Europe (*Cer. fuliginator*, Linn.) is almost exclusively confined to calcareous soils.

Other Lamariæ have the thorax cylindrical, and unfurnished with tubercles or spines. The body is always elongated,—in some almost linear. They compose the genus *SAPERDA* of Fab., which has been greatly subdivided. We have several British species, of which we shall here name only *S. carcharias*, an insect about an inch in length, covered with a yellowish ashy down, spotted with black, and the antennæ coloured alternately with black and grey. Its larva lives in the trunk of the poplar, and sometimes proves injurious to plantations of that tree.

B.

In this our second principal section of the Longicornes, forming

TRIBE 4TH, LEPTURETÆ,

The eyes are rounded, entire, or scarcely emarginate, and the antennæ are then inserted forwards, or at most at the anterior extremity of that feeble emargination. The head is always inclined, prolonged posteriorly behind the eyes in several, or abruptly narrowed into a neck-like form at its junction with the thorax. This last part is conical

or trapezoidal, and narrowed anteriorly. The elytra become gradually narrower from the base. This tribe corresponds to the genus *Leptura* of Linnæus, with the exception of a few species which fall more naturally among the preceding tribes, and also of such as belong to the more modern genus *Donacia*. We shall here notice only a few of the genera which, as native to our own island, are the most likely to interest the British naturalist.

In the genus *RHAGIUM* (of which we have three indigenous species) (Plate CCXXVII. fig. 6), the antennæ are simple, and at most not more than half the length of the body. The terminal articulation of the palpi forms a triangular club. The head is large, almost square, with the eyes entire. The sides of the thorax are furnished with a conical or spinous tubercle. In the genus *TOXOTUS*⁴ the antennæ are at least as long as the body, simple, with the first article much shorter than the head. The eyes are entire, or very slightly emarginate. The body is triangular, or forms a lengthened square, narrowed posteriorly. *T. meridianus* and *chrysogaster* are supposed to be synonymous,—in which case we have probably not more than two British species. In the genus *LEPTURA*⁵ properly so called, the head is abruptly narrowed immediately behind the eyes, and the antennæ, inserted near the anterior extremity of their inner emargination, are distant at their base. The two usual eminences from which they spring are almost confounded in one plane. The thorax is almost always smooth, or without lateral tubercles. The majority of the genus occur in Europe, and Britain produces about a score. Few of them have yet occurred in Scotland, probably owing to our comparative deficiency in wood. We have met with only one species in the neighbourhood of Edinburgh, *L. ruficollis*.

FAMILY V.—EUPODA.

Some of the component parts of this family are nearly allied to the Longicornes or preceding tribes, while others so much resemble the Chrysomelæ as to have been arranged with the latter by Linnæus. The organs of mastication present the same range of affinities. Thus, among the Donaciæ, the ligula is membranous, bifid or bilobed, as among the Longicornes, and their maxillæ are very analogous to those of the latter; while among the concluding Eupoda the ligula is almost square or rounded, and analogous to that of the ensuing family, called *CYCLICA*. At the same time the maxillary lobes are membranous, or but slightly coriaceous, whitish, or of a yellowish hue; the exterior expands towards the extremity, and has not the figure of a palpus,—a feature which allies our present family rather to that which we have left than to the one which follows. The body is more or less oblong, with the head and thorax narrower than the abdomen. The antennæ are filiform, or gradually enlarge towards the extremity, and are inserted before the eyes. These are in some entire, round, and projecting, in others slightly emarginate. The head is received posteriorly by the thorax, which is cylindrical, or in the form of a transverse square. The abdomen may be called large when compared with the other parts, and forms a lengthened square, or elongated triangle. The articulations of the tarsi, excepting the terminal one, are furnished beneath with little cushions, and the penultimate is bifid or bilobed. The posterior thighs are very large in many species,

¹ *Fauna Suecica*.

² From *πωγων*, beard, and *κερας*, horn.

³ Named from *λεπτος*, slender, and *ουρα*, the tail, in allusion to the attenuated form of the elytra.

⁴ *δορκαδίων*, a small species of deer.

⁵ *τοξότης*, an archer?

Coleoptera and it is from that character that the family derives its name. They are all winged insects, and occur on the stems and leaves of various plants, especially, so far at least as many of the European species are concerned, on the liliaceous tribes. The larvæ of the Donaciæ feed on the internal portion of the roots of aquatic plants. Those of other genera live exposed, but, after the manner of the Cassidæ, cover themselves with a case or scabbard formed of their own excrementitious matter. Latreille divides the family into two tribes.

TRIBE 1ST, SAGRIDES.

The mandibles terminate in a sharp point. The ligula is deeply emarginate or bilobed.

In some the palpi are filiform, the eyes emarginate, the posterior thighs very large and strong, and the tibiæ arcuated. We here place the genera MEGALOPUS,¹ Fab. and SAGRA properly so called (Plate CCXXVII. fig. 7). The former insects are proper to South America; the latter, although one occurs in Africa, are characteristic of China, and the great eastern islands, such as Java, the Celebes, and Ceylon. Some of the Sagrae are among the richest and most beautiful of the coleopterous tribes. There is something striking in their gigantic limbs, and their colours consist of burnished green and gold, mingled with violet and deep flame colour.

In others the palpi are enlarged at their extremity, the eyes entire, and the thighs of nearly equal dimensions. Such are the genera ORSODACNA of Lat. and PSAMMÆCUS, Boudier.²

TRIBE 2D, CRIOCERIDES.

The extremity of the mandibles is truncated, or presents two or three teeth. The ligula is entire, or but slightly emarginate. These insects correspond to the genus CRIOCERIS³ of Geoffroy, which Latreille divides as follows.

In some the mandibles taper to a point, and present two or three teeth at the extremity. The palpi are filiform, the antennæ of ordinary thickness, almost granose in certain species, and chiefly composed in others of articulations in the form of a reversed cone, or perceptibly thicker towards their superior extremity.

In the genus DONACIA, Fab. (Plate CCXXVII. fig. 8), the posterior thighs are large and inflated. The antennæ are of equal size throughout, and composed of lengthened articulations. The eyes are entire, and the terminal joint of the tarsi is inclosed, for the greater part of its length, by the lobes of the preceding articulation. This interesting genus was confounded with *Leptura* by Linnæus and Degeer, and with *Stenochorus* by Geoffroy. It was established by Fabricius under its present name, from *δοῦξ*, a reed, on account of the species of which it is composed being found on reeds and other aquatic plants, such as those of the genus *Iris*, *Sagittaria*, *Nymphæa*, &c. to which they cling with great tenacity, and on the roots of which the larvæ are supposed to feed. In the form of their bodies and antennæ they show an alliance to the Cerambycidæ, but their habits, and the structure of the cibarian organs, ally them still more closely to *Crioceris* and *Galeruca*. They are frequently bronzed or gilded in their aspect, and are covered in some cases by a fine silky down, which is supposed to prove useful to them when they fall into the water. Indeed, even in the perfect state, they are partly aquatic, and may be seen to seek repose and shelter on the under side of the leaf of a water lily, where they are

necessarily submerged. According to M. A. Brongniart, the chrysalids are attached to their filaments by one edge only. M. Leon Dufour inclines to think, in consequence of anatomical investigation, that the Donaciæ ought to be formed into a particular family. His observations, as we are informed by M. Latreille, demonstrate that their hepatic vessels, in number, form, structure, and arrangement, constitute a very remarkable exception to those of the Tetramera in general, and one which even appears peculiar to the genus. These vessels only open into the chylic ventricle, while in all the other Tetramera which M. Dufour has dissected, they have two insertions, one of which is ventricular, and the other cæcal. These biliary ducts, which are only four in number, are of two different kinds,—the first are capillary, and disposed in two strongly flexed curves, and are inserted by four distinct ends into a short obround vesicle placed at the inferior and somewhat lateral extremity of the chylic ventricle,—the others are much shorter, thicker, more dilatable, thin, and tapering at both ends, with one extremity free, and separately inserted by the other into the superior and dorsal region of the ventricle. They contain a whitish pulp, which is regarded as an alimentary substance. The œsophagus is capillary, and has no dilatation in the form of crop. The chylic ventricle is beset with projecting papillæ.⁴ Britain produces above twenty species of Donaciæ—a great amount, when we consider that Dejean's Catalogue contains only twenty-six in all. The genus may be regarded as characteristic of Europe, for scarcely any occur in other countries, although a few have been collected in America.

The genus CRIOCERIS properly so called, differs from the preceding in the posterior legs being scarcely, if at all, larger than the others. The antennæ become somewhat enlarged towards the extremity, are almost granose, with their articulations not much longer than broad. The eyes are elevated and emarginate, and the posterior extremity of the head forms a kind of neck behind these latter organs. These insects are of small size, their bodies narrow and elongated, and frequently ornamented with lively colours. They live on the leaves of various plants,—Liliaceæ, Asparagi, &c. and occur in gardens and meadows. When seized they produce a sharpish sound, by rubbing the superior extremity of the abdomen against the inferior extremity of the elytra. The larvæ feed on the same plants as those on which we usually find the perfect insects, and are somewhat adhesive or tenacious by means of their six scaly feet. Their bodies are soft, short, and inflated; and they protect themselves in that early state from the action of the sun and the changes of the season, by covering their backs with their own ordure. They occupy a subterranean position in the nymphæ state. The species are extremely numerous as the genus was originally constituted, but it has been greatly restricted in recent times. Mr Stephens gives seven as the amount of British species. Of these not above three have yet been found in Scotland. *C. asparagi* was taken near Edinburgh by Sir Patrick Walker.

In others the mandibles, instead of tapering to a point, as in the two preceding genera, are truncated. The palpi are terminated by a strongly inflated joint, truncated, with a small angular prolongation, exhibiting the appearance of another joint. The antennæ are slender, and composed of very long and almost cylindrical articulations. Such is the genus MEGASCELIS of Dejean and Lat. (Plate CCXXVII. fig. 9), peculiar to South America.

¹ From *μεγαλούς*, having large feet.

² For their distinctive characters, see *Règne Animal*, t. v. p. 134-5.

³ From *κριός*, a ram, and *κερας*, a horn.

⁴ *Règne Animal*, t. v. p. 136.

FAMILY VI.—CYCLICA.

In this family the first three joints of the tarsi are still spongy, or furnished beneath with pellets, the penultimate joint divided into two lobes, and the antennæ filiform, or a little larger towards the extremity; but the body is usually rounded, with the base of the thorax as broad as the elytra in such (and these are few in number) as are of an oblong form. The exterior division of the maxillæ, in its narrow and almost cylindrical form, and darker colour, presents the appearance of a palpus; the interior division is broader and destitute of a scaly tooth. The ligula is almost square or oval, entire, or slightly emarginate. It appears from the anatomical researches of M. Leon Dufour, that the alimentary canal is at least thrice the length of the body in such of the genera as have been examined; that the œsophagus is usually inflated behind the crop; and that the chylic ventricle, or stomach, is generally smooth, at least throughout a great part of its length. The biliary apparatus resembles that of the Cerambycidae and other Longicornes, in the number and double insertion of the vessels of which it is composed;—these amount to six, two of which (except in the genus *Cassida*) are for the most part shorter and more slender. The larvæ have six feet; their bodies are soft, and frequently coloured. They feed, like the perfect insect, on the leaves of plants, to which they adhere by means of a viscid humour. Some enter the earth prior to their assumption of the nymphæ state, while others undergo that change attached to the plants on which they feed, and partly encompassed by the exuviae of the larva. The perfect insects are of small size, but they are frequently adorned by brilliant colours and metallic splendour. They are slow and timorous in their general movements, and when attempted to be seized, they closely fold their feet and antennæ, and drop to the ground. Several species are good leapers, and the females are extremely prolific. Latreille divides this family into three tribes, according to the mode in which the antennæ are inserted.

TRIBE 1ST, CASSIDARIÆ.

These have the antennæ inserted on the superior part of the head, and approximate, straight, short, filiform, and almost cylindrical, or increasing gradually towards the extremity. The mouth, situate altogether underneath, and with very short almost filiform palpi, is sometimes arched (*cintrée*), sometimes partially received into the cavity of the præsternum. The eyes are ovoid or round; the legs contractile and short, with the tarsi flattened,—the lobes of the penultimate articulation entirely inclosing the terminal one. The body being flat beneath, these insects, by the disposition of their tarsi, are enabled to adhere closely to the surface of vegetation, and to remain there immovable; in other respects the body is generally orbicular or oval, and is margined all round, or overlapped, by the thorax and elytra. The head is concealed beneath the thorax, or is received into its anterior emargination. The colours are extremely varied, and are distributed in the form of spots and radiated markings, in a manner delightful to look upon. The larvæ present a less inviting aspect, and have the instinctive habit of covering themselves with their own excretions.

In the old genus *HISPA*,¹ of Linn. the body is oblong, with the head entirely free or exposed, and the thorax trapezoidal. The mandibles have only two or three teeth; the external maxillary lobe is shorter than the internal,

and the antennæ are filiform, and borne projecting forwards. These insects now form the genera *ALURNUS*,² Fab. (Plate CCXXVII. fig. 10), and *HISPA* properly so called (ibid. fig. 11).

The genus *CASSIDA*,² Linn. and Fab. (Plate CCXXVII. fig. 12), is distinguished from the preceding by the orbicular or almost ovoid form of the body, which, however, in a small number is nearly square. The thorax, more or less semicircular, or in the form of the segment of a circle, entirely covers and conceals the head, or incloses it in its anterior emargination. The elytra, often elevated about the region of the scutellum, project over the body. The mandibles are furnished with not fewer than four teeth, and the external maxillary lobe is at least as long as the internal. The name by which the insects of this genus are distinguished was no doubt bestowed upon them on account of a strongly marked character in their structure. The edges of the thorax and elytra overlap and protect the limbs and abdomen on all sides, and the head is also nearly covered and concealed by the prothorax. Many of the species are highly ornamental, and present pleasing combinations of green and golden hues, which, however, soon disappear or diminish in intensity after the death of the insect, but may be temporarily restored by the use of hot water. These insects are herbivorous in their habits, and are fond of artichokes and thistles. The structure and habits of the larvæ are rather singular, and have been studied and described by Goedart, Roesel, Réaumur, and Degeer. They are flattish, rather broad, and beset laterally by sixteen branched spines placed horizontally on each side of the posterior and superior portion of the body. At the base of these spines may be observed seven small cylindrical truncated tunnels, each placed on a distinct segment. These are probably the stigmatic openings. The head is small, of a corneous consistence, and presents four small tubercles on each side of its superior part, and only three on its inferior. These are regarded by Degeer as genuine eyes. Six scaly feet, terminated by a brown-coloured hook, sustain the body, which is terminated by a two-branched fork, curved over the back, and usually bearing a pile of excrementitious matter, under which the larva lies in part concealed. It can elevate or depress this “stercoraceous parasol” at pleasure, for the varying purposes of shade or shelter. The nymph is shorter than the larva, broad, flattened, of an oval form, and surrounded by peculiar appendages. It has an ample thorax, terminated by a circular arch, and furnished with similar points or appendages. The legs and the segments of the abdomen are perceptible. It was in the aspect of one of these nymphæ that Goedart supposed he recognised a representation of the human figure surrounded by an imperial crown. The genus *Cassida* presents an immense amount of species. About twenty are indigenous to Britain, several more occur on the continent of Europe, and, including exotic species, Dejean enumerates 103 as the amount (in 1821) of his then splendid, and now (1834) unrivalled collection of Coleoptera.

TRIBE 2D, CHRYSOMELINÆ.

In this tribe the antennæ are inserted in front of the eyes, near their internal extremity, and are distant at the base. None of the species are capable of leaping. They form, in the earlier works of Fabricius, the genera *Cryptcephalus* and *Chrysomela*, of which we shall here notice the principal component parts, as modified by the systematic views of recent writers.

¹ Perhaps from *hispidus*, shaggy.² From *cassida*, a helmet.

Coleoptera
Tetramera.

The original genus *CRYPTOCEPHALUS*¹ contained those Chrysomelinæ of which the head seemed plunged vertically into an arched or hood-like thorax, in such a way that the body, generally in the form of a short cylinder, or almost ovoid, and narrowed anteriorly, appears, when viewed from above, as if truncated in front, or deprived of the head. The terminal articulation of the palpi is always ovoid.

In some of these the antennæ are short, and pectinated or serrated from the fourth or fifth joint, as in the genus *CLYTHRA* of Leach and Fab. of which *C. quadripunctata* (a *Chrysomela* of Linn.) may be mentioned as a well-known British species. It measures about half an inch in length, and has red elytra, with a pair of black spots on each. Its larva lives in a little coriaceous tunnel, which it drags along with it. We here place also the singular genus *CHLAMYS*² of Knock³ (Plate CCXXVII. fig. 13), in which the upper surface of the body is extremely rugged and unequal. Nothing is known of the history or transformations of these insects, all of which, as far as yet observed, are natives of the new world, especially of Brazil, a region so remarkable for its entomological riches. In a state of repose they draw in their legs and antennæ close upon their body, and when not in motion are with difficulty recognised as living creatures. The species are few in number, and by no means common in collections. Mr Kirby has described a new species under the name of *Chlamys bacca*,—"Animal singulare, baccam rubicundam acinis constantem superficie rugoso simulans."⁴ In the genus *LAMPROSOMA*⁵ of Kirby (Plate CCXXVII. fig. 14), the body is almost globular, very smooth and convex, and the thorax extremely short, broad, gradually raised, and slightly lobate at the middle of its posterior margin.

In other groups, the antennæ, perceptibly longer than the head and thorax, are simple and filiform, or enlarged towards the extremity, or even terminated by a club,—in which case they are generally toothed like a saw, but only from the seventh joint. In several the body is oval, and narrowed in front. The last article of the antennæ is furnished with an appendage, so as to produce an appearance of twelve joints. In the genus *CRYPTOCEPHALUS* properly so called, the body is cylindrical, and the thorax as broad as the abdomen throughout its length. The antennæ and palpi are of the same size throughout. We have above a score of species in Great Britain. In the genus *EUMOLPUS* of Kugelan the body is narrowed in front, and almost ovoid. The mandibles are of ordinary size, and the second joint of the antennæ is shorter than that which follows. Almost all of them are exotic, although a few are found in Europe, of which *E. vitis*, Fab. and certain others, are said to occur in England. According to Geoffroy, the larva of the last-named insect is extremely destructive to vineyards.

We now approach the second great genus of the present tribe, that called *Chrysomela* by Linnæus. Of its modern reconstruction we shall likewise present the reader with a general sketch. The body of these insects is usually ovoid or nearly ovular, with the head salient, projecting or merely inclined. The antennæ are simple, about half the length of the body, and most frequently granose, and insensibly enlarged. When the great Swedish natu-

ralist established his extensive genus *Chrysomela*, he included within its somewhat too ample boundaries numerous groups, which the more precise observation and richer materials of later entomologists have caused to be erected into separate genera. It is thus that we owe *Erotylus*, *Colaspis*, and *Adorium* to Fabricius, *Eumolpus* to Kugelman, *Helodes* to Paykul, *Doryphora* to Illiger, and *Paropsis* to Olivier,—besides several others, to the origin of which we need not here particularly allude. Many of the species of this genus are among the most beautiful and highly adorned of all the insect tribes. Azure, and green, and gold, form their ordinary costume; and to that lustrous aspect, combined with their compact and rounded forms, they no doubt owe their title of *Chrysomela*, which in the Greek language signifies an apple of gold.⁶ These insects are of small or medium size. Few of them measure more than half an inch in length, and the greater number do not equal that dimension. They are strictly herbivorous, and sometimes commit considerable ravages on agricultural and garden produce. The larvæ have in general six feet, an elongated body, beset with warts or tubercles, and terminated by a kind of nipple, which secretes a viscous fluid, used both in walking, and in order to fix the insect firmly before its conversion to the nymphæ state. Their transformations usually take place in the open air, in which case they are protected by the hardening of their natural envelope. Many of the species are gregarious, while others are solitary; and it is among the latter that such occur as undergo their metamorphoses under ground. We shall now enumerate the principal generic groups into which the old genus *Chrysomela* has been subdivided.

In some the body is always ovoid, or nearly oval, and furnished with wings; the palpi terminate in a point. These insects resemble the *Eumolpi* already mentioned, and differ from the ensuing *Chrysomelinæ* in their filiform antennæ, which are longer than half the length of the body, composed of elongated nearly cylindrical articles, of which the eleventh or terminal bears an appendage or false joint nearly half as long as the article itself. Such are *COLASPIS*, Fab. which have no projection of the mesosternum; and *PODONTIA*, Dalman, in which that part projects in the form of a short and conical point, the end of which is received into a posterior emargination of the præsternum.⁷

In the following groups the antennæ are short, composed of articulations in the form of a reversed cone, or more or less nearly granose, and enlarged towards the extremity. The false joint or terminal appendage is very short and indistinct. In the genus *PHYLLOCHARIS* of Dalman there is no mesosternal projection; but in *DORYPHORA*⁸ of Illiger (Plate CCXXVII. fig. 15), that part is advanced like a distinct horn. The former genus inhabits New Holland and the island of Java,—the latter is peculiar to South America. The genus *PAROPSIS*,⁹ Olivier, or *Noto-clea* of Marsham (ibid. fig. 16), is distinguished from all the rest of the family by the maxillary palpi, of which the terminal article is much larger than the others, and hatchet-shaped. These insects, in so far as entomological research has yet extended, seem peculiar to New Holland. The two genera next ensuing interest our native naturalists as abundant over Britain. The terminal article

¹ From κρυπτος, concealed, and κεφαλη, the head.

² Neue Beträge zur Insectenkunde, p. 122.

³ Linn. Trans. vol. xii. p. 446. Monographs of the genus *Chlamys* have been published both by Kollar and Klug.

⁴ From λαμπρος, bright, and σωμα, body.

⁵ The word *chrysomelum*, from χρυσος, gold, and μήλα, an apple, denoted in ancient times a fruit with a yellow rind, and was deemed by Linnæus sufficiently applicable to the insects of our present genus, on account of their rounded form and brilliant colouring.

⁶ See Dalman's *Ephemerides Entomologicæ*.

⁷ From δρυφορος, a pike-bearer, in allusion to the sternal spine.

⁸ From χλαμυς, a coat of mail.

⁹ From παροψις, a platter.

Coleoptera of their palpi is also well distinguished from the preceding, to which it is equal, if not larger, in size,—its form being more or less semi-ovoid. These insects are widely spread over most parts of the ancient continent, especially Europe. In the genus *TIMARCHIA* of Megerle and Dejean (Plate CCXXVII. fig. 17), the species are few in number, and apterous. The elytra are joined together, the body gibbous, and the tarsi much dilated, especially in the males. They occur on the ground in woods, fields, and by the sides of highways. Their movements are slow and heavy, and a yellowish or reddish liquor frequently exudes from their articulations. Linnæus classed a well-known species of this genus (*T. tenebricosa*) as a tenebrio. It has been dissected by M. Leon Dufour, and exhibited an intestinal tube three times the length of the body. It presented no appearance of a crop; and the stomach, which was long and folded on itself, contained no sensible papillæ: some small transverse muscular bands were just discernible. The stomach is followed by a filiform intestine, then by an oblong cæcum, bordering on the rectum. As far as our own observation has extended, the species, with a few exceptions from the north of Africa, seem confined to Europe. In the genus *CHRYSEMELA* properly so called (Plate CCXXVII. fig. 18), the species are all provided with wings, and the terminal article of the palpi is as large or larger than the preceding ones, and in the form of a truncated ovoid, or reversed cone. The species of this delightful genus are extremely numerous, even in its now restricted state. Comte Dejean was many years ago in possession of 120 species, and we know that his collection has recently been much augmented. Even in Britain we possess about thirty species, exclusive of fourteen kinds of *Phædon* and six of *Melasoma*, genera so nearly allied in structure and economy, that some authors do not yet distinguish them from the *Chrysomelæ* strictly so called. We regret that within our present limits we cannot describe the species. We shall merely mention that we lately received one of the largest and most beautiful, *C. fulgida*, from the valley of Clova in Forfarshire. It was previously unknown in Scotland. Another species of very exquisite aspect, *C. cerealis*, common in France upon the broom, has of late years been taken occasionally in Wales.¹ Our own collection is indebted for it to our liberal friend and valued correspondent Mr Melly of Manchester, a skilful and accomplished entomologist, and the owner of one of the largest and probably the best conditioned of the general cabinets of Coleoptera in Britain.

Latreille terminates the tribe with such as have their maxillary palpi attenuated at the extremity, and ending in a point. These form two genera,—*PHÆDON* of Megerle, in which the body is ovoid or orbicular; and *PRASOCURIS* of Lat. (Plate CCXXVII. fig. 20).² Of the former, *C. fastuosa*, Linn. may be cited as a beautiful example, which occurs in great plenty at the base of Salisbury Crags and other places near Edinburgh, on the *Lamium album* or white dead-nettle,—of the latter, *P. Phellandrii* and *Beccabungæ* are well-known British species.

TRIBE 3D, GALERUCITÆ.

Coleoptera
Tetramera.

Characterized by the antennæ being always at least half as long as the body, of the same thickness throughout, or insensibly enlarged towards the extremity, inserted between the eyes, at a short distance from the mouth, and usually approximate at their base, and close upon a small longitudinal carina. The maxillary palpi, thickest towards the middle, are terminated by two joints of a conical form, but opposed or united by their base, the terminal one being either truncated, or obtuse, or pointed. The body is sometimes ovoid or oval, sometimes nearly hemispherical. Several, especially of the smaller kinds, have the posterior thighs very large, which gives them the power of leaping. They form the old genus *Galeruca*.

Latreille divides these insects into two principal groups, the *Isopodes*, or such as cannot leap, and the *Anisopodes*, or such as possess that faculty.

To the former belong the genera *ADORIUM*, Fab., of which the species are foreign; *LUPERUS*, Geoff., of which we possess two British species; and *GALERUCA* properly so called, of which our indigenous kinds are more abundant, and which is likewise extremely numerous both in Asia and America. *G. tanacetii* occurs in most parts of Britain. We took it in Sutherland. Java produces a very beautiful species, named *G. albicornis* by Dejean.

To the leaping *Galerucitæ* belong numerous insects, of which the posterior thighs are much enlarged. They were scattered by Fabricius through the genera *Chrysomela*, *Galeruca*, and *Crioceris*, and have been united by other naturalists under the single genus *ALTICA*.³ Though of insignificant dimensions, their colours are varied and brilliant, their movements lively, and their powers of devastation considerable. They feed on the leaves of plants, and are familiarly known by the name of garden fleas. South America produces a great many species.⁴ Many subdivisions have been proposed of the old genus just named. Of these, Latreille admits as established groups the genera *OCTOGONOTES* of Drapiez,⁵ *EDIONYCHIS*, *DIBOLIA*, *LONGITARSUS*, Lat., and *ALTICA* properly so called. The last-named genus is the most frequent and best known in Britain. The species are of small dimensions, and occur in great numbers during the spring in humid places, and are extremely destructive both in the larva and perfect state to pot-herbs and other garden produce. The larvæ resemble those of *Chrysomela* and *Crioceris*, and some of them are remarkable for discharging an odorous and acid fluid from certain small tubercles on their backs. The nymphæ bear a likeness to those of *Coccinella*, and remain from fifteen to twenty days in that condition. The perfect insects are often highly adorned, and the species are extremely numerous. We shall mention merely *H. nemorum*, which is oblong-ovate, black, thickly punctured, with a longitudinal yellowish stripe on each elytron, the base of the antennæ, tibiæ, and tarsi testaceous. This species is but too abundant over all our country. "The chief dependence," say Messrs Kirby and Spence, "of our farmers for the sustenance of their cattle in the winter is

¹ Certain species, of a darker or more obscure complexion than the others, form the genus *MELASOMA* of Dillwyn, so called from *μελας*, black, and *σωμα*, body. We may mention as an example, *M. populi*, the largest of the *Chrysomelidæ* hitherto found in Scotland. On each of the nine intermediate dorsal segments of the larva of this species there is a pair of black, elevated, conical tubercles, of a hard substance, from all of which when touched it emits a small drop of a white milky fluid, the smell of which, according to Degeer, is almost insupportable, being inexpressibly strong and penetrating. These drops proceed at the same instant from all the eighteen scent organs, which then present a singular spectacle. The precious fluid, however, is by no means wasted when exercised, for each drop, after a momentary appearance, during which it dispenses its perfume, is withdrawn again within its receptacle, till again required. (See Degeer, t. v. p. 291; and Kirby and Spence's *Introduction to Entomology*, vol. ii. p. 246.)

² *Helodes* of some other authors.

³ We are indebted to Illiger for a monograph of these insects, published in the *Magazin für Insectenkunde*.

⁴ *Annal. des Sciences Phys.* iii. p. 181.

⁵ From *αλτικος*, a leaper.

another most useful root, the turnip; and they have often to lament the distress occasioned by a failure in this crop, of which these minor animals are the cause. On its first coming up, as soon as the cotyledon leaves are unfolded, a whole host of little jumping beetles, composed chiefly of *Haltica nemorum*, called by farmers the *fly* and *black jack*, attack and devour them; so that on account of their ravages the land is often obliged to be resown, and frequently with no better success. It has been calculated by an eminent agriculturist, that from this cause alone the loss sustained in the turnip crops in Devonshire in 1786 was not less than L.100,000.¹

FAMILY VII.—CLAVIPALPI.

The insects of this family resemble the others of the same section in having the under part of the first three articulations of the tarsi furnished with brushes, and the penultimate bifid,—but they are distinguished from them by their antennæ, which are terminated by a distinct perfoliated club, and by their maxillæ armed on the inner side with a claw or corneous tooth. A few have the articles of the tarsi entire, but they still differ from other *Tetramera* with analogous tarsi, in their globular or ball-like form. In this family the body is usually rounded, frequently even very convex and hemispherical. The antennæ are shorter than the body, the mandibles emarginate or dentated at the extremity, and the palpi terminated by a large joint; the last joint of the maxillary palpi is very large, transverse, compressed, almost lunate. The form of the organs of manducation indicates that these insects are gnawers; and most of the European species occur on tree fungi, beneath bark, &c.

Some have the penultimate joint of the tarsi bilobed, and are not contracted like a ball. Of these, a certain number have the last article of the maxillary palpi transverse, and almost lunate or securiform. Such are the following genera. *EROTYLUS*,² Fab. (Plate CCXXVII. fig. 19), in which the intermediate articles of the antennæ are almost cylindrical, and the terminal club oblong. The corneous interior division of the maxillæ is terminated by two teeth. They are peculiar to South America.³ *TRIPLAX* (*Triplax*, *Tritoma*, Fab.) differs from the preceding in the antennæ, which are almost granose, and terminate in a shorter and ovoid club. The interior division of the maxillæ is membranous, with a single small terminal tooth. The hemispherical or rounded species form the genus *TRITOMA* of Fab., while those of an oval or oblong shape constitute the genus *TRIPLAX* of that author.

The remainder of this little group have the last article of the maxillary palpi elongated, and more or less oval. Such are *LANGURIA* of Lat., of which the species are strangers to Europe; and *PHALACRUS* of Paykul (*Anisotoma*, Illiger and Fab.). The latter genus contains certain small shining hemispherical insects, frequently found on flowers. They pass the winter under moss or beneath the bark of trees, where they probably also undergo their metamorphosis. Their general colours are brown or black; their movements are rapid, and they are with difficulty seized or retained, on account of their smooth and polish-

ed surface. They differ from the last-named exotic genus, *Coleoptera* not only in their general form, but in the club of their antennæ being composed of three instead of five articulations. *Trimera*.

In the remaining *Clavipalpi* all the joints of the tarsi are simple, and the body is almost globular. Such is the genus *AGATHIDIUM*, Illig. so named from *αγαθίς*, *a clue*, probably in reference to the faculty possessed by the species of rolling themselves into a ball,—in which state they feign death in the most imperturbable manner. They occur in woods, beneath the bark of trees, and in mushrooms. We regard the genus, of which about a dozen species occur in Britain, as rather characteristic of the north of Europe. It was originally constituted by a dismemberment of *Sphæridium*, from which, according to the sectional system of Latreille, it stands at a great distance, having, in common with other *Tetramera*, only four articulations to all the tarsi. The same character, in this instance we fear an artificial one, also removes it widely from *Anisotoma*, *Leiodes*, and other genera with which it is, in all likelihood more naturally, conjoined by Mr Stephens and other English entomologists.⁴

TRIMERA.

Three Articulations to all the Tarsi.

This, the fourth primary section of the coleopterous order, consists of three families, of which the first two bear a strong relation to the concluding genera of the section we have just quitted. Their antennæ, almost always composed of eleven articulations,⁵ terminate in a club formed by the three last joints. The club is compressed, and in the form of a reversed triangle. The first article of the tarsi is always very distinct; the penultimate is usually bilobed; and the last, presenting a knot at its base, is terminated by a pair of hooks. The elytra are not truncated, and entirely cover the abdomen. The genera of the third family, however, differ from the other two in the characters last mentioned, in which, as in several others, they make an approach to the *Brachelytra*, and other groups of the great pentamerous section. In their habits also they differ greatly from the rest of the trimorous families.

1ST, FUNGICOLÆ.⁶

These have the antennæ longer than the head and thorax, the body oval, with the thorax trapezoidal. The maxillary palpi are filiform, or slightly enlarged at the extremity, but not terminated by a comparatively very large and securiform article. The penultimate joint of the tarsi is always deeply bilobed. The genera are *EUMORPHUS*,⁷ Weber (Plate CCXXVII. fig. 21), *DAPSA*, Ziegler, *ENDOMYCHUS*,⁸ Web. (ibid. fig. 22), and *LYCOPERDINA*, Lat.⁹

2D, APHIDIPHAGI.¹⁰

Of the great majority of these the body is almost hemispherical, the thorax very short, transverse, nearly lunate. The antennæ terminate in a compressed obconical

¹ Introduction to Entomology, vol. i. p. 185.

² See Monographie du genre *Erotyle*, by M. Duponchel, inserted in the twelfth volume of the *Memoires du Muséum d'Histoire Naturelle*.

³ For the Scottish species of these, and the allied genera, see *Entomologia Edinensis*.

⁴ Latreille could clearly make out only nine in those of *Clypeaster*, but he thinks there may be some error in consequence of defective observation, arising from the minuteness of the species.

⁵ From *fungus*, and *colo*, to inhabit.

⁶ From *εμορφία*, elegance of form.

⁷ From *ενομυχος*, concealed within.

⁸ From *ενομυχος*, concealed within.

⁹ See *Règne Animal*, t. v. p. 160.

¹⁰ From *aphis*, and *φαγος*, eating.

Coleoptera club, composed of the three last articles, and are shorter than the thorax. The terminal article of the maxillary palpi is very large and securiform, and the penultimate article of the tarsi is deeply bilobed. In the remainder of the family the articles of the tarsi are simple, or at least the penultimate is very slightly bifid, a character which, with certain others, distinguishes these insects from the Fungicolæ.

In the extensive and beautiful genus COCCINELLA, commonly called Lady-birds (Plate CCXXVII. fig. 23), the antennæ are distinctly composed of eleven articulations. The body is nearly hemispherical, the thorax very short, slightly if at all margined, and the penultimate joint of the tarsi is deeply bilobed. The head is not concealed. This genus was established by Frisch, and has been adopted by all succeeding entomologists. It serves, according to Mr Curtis, as a remarkable example of the value of structure in the combination of groups, and of the slight importance of the distribution of colour when employed to distinguish species. "As a genus, Coccinella is so natural that its appellation has never been disturbed; whereas the species composing it are so variable that many of them have been described under a great variety of names."¹

These insects are distinguishable from the neighbouring genera of *Chrysomela* and *Erotylus* by the number of articulations of the tarsi, which never exceed three. In this character they so far coincide with *Eumorphus*, *Endomychus*, and *Dasycerus*,—but from those genera they differ in the shortness of their antennæ, the form of their bodies, and the development of the last articulation of the maxillary palpi. The general form of these beautiful, and for the most part familiarly-known insects, is hemispherical,—an aspect produced chiefly by the convex shape of the elytra. The under surface is extremely flat, and the legs are short, and, except when the insect is in motion, scarcely project beyond the lateral edges of the elytra. Leon Dufour has illustrated the anatomical structure of this genus with his accustomed accuracy. He discovered in *C. septempunctata* a salivary apparatus composed of three pair of diaphanous vessels, of extreme tenuity, more or less twisted, and extending from the hinder part of the mouth into the abdomen, where the extremities appear to float. He was, however, unable to detect the appearance of any gland or other organ of an essentially secreting nature; but when submitted to a powerful microscope, these vessels exhibited a structure entirely analogous to that of the salivary conduits observable in the dipterous and hemipterous tribes. A linear and tubular axis was perceptible through their pellucid coats, resembling that of the excrementitious secretions of the Carabidæ. The digestive canal is itself scarcely longer than the body of the insect, and is consequently nearly straight. The œsophagus seems inclosed in the head, in such a way that, to render it observable, the alimentary tube must be drawn backwards. The stomach is not preceded by any crop or gizzard. It is bilobed at its origin, where it approaches the head, and receives the œsophagus in the notch or slope produced by that bilobation. It is longer than the rest of the tube,—is very smooth and dilatable,—and was found filled sometimes with a blackish, sometimes with a yellowish pulp. Near its termination were the biliary vessels, six in number. These vessels are somewhat large in proportion to the size of the

insect, and each has a distinct and isolated insertion on the stomach, like a cæcum. They have a very varicose aspect, and always appear diaphanous. The insertion of these biliary vessels indicates the limits of the stomach, and we have then a very short intestine, followed by a slightly bulged cæcum, and a rectum distinctly marked.

The larvæ of the Coccinellæ feed on Aphides, and are extremely useful in the destruction of those noxious insects which abound to the deterioration of so many valuable plants. In the perfect state many of the species pass the winter in the clefts of palings and the chinks of walls. Their eggs are usually laid in spring. These are of a yellow colour, with a disagreeable smell, and produce larvæ of an aspect very different from that of the perfect insect. In that early condition the body is much broader than deep, and is pointed towards the extremity, which bears a fleshy projection, carried by the insect on the plane of its position, and serving as a kind of supernumerary foot. The body consists of twelve rings or segments, which in some cases are garnished with spines or tubercles, in others smooth. When the larvæ have attained to their full size, they adhere by their hinder extremity to a leaf or a stone, and partly freeing themselves from a slough or skin, they assume the state of Chrysalis. In the course of a week or two, according to the species, the perfect insect makes its appearance. It is at first soft, flexible, and almost colourless, but a very short period suffices to adorn it with those gay and contrasted markings which render the Coccinellæ or "Lady-birds" among the most admired of all the smaller tribes of coleopterous insects. Some contrariety of opinion appears to exist in regard to the food and habits of these insects in the perfect state. Perhaps their instincts may vary according to circumstances, or may present a disparity in the species. We have frequently observed them preying upon Aphides; and yet Bosc, in describing the *Coccinella borealis* of America, mentions its destructive attacks upon the leaves of the melon plantations; and other species are said to be injurious to the crops of lucerne and cinquefoils. Their numbers vary greatly in different years. In 1807, as Messrs Kirby and Spence inform us, the shore at Brighton, and all the watering-places on the south coast, were literally covered with them, to the great surprise and even alarm of the inhabitants, who were ignorant that their little visitors were merely emigrants from the neighbouring hop-grounds, where in their larva state they had slain their thousands and their tens of thousands of the Aphis, which, under the name of the *Fly*, so frequently blasts the hop-grower's expectations.² Mr Stephens enumerates thirty British species of this genus, almost every one of which exhibits several striking varieties.³

In the remaining Aphidiphagi the body is very flat, in the form of a buckler, and the head is concealed beneath a nearly semicircular thorax. The antennæ do not seem to consist of more than nine articulations, and terminate in an elongated club. The articulations of the tarsi are entire. The præsternum forms anteriorly a kind of chin-cloth (*mentonnière*). Such is the genus CLYPE-ASTER, of which the species occur under stones, and beneath the bark of trees.

3D, PSELAPHII.

This little family, in its short and truncated elytra, which leave the abdomen in part exposed, presents a cer-

¹ *British Entomology*, vol. v. f. 208.

² *Introd. to Entomology*, vol. i. p. 257; and *Entomologia Edinensis*, p. 293.

³ The natural union of these apparently distinct kinds may have given rise to the belief that different species of Coccinellæ cohabited with each other. "On trouve quelquefois," says Latreille, "des individus très différents par leurs couleurs accouplés; mais on n'a pas suivi les résultats de ces mélanges." (*Règne Animal*, t. v. p. 162.)

tain resemblance to the brachelytrous tribes, particularly the genus *Aleochara*.¹ The abdomen, however, is much shorter and wider, and is very obtuse and rounded posteriorly. The antennæ terminate in a club, or are enlarged towards the extremity, and sometimes consist of only six articulations. The maxillary palpi are usually very large. All the articulations of the tarsi are entire, and the first, much shorter than the following, is scarcely perceptible on a cursory examination; the last is frequently terminated only by a single hook. These insects occur upon the ground among vegetable debris. Some are found in ants' nests.

Such as have eleven joints to the antennæ form the genus *PSELAPHUS*² of Herbst (*Staphylinus*, Linn.), which is thus subdivided by Latreille. A limited number have two hooks to the tarsi. These form the genera *CHENNIUM*, Lat. (Plate CCXXVII. fig. 25), and *DIONIX*, Dejean. The remainder have only a single hook to the tarsi. Such are *PSELAPHUS* proper (ibid. fig. 24) of Lat., *BITHYNUS*, *ARCOPAGUS* and *BRYAXIS* of Leach, and *CENISTES* of Reichenbach.³

The last of the Pselaphii, and with these we conclude the great coleopterous order, are distinguished by this peculiarity—that the antennæ are composed of not more than six articulations, and in certain cases (genus *ARTICERUS* of Dalman⁴) apparently of only one. In the genus *CLAVIGER*⁵ (Plate CCXXVII. fig. 26) six joints are quite perceptible (ibid. fig. 27). These insects do not seem to have any eyes. The maxillary palpi are very short, without distinct articulations, and furnished with two terminal hooks. The first two articulations of the tarsi are very short, the third or last very long, with a single terminal hook. These insects occur beneath stones in dry situations.⁶

ORDER II.—ORTHOPTERA.⁷

In this order the wings are likewise four in number. The elytra or upper pair are softer and more flexible than in the preceding order; they are semi-membranous, reticulated, and for the most part do not form by their junction, when closed, a straight line along the dorsal suture. The true wings are folded longitudinally, and usually after the manner of a fan, and are divided by longitudinal membranous nervures. Maxillæ terminated by a corneous piece, toothed, and protected by the galea, a portion which corresponds to the exterior division of the jaws of coleopterous insects. In this order there is also a kind of tongue or epiglottis. The metamorphosis is semi-complete.

Linnaeus arranged the first genus of our present order with his Coleoptera, placing it, however, by itself at the termination of that order;—the remaining genera were

grouped with his hemipterous tribes. We owe their separation to Degeer, who formed the whole into an order, under the name of *Dermaptera*.⁸ They correspond to the *Ulonata* of Fabricius. The title which they now bear was imposed by Olivier.

The body of orthopterous insects is generally of an elongated form, and of a somewhat soft and fleshy consistence. It is composed as usual of head, thorax, and abdomen. We shall briefly describe the general characters of these parts. The head varies considerably in size, form, and position. It is usually large and vertical, and presents in the greater number of species two or three stemmatic eyes. The front is sometimes prolonged into a conical form, as in certain species of the genera *Truxalis* and *Mantis*; sometimes it bears a kind of fleshy appendix resembling a veil, as in the *Gryllus umbraculosus* of Spain. The true eyes occupy the sides of the head, and are generally very large, with a reticulated aspect. The antennæ do not vary so greatly in their structure as among the Coleoptera, but they are usually composed of a greater number of articulations. They are generally inserted in front of the eyes, but sometimes beneath or between them. Their articulations are not very distinct, and as to shape they are filiform, setaceous, massive, perfoliated, and sometimes ensiform, or resembling the blade of a sword.

The mouth consists of a labrum, two mandibles, a pair of maxillæ, a labium, and four palpi. The labrum is attached to the clypeus by a distinct suture; it is moveable, always external, demi-coriaceous, somewhat arched or vaulted, almost semicircular, rounded in front, and advancing on the mandibles. The mandibles are scaly, or corneous and strong, triangular, short, thick, with the exterior side arched, and the interior armed with many unequal teeth or dentations. According to the observations of Marcel de Serres, these dentations bear a close relation to the mode of nourishment; and he distinguishes them, as we do the dental system of the Mammalia, as *incisive*, *canine*, and *molar*. These last are the largest, and there is never more than one in each mandible, placed towards its base. The three sorts of teeth never exist simultaneously, and it is by their presence or absence, and by the modifications of their forms, that we may recognise the nature of the various substances by which the different tribes of Orthoptera are nourished. In the genera *Mantis* and *Empusa*, for example, which are purely carnivorous, we find only the canine teeth or *laniares*. Those species which have only incisive and molar teeth are herbivorous, while such as are omnivorous possess canine and molar teeth, but of smaller dimensions. The maxillæ resemble in a great measure those of the carnivorous Coleoptera. They are very strong, corneous, at least on their superior portion, which forms a kind of large conical tooth, provided with two or three dentations. They also bear

Orthoptera.

¹ The *Pselaphida* of Mr Stephens form the first family of his *Brachelytra*. (*Nomenclature of British Insects*, 2d edition, col. 89.)

² From *ψηλαφάω*, to feel one's way.

³ For the details of the above genera, of which we can only indicate the names, see Reichenbach's *Monographia Pselaphorum*; the 3d vol. of Leach's *Zoological Miscellany*; the 4th of Gyllenhal's *Insecta Suecica*; the article *Pselaphiens* of the *Encyclop. Méth.*; and the *Règne Animal*, vol. v. p. 164.

⁴ Memoir (in Swedish) *On the insects inclosed in amber*, p. 21.

⁵ *Claviger*, a club-bearer. See a Monograph of the genus by Müller, in the 3d vol. of Germar's *Magazin der Entomologie*.

⁶ Two additional primary sections of the order Coleoptera were formerly recognised, under the names of *DIMERA* and *MONOMERA*. These are now suppressed, for the reasons assigned at page 110 of this article.

⁷ *ULONATA*, Fab.

⁸ The order now known under the name of *Dermaptera*, and admitted as such by many modern writers, is an osculant one, connecting the *Coleoptera* and *Orthoptera*, and is composed of the genus *Forficula*. The elytra are of a coriaceous consistence, without veins, have a straight suture, and inclose wings which are folded longitudinally as well as transversely. These characters serve to connect it with the preceding order, while the form of the wings, the organs of the mouth, and the nature of the metamorphosis, exhibit its alliance to the orthopterous tribes, along with which we have consequently ranked it in the present treatise, in conformity with the views of M. Latreille, although we are aware that most English entomologists, and many foreign ones, prefer that it should be distinguished as above mentioned.

Orthop-
tera.

two palpi, but that which is named the internal palpus among the carnivorous Colcoptera is here transformed into a membranous inarticulate piece, sometimes cylindrical, in other instances triangular or dilated, but in all cases vaulted above, and covering the extremity of the maxillæ. It is to this particular portion, or internal maxillary palpus, that Fabricius applied the name of *galea*, or helmet, a term not very accurately translated *galette* by Olivier. The external maxillary palpi, which alone are apparent, are composed of five articulations, of which the two first are extremely short; and it is in these palpi that Olivier and Marcel de Serres suppose themselves to have discovered the organ of the sense of *smell*. The latter author observed in their interior a pair of nerves spreading themselves over the vesicular membrane which terminates their last articulation. These he names the olfactory nerves: one is furnished by the fifth pair, which springs from the inferior face of the brain, and the other by the first pair, which derives its origin from the lateral and superior face of the first ganglion of the head. Between these two nerves there is a trachea, which, before it reaches the vesicular membrane, commences to form a pneumatic pouch. This pouch is more fully developed in the interior of the palpus, and throws off numerous ramifications, which spread themselves within the cavity of the organ. It was this peculiar structure which induced Olivier and Marcel de Serres to regard these palpi as the organs of the sense of smell. We may add, however, that Latreille is by no means satisfied that they are so, and thinks that additional observation is necessary to establish this alleged fact in the physiology of insects. The labium, or ligula, of the Orthoptera, is almost membranous, elongated, slightly enlarged towards its extremity, and divided into two or four stripes or portions.

The interior of the mouth exhibits an additional piece, which some regard as a tongue; it is fleshy, longitudinal, carinated above, broader at its base, slightly restricted before its anterior extremity, rounded, immovable, and somewhat notched at its point. The mentum is coriaceous, in form of a transverse square, rather narrow towards the summit. The labial palpi are composed of only three articulations, as among the coleopterous tribes.¹ Those of the maxillæ consist of five.

The thorax is composed, as in other cases, of a prothorax, a mesothorax, and a metathorax. The first is generally the largest, and is the only part exposed. It presents a great variety of forms, some of which are sufficiently singular. The elytra, in the greater number, are coriaceous, thin, flexible, semitransparent, and reticulated. They are occasionally almost horizontal, with a straight dorsal suture, as among the Coleoptera; but they are much more frequently more or less inclined, with their inner edges crossing each other when closed over the back. The true wings are broader than the elytra, membranous, full of reticulations, and longitudinally folded after the fashion of a fan. To this latter character, however, the somewhat anomalous genus *Forficula* (containing the earwigs) presents an exception, as in it the wings are also transversely (as well as longitudinally) folded, as among the Coleoptera. In some cases the females, and in a few instances both sexes, among the Orthoptera, are destitute of wings. In many species the elytra of the males are short or rudimentary, and in that sex also a portion of the inner margin of these parts frequently resembles talc or parchment, and exhibits large irregular nervures. It is by the rapid friction of these upon each other

that the monotonous song, or *stridulation* as it is called, of many species is occasioned. In others, however, a shrill monotonous cry is produced by rubbing the posterior limbs against the edges of the elytra.

The legs of orthopterous insects are sometimes similar to each other. In other cases the anterior pair are more extensile, and are armed with spines, with which they transfix their prey,—or they are dilated, compressed, strongly toothed externally, and adapted for burrowing in the earth. The posterior legs, as among locusts and grasshoppers, are frequently much larger than the others, and fitted for powerful leaping; and both the middle and posterior pair are more widely apart from each other at their origin than among the coleopterous species. The articulations of the tarsi differ in the different tribes; but we believe that no *heteromerous* species have been yet observed. These articulations are not unfrequently furnished beneath with little membranous cushions, and the terminal articulation is always provided with a pair of hooks or claws.

The form of the abdomen varies in this order. It is divided externally into eight or nine rings, and is often terminated by projecting appendages. Many of the females are furnished with an ovipositor, composed of two portions closely applied, and frequently surrounded by a common envelope.

In relation to the anatomy of the Orthoptera, we may state, that they are all characterized by a first membranous stomach or crop, succeeded by a muscular gizzard, armed interiorly with scales or corneous teeth, according to the species. Around the pylorus, except in the *Forficula*, are two or more blind intestines, furnished at their base with many small biliary vessels; and numerous other vessels of a similar nature are inserted towards the middle of the intestine. The digestive system of the larvæ resembles that of the perfect insect.

M. Marcel de Serres has particularly devoted himself to the study of the internal structure of these creatures. He informs us that the Orthoptera with setaceous antennæ, such as the genera *Blatta*, *Mantis*, *Gryllo-talpa*, *Gryllus*, and *Locusta*, have only elastic or tubular tracheæ, and these of two kinds,—the one arterial, the other pulmonary. The latter alone distribute the air to all parts of the body, after having received it from the former. In the genera characterized by cylindrical or prismatic antennæ, such as *Acrydium* and *Truxalis*, the pulmonary tracheæ are replaced by vesicular ones. They are covered by cartilaginous hoops or moveable ribs, and receive air by means of tubular or elastic tracheæ, which proceed from the arterial kind. According to the same authority, the nutritive system is more or less developed, and exhibits four principal modifications. *Gryllus* and *Gryllo-talpa* in that respect excel the others. In them the crop is shaped like a bagpipe, and placed on one side, while in the rest it is on a line with the gizzard. In the latter also the hepatic vessels are inserted insulately, but in the former by means of a common deferent canal. The genera *Truxalis* and *Acrydium* (crickets), although resembling *Locusta* (*Sauterelles*) in their digestive system, differ in respect to the superior hepatic vessels, which are not furnished at their extremity with secreting vessels, and no longer form enlarged pouches, but cylindrical and elongated canals. The intestines of *Blatta* and *Mantis* present only two divisions; their nutritive system is in other respects the same. The *Forficula*, of which Mr Kirby and Dr Leach form a distinct order under the title of *Der-*

Orthop-
tera.

¹ This characteristic is assigned by Latreille (*Règne Animal*, t. v. p. 168) and other writers; but we have ourselves detected four articulations in the labial palpi of several genera.

Orthoptera. *maptera*, do not appear to have been investigated by Marcel de Serres.¹ According to Baron Cuvier, they differ from all other Orthoptera in wanting the superior hepatic vessels.

The metamorphoses of the Orthoptera are called semi-complete, and consist chiefly in the development and increase of the elytra and wings. Both the larvæ and nymphæ feed and move about like the perfect insects, and differ chiefly by the entire want of wings in the first state, and their rudimentary condition in the second. These insects lay an immense number of eggs, of an elongated form and considerable size. They are sometimes deposited in a mass, and inclosed together within a capsule. Both young and old are extremely voracious, and frequently produce the most frightful consequences by their devastations. On the other hand, we are not aware of any recompensing advantages derivable to the human race from any species of orthopterous insects. Several eastern tribes no doubt use them as food, and seem to have done so in remote times, as indicated by the ancient name of *Acridophagi*; and the sacred writings have recorded that the food of John the Baptist in the wilderness was "locusts and wild honey." We believe that no aquatic species is contained in this order.

Mr Macleay has observed, that although there may be reason for hesitation with respect to the types of the Neuroptera, there is none in relation to the principal forms of the orthopterous order. These forms seem to have been perceived by all entomologists, and their dissimilarity has led to tribes being regarded in the light of orders. "Indeed no forms that are within the limits of an order can be more distinct from each other than those of a *Phasma*, *Truxalis*, *Locusta*, *Acheta*, *Blatta*, and *Forficula*; and we accordingly find that they have been considered as the types of so many groups by Linnæus. The affinity of *Blatta* to *Mantis* is acknowledged in the *Règne Animal*. The genus *Proscopia*, lately instituted by Professor Klug of Berlin, one of the first entomologists of the present day, proves the proximity of *Phasma* to *Truxalis*; and no entomologist is ignorant that the chain of connection from *Acridium* to *Locusta*, from *Locusta* to *Acheta*, and from this to *Blatta*, has been long since detected, and is now perfectly established. Hence some notion may be obtained of the contents of the orthopterous circle, if we reckon the above-mentioned five genera as the types of the following tribes:

1. Phasmina.
2. Acridina.
3. Locustina.
4. Gryllina.
5. Blattina.

But as this series returns into itself, and the genus *Forficula* cannot be inserted therein without disturbing its regularity, we must agree with Degeer and Mr Kirby, that it belongs to a distinct order. That this order can only be esteemed osculant between the *Orthoptera* and *Coleoptera*, the reader will perceive by referring to its place in the *Systema Naturæ*. The *Dermaptera*, for so they are termed, from its having been the name originally proposed for the *Orthoptera* by Degeer, are in fact coleopterous insects, with the metamorphosis and caudal appendages of the true *Orthoptera*.²

This is a much less numerous order than the preceding, in the amount at least of the ascertained species, and in Great Britain we have not above sixty different kinds.

FAMILY I.—CURSORIA.

All the feet formed for running. Wings and wing-cases almost always placed horizontally on the body. Females unprovided with a corneous ovipositor.

GENUS FORFICULA. Tarsi triarticulate. Wings folded like a fan, and refolded transversely beneath the elytra, which are extremely short, with a straight suture. The body is linear, and terminated by two moveable scaly pieces, in the form of a pair of pincers. Head exposed. Antennæ filiform, inserted before the eyes, and composed of from twelve to thirty articulations, according to the species. The ligula is forked.³ See Plate CCXXVIII. figs. 3, 4, and 6.

The insects of this genus, known under the familiar name of *earwigs*, are frequent in moist places, beneath stones, under the loose bark of old trees, or in decayed timber. They are injurious in gardens, where they attack various kinds of fruit. They also pierce the petals of flowers, and do not refuse animal food. Our entomological cabinet, when left open for a summer night, has sometimes suffered from their depredations. They may therefore be regarded as omnivorous. Their alleged inclination to enter the *ear* is a vulgar error, not derided however even by the Swedish sage:—"Aures dormientum interdum intrans," says Linnæus, "spiritu frumenti pellenda."

We shall not here describe the species, as their general appearance must be familiar to the reader; but we shall devote a few lines to the manners of the common earwig, *F. auricularia*. The female is known to watch over her eggs with great care,—an uncommon tendency among insects. Degeer placed an earwig, with her eggs, in a box with fresh earth, early in the month of April. They had been scattered by accident about the box; but she soon collected them together, and placed herself above them, as if she were hatching. Towards the middle of May the young made their appearance. They seemed large in proportion to the eggs, and appeared as if swollen. The movement of the dorsal vessel was very perceptible through the skin. These larvæ have neither wings nor elytra. They are composed of thirteen segments, of which the first three bear the legs, and the last exhibits the germ of the pincers, which are conical and slightly divergent. The antennæ are composed of eight articulations. Degeer endeavoured to bring up the young along with their mother, and fed them with slices of apple. They were observed to cast their skins several times, and after each of these changes the antennæ gained an additional articulation. The pincers also became longer, and their points approached each other, as in the adult insect. These larvæ, however, all perished by degrees but one; and the mother also perished, and was found half devoured by her offspring, an ungrateful return for such tender solicitude. This unnatural voracity, however, probably arose from a deficiency of other food, as they are never observed to attack each other in a state of freedom. The remaining larva increased in size, and assumed the nymphal state towards the end of July. The cases of the elytra and wings are flat, and closely pressed upon the back, and the pincers have assumed their usual aspect. It therefore does not greatly differ from the perfect insect.

The genus contains many species, and is widely distributed. Several sub-genera have been instituted by Dr

¹ They have since been examined by M. Dufour. See the note of the ensuing page.

² *Hor. Ent.* p. 435.

³ For the details of internal structure of this genus, see the *Mémoire sur l'Anatomie des Labidours*, by M. Dufour, in the 13th vol. of the *Annales des Sciences Nat.*

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Leach and others; but the nature of our present article does not admit of our taking cognisance of those minor groups.

GENUS BLATTA. Tarsi with five articulations. Wings folded only in a longitudinal direction. Head concealed beneath the shield of the thorax. Body oval or orbicular, and depressed. Antennæ setaceous, inserted in an internal notch of the eye, and composed of a great number of articulations. Palpi long. Thorax shield-shaped. (Plate CCXXVIII. fig. 7.)

The elytra of these insects are usually as long as the body, coriaceous or semi-membranaceous; and when closed, cross each other a little at the suture. The posterior part of the body is furnished with two conical and articulated appendages. Their crop is longitudinal, their gizzard furnished interiorly with strong hooked teeth, and there are from eight to ten cæca around the pylorus.

The Blattæ, or *cockroaches*, as they are called in this country, are nocturnal insects, which seldom fly, but run with great rapidity. Some inhabit woods or the crevices of old walls, while others frequent store-rooms and dwelling-houses, where their voracious propensities produce great damage to all kinds of provisions. They likewise destroy silk and woollen stuffs, and even leather. But their ravages are chiefly confined to warm countries. The species are numerous. Olivier¹ has described thirty-seven; and many have been discovered since his time. The *Blatta orientalis* of Linn. is about an inch long, of a reddish chesnut-brown. The wings, which are shorter than the abdomen in the male, are merely rudimentary in the female, and are wanting in the larvæ of both sexes. The eggs, to the number of sixteen, are inclosed symmetrically in an oval compressed shell, which is at first white and afterwards brown. It is tolerably solid, and is toothed along its edges like a saw. The female carries it about with her for some time, and afterwards attaches it to a favourable position, by means of a gummy exudation. This species, originally imported from eastern countries, is now widely spread over Europe, and occurs as far north as Finland.

The *Blatta Americana* of Linn. is a native of South America and the Antilles, from whence it was imported into Asia and Africa, and from these to European countries, where it chiefly infests sea-port towns, preying on sugar and other colonial produce. Sonnerat has described its combats with *la Mouche verte*, a brilliant fly of the family of Ichneumonidæ. The thorax of this species is yellowish, with two spots and a border of brown. It may also be known by the great length of its antennæ.² Including foreign importations, we have now twelve species of the genus *Blatta* in Britain.

GENUS MANTIS,³ Linn. Tarsi with five articulations. Wings folded longitudinally. Head not concealed. Body narrow and elongated. Palpi short, and ending in a point. Ligula quadrifid.

We may observe, that the genus *Mantis*, as originally constituted by Linnæus, contained a great variety of very singular and somewhat incongruous forms. It has since been greatly restricted, and more precisely defined, by Illiger, Latreille, Lichtenstein, and other modern writers. Thus it is distinguishable from *Empusa* of Illiger, by the antennæ, which in the latter genus are pectinated in the male sex, and by the want of the frontal prolongation of the head. From the spectre insects (*Spectrum*) with which they were likewise combined by Linnæus, the true

species of *Mantis* may be easily discriminated by the form and relative length of the legs, which in the spectres are of uniform size. The head in *Mantis* is triangular, vertical, with large eyes, and three small distinct stemmata. The antennæ are simple, setaceous, inserted between the eyes, and composed of numerous articulations. The labrum is entire; the mandibles cutting or incisive; the palpi filiform, pointed, not compressed; and the ligula is composed of four parts or divisions of nearly equal length. The thorax is long, and composed almost entirely of the first segment, of which the anterior extremity is frequently dilated, and the sides rounded. The first pair of legs are held in advance and raised, the haunch being very large, and the thigh toothed and compressed; the tibia is also toothed, and terminated by a strong hook or crotchet. The other legs are slender, simple, and unarmed with teeth or spines. The elytra are horizontal, narrow, lengthened, rather thin, semitransparent, and overlap each other on their inner edges. The under or true wings are folded lengthways like a fan. The abdomen is oblong, and is terminated by two conical articulated appendages, and a compressed scaly plate, arched on the back, and composed of several short pieces received into a pair of anal valves.

Such, we conceive, are the characters of the genus *MANTIS* properly so called. It contains a considerable number of species, all characterized by singular and eccentric forms. We do not know by what means it has happened that an insect of this genus has become, in various parts of the world, if not an object of religious worship, at least a subject of superstitious wonder and credulity. From time immemorial the *Mantis*, in Turkey, has been regarded as a sacred insect; and even among the apathetic Hottentots, so sparingly endowed with any thing allied to the nobler faculties, it is said to be held in still higher estimation. The *Mantis religiosa* of Europe, called *Prega-Diou* (Prie-Dieu) in the southern provinces of France, is well known as living habitually under the safe-guard of a religious veneration on the part of the peasantry, who deem it a faithful guide and guardian of children who have lost their way. It has obtained the name of *religiosa*, from the incessant movements of its fore legs, which it is continually raising into the air, and as it were clasping together. This action, however, is the result of its peculiar instinct and mode of life; for the insect, in common with the rest of the genus, is a fierce, cruel, gormandising creature, and so far from indulging, as is fondly supposed, in a state of religious abstraction, is continually seeking for what it may devour. It preys upon all the weaker insects, which it either crushes to death, or relentlessly impales alive upon the sharp spines of its own shanks. To effect this, it is perpetually moving its arms or fore-legs in the air, and closing one armed joint upon another, so that whatever insect prey approaches within its reach is immediately transfixed and devoured. In some of the French provinces it is called the *sorcerer*. Four or five different species are found in Europe, and many more occur in the warmer regions both of the old world and the new.

In the nymph or intermediate state, the Mantides are as active and voracious as the perfect insect. Following the footsteps of Rossi (author of the *Fauna Etrusca*), the writer of the present treatise has frequently watched their manœuvres on the plains of Pisa, and has more than once had occasion to regret the loss of rarer captures, in consequence of their indiscriminate voracity.

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¹ *Encyclopédie Méthodique*, t. iv.

² For the other species, consult Degeer's *Mémoires*, t. iii.; *Encyclop. Méthodique*, t. iv.; Fuessly's *Archives des Insectes*, tab. 49, 2-11; Quekbert's *Illust. Icon. Insect.* iii. 21, 1; and the *Horæ Entomologiæ* of M. Toussaint Charpentier, p. 71-78.

³ From *μαντις*, a prophet or soothsayer.

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tera. But he cannot say that he ever confirmed the observation of Roesel.¹ On the back of the nymph there are four lamina or flattened cases, which contain the germs of the wings and elytra. The eggs are deposited in a lengthened mass of two rows, and protected by an envelope somewhat of the consistence of parchment. They are of a yellow colour and elongated form, and are usually attached by the female to the stalk of a plant.²

Such as have the front prolonged in the form of a horn, and in which the males are provided with pectinated antennæ, form the genus *EMPUSA*³ of Illiger. Their limbs are furnished with rounded membranous appendages resembling ruffles, and in several the edges of the abdomen are festooned. (Plate CCXXVIII. fig. 1.)

Others have the anterior legs similar to the rest; the stemmatic eyes indistinct or non-existent; the first segment of the thorax shorter or not longer than the following one; the interior divisions of the ligula shorter than the lateral; the antennæ inserted before the eyes, and the head almost ovoid and advanced, with the mandibles thick and the palpi compressed. These form the genus *SPECTRUM*,⁴ Stoll, which has since been divided into two,⁵ both of which are truly remarkable for the singular adaptation of their form and colour to such productions of the vegetable kingdom as they most affect. The sexes often differ greatly. 1st, In the genus *PHASMA*⁶ of Fabricius (Plate CCXXVIII. fig. 5), the body is filiform and linear, and resembles the stem of a plant or the twig of a tree. Several are entirely apterous, or have extremely short elytra. Very large species occur in the East Indies, the Moluccas, New Holland, and South America. *P. gigas* measures nearly a foot in length. The body is green, tuberculated on the thorax; the elytra very short and likewise green; the wings are large, of a reddish-grey, reticulated, with numerous bands and spots of brown, and with a large lateral space of a coriaceous texture and greenish colour. The legs are spinous. It occurs in the East Indies. *P. Rossi*, a much smaller and apterous species, occurs in the south of France. 2d, In the genus *PHYLLIUM*⁷ of Illiger (Plate CCXXVIII. fig. 2), both the body and legs are flattened and membranous, and the first segment of the thorax is cordiform. The wings and elytra vary in their degree of development in the different species, but they frequently cover the abdomen in such a manner as to make it appear as if two leaves had fallen upon the insect. Some seem green and fresh, others brown and withered, while an intermediate kind present the red and yellow hues of autumn. This imitation, or rather representation, of the vegetable kingdom, is indeed so singular as to attract the attention and excite the astonishment of the least curious inquirer; and it is in reference to the peculiar character just mentioned that these insects are known by the name of *walking leaves*. According to some authors, the antennæ of the males are long, slender, setaceous, and composed of a great number of nearly cylindrical articulations,—while those of the females are shorter than the head, conical, granular, and composed of not more than nine articulations. It appears that this great disparity between the

sexes led Latreille into an error when he formed a distinct species of *Ph. longicornis*, which is in fact the male of *Ph. siccifolia*. The latter (see the figure last referred to) is fully three inches long, very flat, and of a pale yellowish-green colour. The thorax is short and dentated on the sides, and the foliations of the thighs are likewise dentated. In the female the antennæ are very short, the elytra as long as the abdomen, and the true wings wanting. The form of the male is narrower and more lengthened, and the antennæ long and setaceous; the elytra are short and the wings long. This species, Latreille informs us, is raised by the inhabitants of the Sechelles Islands as an object of entomological commerce. The same species, and some others nearly allied, occur in India, and the great eastern islands, such as Java, the Celebes, &c.

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FAMILY II.—SALTATORIA.

Posterior legs very strong, spiny, and formed for leaping.

The males of this family (which corresponds to the great genus *Gryllus* of Linn.) are musical, that is, provided with the power of producing peculiar sounds, by friction of certain parts of their structure upon others. Most of the females deposit their eggs in the earth.

GENUS *GRYLLUS*. Tarsi with three articulations. Elytra and wings horizontal, the latter folded longitudinally, and forming, when closed, a slender thread-like acumination beyond the elytra. Antennæ setaceous, inserted between the eyes. Ligula with four divisions, of which the central are very small. Labrum entire, with a projecting slip in that of the female.

This genus contains the insects commonly called crickets. They inhabit both fields and dwelling-houses. The common species (*G. domesticus*, Linn.) (Plate CCXXVIII. fig. 9) is of a pale yellowish or clay colour, mingled with brown. The female bears a long ovipositor, and the male is characterized by his perpetual cry of *cree cree*, uttered most continuously during warm weather, or in the vicinity of ovens or large kitchen fires. These insects remain in their retreats during the day, and come forth in the night season to seek their prey. They feed on bread, flour, and other articles of domestic economy. Latreille says they also devour insects. The common cricket is widely distributed over Europe. In Spain it is kept by the peasantry in little cages hung by the fireside, for the sake of its song.

The field cricket (*G. campestris*) is larger than the preceding. It is of a blackish hue, with the base of the elytra yellowish. The head is large. The posterior thighs are red beneath. The female, during the month of July, lays about three hundred eggs, from which the young are excluded in fifteen days. They feed on herbs and roots, and moult or change their skins before winter. During that inclement season they lie torpid under ground, and re-appear in spring. The larvæ are apterous, the nymphæ bear the rudiments of wings and elytra, the perfect insects, which possess the power of flight, are ma-

¹ "Il a conservé des Mantes en les nourrissant avec des mouches ou autres insectes; quand on les mets ensemble elles se dévorent. Un mâle et une femelle de ces insectes ayant été enfermés dans un vase de verre, le premier fut saisi par la femelle, qui lui coupa la tête. Comme ces insectes sont extrêmement vivaces, le mâle vécut encore assez long-temps, et ne fut dévoré par la femelle que quand celle-ci en eut été fécondée." (Guerin.)

² For the species of this and the ensuing genera, see Stoll's *Representation des Spectres, des Mantres, &c.*; Lichtenstein's *Monograph*, in the sixth volume of *Linn. Trans.*; and other works.

³ From *εμψουσα*, an apparition.

⁴ From *spectrum*, a spectre or ideal form.

⁵ Other minor divisions have been effected at a still more recent period, by MM. Lepelletier and Serville (in the *Encyclop. Méth.*), and by M. Latreille in his *Familles du Règne Animal*.

⁶ From *φασμα*, a prodigy.

⁷ From *φύλλον*, a leaf.

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nifested in June and July. This species inhabits Africa and all the southern countries of Europe, where the peasant children are in use to *fish* for it, by holding an ant fastened to a hair over its hole. It is foolish and fearless, and will leave its retreat if even a stalk of grass is inserted in its dwelling; hence the French expression of *sort comme un gryllon*. It occurs in England, and we heard its song near Edinburgh for the first time last summer (1833).

There are many very singular insects belonging to this genus. The *Gryllus umbraculatus* occurs in Spain and Barbary. The male is remarkable for a membranous prolongation of the head, which falls over it like a veil. India produces the *G. monstrosus*, of which the elytra and wings are spirally twisted at their extremities. A new and large species has been lately discovered in Sicily by MM. Lefevre and Bibron, and described by them under the name of *G. megacephalus*. Of this insect each particular cry, instead of being momentarily repeated, is prolonged for about half a minute, and may be heard at the distance of a mile.

We shall here briefly notice some of the allied genera. The mole-cricket now forms the genus GRYLLO-TALPA¹ (Plate CCXXVIII. fig. 8), of which the tibiae and tarsi of the two anterior pair of legs are flattened and toothed, and so constructed as to serve for throwing back the earth while burrowing. These insects are destructive in gardens and cultivated fields, by detaching or cutting asunder the roots of plants, during the progress of their subterranean excavations. Their natural prey, however, consists of insects and worms. The female of the best known species (*G. vulgaris*, Lat.) lays from two hundred to four hundred eggs in a commodious dwelling under ground, resembling a bottle with a curved neck. The young dwell together for some time in society. The song of the male is sweet and agreeable.²

An insect found in the south of France by the sides of rivers, a strong leaper, of small size, and of a black colour, spotted with yellowish-white, belongs to the genus TRIDACTYLUS³ of Olivier, characterized by having the anterior pair of legs only formed for digging. In place of the posterior tarsi, there are moveable appendages in the form of claws. The antennae are short, of equal thickness throughout, and composed of ten articulations. The species above alluded to is the *Xya variegata* of Illiger. Charpent. *Horæ Ent.* p. 84, t. ii. fig. 2, 5.

A singular species, misnamed *Blatta acervorum* by Panzer, takes up its abode in ants' nests, and now forms a genus of our present group under the name of MYRMECOPHILA.⁴ The body is oval and apterous, the posterior thighs very large. In the antennae, and the want of stigmatic eyes, it resembles *Gryllus* properly so called.⁵

GENUS LOCUSTA. Tarsi with four articulations. Elytra and wings inclined. Antennae very long and setaceous. Mandibles less dentated, and galea larger than in *Gryllus*. Females provided with an ovipositor compressed in the form of a sabre or cutlass.

These insects are herbivorous. They occur in grassy meadows, and on shrubs and trees. In flying they spring into the air, and then extend their capacious wings, but their flight is neither rapid nor long sustained. The cry of the male is sharp and continuous, and is produced by the friction of the elytra. The genus is extensive,

and occurs in many countries. They are usually of a brilliant green. One of the best known in Europe (it is also an English species) is the *L. viridissima*, Lat. (Plate CCXXVIII. fig. 12). It is about two inches in length, of a fine green colour, without spots. The ovipositor is straight, and of the length of the body. Another species (*L. verrucivora*, Fab.) is likewise green, but the elytra are spotted with brown and black. The ovipositor exceeds the length of the abdomen, and is slightly arched. This latter bites pretty severely, and derives its specific name from a practice said to be followed by the Swedes, who allow it to gnaw their warts, which are alleged speedily to disappear, from the action of a black and bilious liquid which escapes from the mouth of the insect during mastication.

Several species are nearly apterous, or present merely scale-like rudiments of the organs of flight, such as the *L. ephippiger*, which now forms a genus under its specific name. Some have the antennae bearded beneath, with the oviduct shaped like a boat, and form the genus SEAPHURA of Kirby.⁶

All the preceding genera of the leaping or saltatorial Orthoptera have this character in common, that the males effect their peculiar cry chiefly by a portion of the elytra, which is discoloured, transparent, and somewhat resembles a mirror or small tambourine. But in the following genera, the stridulation of the male is effected by the friction of the spiny legs against the sides and edges of the elytra and wings. The antennae are sometimes filiform and cylindrical, sometimes sword-shaped, or terminated by a mass, always at least as long as the head and thorax. The ligula in the greater number has only two divisions. There are three simple eyes, the labium is notched, the mandibles much toothed, the abdomen conical and laterally compressed. The tarsi are composed of three articulations, and the female is not furnished with a prolonged ovipositor. They all leap better than the preceding genera, and have a higher and more sustained flight. They feed on vegetables, and are extremely voracious. They compose the old genus *Acrydium* of Geoffroy, which Latreille divides as follows.

*

Mouth exposed, ligula bifid, a membranous cushion between the hooks, at the end of the tarsi. GENUS PNEUMORA. Antennae filiform, of sixteen articulations, inserted close upon the inner margin of the eye. Posterior legs shorter than the body, and less adapted for leaping. Abdomen large, vesicular, and appearing as if empty.

We know little of the manners of the insects of this genus (Plate CCXXVIII. fig. 14). They inhabit southern Africa, and feed on vegetable substances. The *P. sexguttata* has green elytra, with three silvery spots on each. It is a very beautiful insect.

GENUS PROSCOPIA, Klug. Without wings. Body long and cylindrical. Head prolonged anteriorly into a point or cone, bearing two short filiform antennae, composed at most of seven articulations, of which the last is pointed. Posterior legs large and long, approximated to the intermediate, which are farther than usual from the anterior pair.

These singular insects are peculiar to South America, and are usually of a large size. Klug, in his monograph of the genus, has described fifteen species.⁷

¹ From *gryllus*, a cricket, and *talpa*, a mole.

² For a curious account of the habits of the mole-cricket, see *Nouv. Cours d'Agriculture*, deux ed. t. v. p. 163. Its anatomy is described in *Ann. du Mus. d'Hist. Nat.* t. xx. p. 213.

⁴ *Memorie Scientifiche di Paolo Savi*, Pisa, 1828.

⁶ See also *Règne Animal*, t. v. p. 184; Charpentier's *Horæ Ent.*; and Thunberg in the *Mém. de l'Acad. Imper. de Petersbourg*.

⁷ See *Proscopia*, *Novum genus Insectorum Orthopterorum*, in folio, with two plates.

³ From *τρεῖς δακτύλοι*, with three fingers.

⁵ *Règne Animal*, t. v. p. 183.

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Orthoptera. GENUS TRUXALIS, Fab. Head pyramidal, bearing on its extremity, and above the eyes, two prismatic, compressed, ensiform antennæ.

Orthoptera. We are acquainted with about a dozen species of this genus. Their distinctive characters have not yet been well expressed, and it is not improbable that several have been confounded. They are characteristic of the warmer countries of the ancient continent. The best known is the *T. nasutus* of Fab. figured by Roesel, *Insect. ii. Gryll. iv. 1, 2.* See also Drury, *ii. xl. 1.* It occurs in Africa and the south of Europe (Plate CCXXVIII. fig. 10).

GENUS ACRYDIUM. Head ovoid. Antennæ filiform, or terminated by a button, and inserted between the eyes, at some distance from their inner margin. Body solid, and not vesicular. Hinder legs longer than the body.

This genus contains the noted insects commonly called locusts, the structure and history of which we shall briefly detail. The head is largely developed, and supports two rather short antennæ, composed of twenty articulations. The true eyes are oval, projecting, and situated on the sides of the head, while the stemmatic eyes, three in number, form a triangle on its summit. The mouth is composed of a large and broad upper lip, slightly notched on its anterior margin; of strong cutting mandibles, irregularly toothed; of maxillæ terminated by three teeth, and supporting at the same time the galeæ by which they are covered, and a pair of filiform palpi, consisting of five articulations; of an inferior lip, broad, advanced, bifid at the extremity, and giving insertion to a pair of filiform palpi of four articulations. The prothorax, of the same breadth as the body, sometimes exhibits superiorly small keels, which are prolonged transversely on the sides in slight impressions, appearing to indicate the natural divisions of that portion of the thorax. The chest of the mesothorax and metathorax, or rather the sternum, is broad, flattened, and very dissimilar to that of *Locusta* (Saute-relles), in which it has the appearance of two triangular foliaceous plates. The elytra are coriaceous, narrow, and as long as the wings, which are large, reticulated, folded like a fan, and frequently ornamented by brilliant shades of red or blue. The legs are of unequal length,—the two anterior pair being of ordinary proportions, while the hindmost are large, and formed for leaping. Many species exhibit on each side, and near the origin of the abdomen, a large cavity, closed interiorly by a thin membranous diaphragm, of a pearly white colour. Latreille regards it as a pneumatic pouch, forming an acoustic instrument. It may no doubt be influential in regulating the sounds uttered by these insects, which, however, are certainly produced in the first place by the alternate friction of the inner face of the hind legs against the surface of the elytra.

The females, which are not provided with an exerted ovipositor, lay their eggs in some instances in the ground, in others on the stalks of plants, to which they adhere naturally by a gummy secretion, and are, moreover, enveloped and protected by a frothy matter, which hardens over them. The larvæ, the nymphæ, and the perfect insects, are all voracious, and feed on plants. The ravages of locusts are so well known to all readers of foreign travels, and accounts of their desolating inroads have been so frequently extracted, and published in numerous popular works, that a few slight notices of the subject will here suffice.

Locusts are of very common occurrence in many parts of Africa. Mr Barrow records, that in the southern districts which he visited, the surface of an area of nearly 2000 square miles might literally be said to be covered by them. The water of a wide river was scarcely visible, in consequence of the innumerable dead locusts which floated on its surface, apparently drowned in their attempts to reach the reeds which grew along its shores. Except these much wished-for reeds, they had devoured every other green thing. Their destruction on a former occasion was sudden and singular. All the full-grown insects were driven into the sea by a tempestuous wind, and were afterwards cast upon the beach, where they formed a bank three or four feet high, and extending nearly fifty English miles. The smell, as may be easily supposed, was most abominable, and was sensibly felt at the distance of 150 miles. In regard to the Indian locusts, a correspondent of Messrs Kirby and Spence informed these authors, that he was an eye-witness to an immense army of locusts which ravaged the Mahratta country, and was supposed to come all the way from Arabia. This column extended five hundred miles, and was so compact when its members were upon the wing, as to darken the sun like an eclipse, so that no shadow was cast upon the ground, and some lofty tombs, distant not more than two hundred yards from the observer, were rendered invisible. These were not the *Gryllus migratorius* of Linnæus (*A. migratorium*, Plate CCXXVIII. fig. 13), but a red species, the peculiar colour of which is said to have added additional horror to the scene;—for after having stript the trees of their foliage, they congregated around the bare and desolate branches, producing a hue like blood. When they moved again, “the sound of their wings was as the sound of chariots, and of many horses running to battle.”

The migratory flight of these insects, their desolating effects upon vegetation, and consequent injury both to man and beast, have afforded a frequent subject of exercise to the pen of the poet; but by none has their injurious inroads been so magnificently portrayed as by the prophet Joel. “A day of darkness and of gloominess, a day of clouds and of thick darkness, as the morning spread upon the mountains; a great people and a strong: there hath not been ever the like, neither shall be any more after it, even to the years of many generations. A fire devoureth before them, and behind them a flame burneth: the land is as the garden of Eden before them, and behind them a desolate wilderness; yea, and nothing shall escape them. The appearance of them is as the appearance of horses; and as horsemen so shall they run. Like the noise of chariots on the tops of mountains shall they leap, like the noise of a flame of fire that devoureth the stubble, as a strong people set in battle array.” “The earth shall quake before them; the heavens shall tremble: the sun and the moon shall be dark, and the stars shall withdraw their shining.” “How do the beasts groan! the herds of cattle are perplexed because they have no pasture; yea, the flocks of sheep are made desolate.”

Dr Southey, “the laurel-honouring laureate,” as he is well called by his friend and fellow poet S. T. Coleridge, has also, in his “wild and wondrous lay” of Thalaba, sketched the progress of these destroyers.

Onward they came, a dark continuous cloud
Of congregated myriads numberless,
The rushing of whose wings was as the sound
Of a broad river headlong in its course
Plunged from a mountain summit, or the roar
Of a wild ocean in the autumn storm,
Shattering its billows on a shore of rocks.

The scene of the above quotation is Arabia, where these insects are very formidable, and of different kinds. Forskal thinks that the species which chiefly infests that tented region, and which he names *Gryllus gregarius*, is distinct from the *Gryllus migratorius* of Linnæus. They come invariably from the east, which induces the Arabs to believe that they are produced by the waters of the Persian Gulf. Nejed is particularly exposed to their ravages; and no sooner have they destroyed the harvests,

Orthoptera.

than they penetrate by thousands into the dwelling-houses, devouring whatever they can find, even to the leather of the water vessels. They appear in the air at a distance like clouds of smoke; and their near approach, accompanied as by a sound of falling water, stuns the inhabitants with astonishment and dread. They alight upon a field, and its verdure disappears,—the lofty palms are stript of their long shadow-casting leaves,—and pulse and all other succulent crops are voraciously devoured. Grain, however, if ripe, usually escapes, in consequence of its hardness and aridity. The Bedouins of Sinai are frequently driven to despair by the multitudes of these flying vermin, which remain for a period of a month or six weeks before they finally disappear. The time of their arrival is towards the end of the month of May, when the Pleiades are setting,—a coincidence which leads the natives to imagine that locusts entertain a dread of that beautiful constellation. Although a few are visible every year, the great flights are inflicted only every fourth or fifth season. Most of the Arabs, except those of Sinai, are in the habit of eating these insects. “In almost every town there are shops where they are sold by measure. In preparing them, the cook throws them alive into boiling water with which a good deal of salt has been mixed. After a few minutes they are taken out and dried in the sun; the head, feet, and wings are then torn off; the bodies are cleansed from the salt, and perfectly dried, after which they are put up into sacks or bags. Sometimes they are broiled in butter, and spread on the unleavened bread used at breakfast. The Jewish Arabs believe that the food of which the Israelites ate so abundantly in the desert was showers of locusts.”¹ They are also used as food in several African countries, and are even exported as articles of commerce. The elytra and wings are first cut off, and then the bodies are preserved in brine. M. Miot, in his translation of Herodotus, has observed that the numerous carcasses of *winged serpents* said to have been noticed in Egypt by the early Greek historian, were in all probability masses of the dead bodies of some large species of locust. Latreille coincides in this opinion.²

The most noted species is that already mentioned under the name of *Acrydium migratorium* (*Gryllus migratorius*, Linn.), Plate CCXXVIII. fig. 13. It measures above two inches and a half in length. Its usual colour is green, obscurely spotted, the elytra pale brown, marked with black. The mandibles are likewise black, and the thorax is marked by a slightly elevated crest. This species is common in Poland, but occasionally extends its ravages into other European countries. It was very destructive in Provence so lately as the year 1819. It is well known in the Levant, in Barbary, and Egypt. These countries produce another species, likewise found in the south of France, the *A. lineola*, Lat. It is of a reddish-brown colour. The crest of the thorax is intersected by three impressed transverse lines; there is a conical pectoral point between the anterior legs, almost as long as the haunches; and the posterior legs are furnished with reddish spines, black at their extremity. This species is eaten in Barbary. Another kind, native to Senegal and other parts of Africa, of a yellow colour, spotted with black (it is figured by both Shaw and Denon, in their Travels), is ground when dry into powder, and used as flour. Many large exotic species are characterized by the superior portion of the thorax being

greatly elevated, much compressed, and forming a sharp crest, rounded and prolonged backwards to a point. Of this kind, though of smaller dimensions, is the *A. armatum*, found in the south of Europe, and figured by Fischer.³ Others have the elytra and wings so abbreviated, at least in one of the sexes, as to be incapable of flight. These form the generic group named *PODISMA* by Latreille. Such as exhibit a swelling or button-like expansion at the tips of the antennæ form the genus *GOMPHOCERUS* of Thunberg;—for example, the *A. sibiricum* (figured by Panzer, *Fauna Insect. Germ.* xxiii. 20), which occurs alike among the desert steppes of Siberia and the mountain passes of St Gothard.

* *

In this second section of the *ACRYDIUM* of Geoffroy, a part of the under portion of the head is received into a cavity of the præsternum. The ligula is quadrifid, and the tarsi are unprovided with a cushion between the claws. The articulations of the antennæ do not exceed from thirteen to fourteen. The thorax is prolonged backwards in the form of a large scutellum, sometimes exceeding the body in length. The elytra are extremely small. Such are the characters of the genus *TETRIX* of Latreille (Plate CCXXVIII. fig. 15), which is composed of a considerable number of small species. A good light has been thrown on their characters and classification by MM. Lepelletier and Serville, in the *Encyclopedie Méthodique*, article *Tetrix*, as well as in the more recent works of Mr Zetterstedt.⁴ The genus contains the little chirping insects so frequent in this country on dry and sunny banks, and known under the familiar name of *Grasshoppers*.

ORDER III.—HEMIPTERA.⁵

The insects of this order have neither mandibles nor maxillæ properly so called. Their mouth is fitted for suction, and is composed of a tubular articulated rostrum, cylindrical or conical, curved inferiorly, or directing itself along the breast, and, when extended, presenting the appearance along its upper surface of an elongated groove or canal, in which are lodged three delicate pointed bristles, covered at their base by a ligula. These bristles form by their union a needle-like sucker, of which the tubular piece just mentioned forms the sheath, in which they are retained by means of the ligula or triangular basal portion. The inferior bristle is in fact composed of two, which unite together not far from their origin, so that the sucker itself consists of four pieces. Savigny is of opinion that the two superior bristles are analogous to the mandibles, and that the inferior represent the maxillæ⁶ of the masticating orders. According to this view, which the author has illustrated with admirable assiduity and skill, the mouth of hemipterous insects is as usual composed of six principal portions, the so-called ligula representing the labrum, and the articulated sheath the labium, of the other orders.⁷ According to Latreille, the languette properly so called also exists, and under a form analogous to that of the supposed labrum, but bifid at the extremity. The palpi, however, have entirely disappeared, with the exception of some slight vestiges of those parts observable in the genus *Thrips*. These representative relations between the parts of the mouth in the mandibulated and haustellated orders had in fact been sus-

¹ *Edinburgh Cabinet Library*, vol. xiv. (Arabia, vol. ii.) p. 460.

² *Règne Animal*, v. 187.

³ *Orthoptera Suecicæ*, 1 vol. 8vo, Lund. 1821, and *Fauna Lapponica*, 1 vol. 8vo, Hamm. 1828.

⁴ *RYNGOTA*, Fab.

⁵ See Plate CCXX. figs. 4 and 6, and the detailed explanation of the same at page 69 (note 1) of this article.

⁶ *Entom. de la Russ.* i. Orthopt. i. 1.

⁷ *Mém. sur les Animaux sans Verteb.* i. part i.

Hemiptera. pected by Latreille previous to their laborious demonstration by the ingenious Savigny.¹

The elytra of a great portion of the hemipterous order are of a coriaceous texture throughout their principal extent, with their terminations membranous. They thus partake of the nature of both elytra and wings, and the order, as formerly mentioned, derives its name from that peculiarity. Among the Cicadæ and the Aphides, however, all the four wings are membranous, and frequently quite clear and transparent. In *Tettigonia*, *Membracis*, *Flatta*, &c. they are of a denser consistence; while in *Aleyrodes* they are farinaceous, and of a milky translucence. Certain kinds are apterous, as the bed-bug, some species of *Lygæus*, and the females of the cochineal insect,—but these anomalies do not remove them from the hemipterous order, to which the structure of the mouth shows them to belong.

The composition of the thorax in these insects begins to experience some modifications, which exhibit their relation to the ensuing orders. The first segment, or prothorax, in certain cases resembles in extent that of the Coleoptera; but in others it is much more minute, and becomes incorporated with the second segment, which is then manifest or exposed. The scutellum is sometimes extremely small, or altogether imperceptible; while in certain genera, such as *Scutellera* and *Membracis*, it is greatly dilated, and covers the entire upper surface of the body, concealing the elytra and wings.

The sucker, regarded as a sting, and so named by the ancient naturalists, is adapted only for the extraction of animal or vegetable matter in a fluid state. The delicate parts of which it is composed penetrate various organic substances, the nutritive juices of which are forced to flow into the interior canal by successive compressions, till they reach the œsophagus.

The antennæ of the hemipterous tribes are frequently very small, and of difficult detection. In *Psylla*, *Cimex*, *Thrips*, and others, they are very obvious; in *Cicada* they are short, simple, setaceous threads; in *Fulgora* they are still shorter and subulated; while in *Nepa*, *Ranatra*, &c. they are placed beneath the eyes, and so abbreviated as to be rendered visible only by reversing the insect.

The eyes are rather large, and between them, on the upper part of the head, in many species, there are two or three of the stemmatic kind, or ocelli, called *yeux lisses* by the French entomologists.

The nature and amount of the tarsal articulations differ according to the genera or tribes; but the greater number of hemipterous insects are characterized by three divisions of the tarsi. In some the anterior tarsi are composed of only a single piece, which is bent upon the leg in the form of a pincer; while in the aquatic genera, such as *Naucoris* and *Notonecta*, the posterior legs are oar-shaped, with the tarsi composed of two articulations.

All hemipterous insects pass as usual through three stages of mutation. But their metamorphosis is not in any case complete, and their changes consist rather in the development of the organs of flight, and the increased bulk of the body, than in any very decided or obvious transformation. Their anatomical structure exhibits a stomach with a rather solid and muscular coat, a small intestine of medium length, succeeded by a large intestine, divided into various swellings, and of a small number of biliary vessels, inserted at some distance from the py-

lorus.² The habits of the order are extremely various, as we shall show when we come to treat of the genera more in detail. Hemiptera Heteroptera.

HETEROPTERA.³

Sucker originating from the front of the head. Elytra membranaceous at their extremity. First segment of the thorax much larger than the others. Wings horizontal or slightly inclined.

FAMILY I.—GEOCORISÆ.⁴

Antennæ exposed, longer than the head, and inserted between the eyes near their internal margin. The tarsi are composed of three articulations, of which the first is sometimes extremely short. These insects form the great genus *CIMEX* of Linnæus, which has now undergone many modifications. They are principally *terrestrial* insects, although some dwell upon the *surface* of waters. From several of the species a disagreeable odour emanates.

GENUS SCUTELLERA,⁵ Lam. Sheath of the sucker of four distinct articulations. Labrum prolonged beyond the head, awl-shaped, and striated above. Tarsi with three articulations, the first as long or longer than the third. Antennæ filiform, of five articulations. Body usually short, oval, or rounded. Scutellum covering the abdomen. (Plate CCXXIX. fig. 1.)

The insects of this genus, formed by Lamarck from *Pentatoma* of Olivier, live on plants, of which they absorb the juices by inserting their suckers in the leaves or tender twigs. They occur in many countries, but are larger and more brilliant in equatorial than temperate regions. The *S. nobilis* of Latr. is of an elongated oval form, and of a metallic or golden blue colour, spotted with black. It is found in Asia. The *S. stokerus* is oval, green, spotted with black, and has a red abdomen. It occurs in the Antilles. Of the European species we shall mention only the *S. lineata* (*Cimex lineatus*, Linn.), which is about four lines in length, red, radiated above with black lines, and marked beneath with black spots linearly disposed. It is common in Central and Southern Europe on umbelliferous flowers.⁶

GENUS PENTATOMA,⁷ Oliv: Elytra exposed. Scutellum covering only a portion of the body. Other characters as in the preceding genus.

The species of this genus, known as *wood-bugs*, and under other names, are extremely numerous. They occur in every region of the world, and under various temperatures. The species proper to the warmer countries of Africa, America, and the East Indies, attain to a considerable size, and are adorned by brilliant colours. The larvæ of these insects do not greatly differ from the perfect state, except in having neither wings nor elytra. The nymphæ possess these organs in a rudimentary state, inclosed in sheaths. Their changes of condition are accompanied by a general casting of the skin. In their various states they exist on vegetable juices, which they seem as it were to pump up by means of their suckers. Some species, however, have been seen to attack insects, even those of their own kind, and suck their softer parts. Almost all of them exhale a disagreeable and penetrating odour,

¹ *Hist. Nat. des Crust. et des Insect.* t. ii. p. 140–143.

² From *ἰσιγοίος*, of a different kind or nature, and *πτερά*, wings.

³ From *γῆ*, the earth, and *κορίς*, bug.

⁴ Consult, for the other species, Fabricius, *Systema Ryngotorum*, genus *Tetyra*.

⁵ *Règne Animal*, v. 192.

⁶ From *scutellum*, a shield.

⁷ From *πεντα*, five, and *τομα*, division.

Hemiptera which adheres to whatever substance the insect touches. Heterop-
tera. The eggs are deposited on the stalks of plants, regularly disposed, and made to adhere by means of a remarkably tenacious liquid. They are not unfrequently adorned by extremely agreeable colours.

A pleasant and curious narrative is given by Degeer, relating to the female of a species of this genus, the *Cimex griseus* of Linn. He found on a birch tree several of these females, each followed by a little troop of thirty or forty young ones, which accompanied their mother as chickens do a hen. The parents seemed to watch over them with the greatest solicitude. This is a singular fact in the history of insects, which for the most part are not personally regardful of the welfare of their offspring, although they seldom fail instinctively to deposit their eggs in situations the best adapted for the sustenance and preservation of the future larvæ. Several of the generic groups proposed by Fabricius, as derivable from the genus *Pentatoma* of Olivier, are not adopted by Latreille; while, on the other hand, several genera proposed by more recent writers have been adopted.¹

GENUS TESSERATOMA, Pel. et Serv. Antennæ with four articulations. Body very flat, membranous, with the margins much dilated, notched, and angular. Thorax prolonged posteriorly in the form of a truncated lobe. This genus was formed upon the *Edessa papillosa* and *ame-thystina* of Fabricius. The species are chiefly from India and the Eastern Islands (Plate CCXXIX. fig. 2). Certain species from Brazil, and we believe other countries, likewise very flat, with the margins notched and dilated, with the anterior extremity of the body forming a clypeus truncated in front, and cloven at the sides, form the genus *PHLÆA* of the *Encyc. Méth.* (Plate CCXXIX. fig. 3).

GENUS COREUS,² Fab. Antennæ with four articulations, filiform, or larger at the extremity, the last being usually shorter than the preceding. Body oval. Sheath, labrum, and tarsi similar to those parts in the genus *Pentatoma*, which they resemble in their habits of life.

The species of this genus have the head in general of a trigonal form, and sunk, without apparent neck, into the prothorax, which is narrow anteriorly, and broader behind. The eyes are small, but prominent. The scutellum is triangular and obvious. The elytra equal the length of the abdomen, which is depressed, with elevated edges. The legs are long and slender. These creatures are said by some authors to feed on other insects, as well as on the juices of plants. The *C. marginatus* is of an obscure brown, with two small advanced points between the antennæ. The latter have their second and third articulations fulvous. It exhales a strong smell of apples. Wolff, *Icon. Cimic.* fascic. i. p. 20, t. 3, fig. 20. The *C. hystrix* is an insect of a very bizarre appearance, found in France and elsewhere. Sparmann collected a species not very dissimilar at the Cape of Good Hope,—of a grey colour tinted in parts with reddish brown; spiny, membranous, the edges of the thorax relieved in roundish lobes. The abdomen likewise margined by numerous brown-coloured lobes. The second and third joints of the antennæ are spiny at the extremity. It was named *C. paradoxus* by Fabricius (Plate CCXXIX. fig. 4). Between the principal genus *Coreus*, Fab. and that named *Lygæus* by the same author, as now restricted, several intermediate ones occur in the system of Latreille.³ Of these, however, we shall mention merely the genus *Neides* (Plate CCXXIX. fig. 5), distinguished by its greatly elongated and almost linear form of body, and slender limbs and antennæ.

GENUS LYGÆUS, Fab. Antennæ terminated by an elongated article, almost cylindrical, and of the same thickness as the preceding joint. The stemmatic approach the true eyes, and the membranous appendages of the elytra frequently offer only four or five nervures. Hemiptera Heterop-
tera.

The *L. equestris* (Plate CCXXIX. fig. 6) is red, spotted with black. The thorax is black before and behind, and there are two points of the same colour on the scutellum. The elytra are traversed by a black band, and there are two small spots and a point of white upon their membranous portion. It measures about five lines in length. The abdomen has four ranges of points. The *C. apterus* (Stoll, *Cimic.* ii. xv. 103) is rather less, red, and without wings. The head, a spot on the centre of the thorax, and a large point on each elytron, are black. The extremities of the elytra are truncated, or without membranous appendages. It sometimes occurs winged. The species with the large anterior thighs have been formed into a separate genus by MM. Lepelletier and Serville. Those with angulated antennæ form the genus *NEIDES* of Latr. already mentioned, and the genus *ALYDUS* of Fab. includes such as have filiform antennæ without dilatation, and the body narrow and elongated.⁴

All the preceding genera of the Linnæan CIMICES agree in having four articulations to the sheath of the sucker, and a prolonged and striated labrum; but those which follow have only two or three apparent articulations to the sheath, and the labrum is short and without striæ. The first joint of the tarsi, and frequently the second also, are very short in the greater number.

a.

Feet inserted in the middle of the chest, and terminated by two distinct hooks, which take their origin from the central extremity of the tarsus. They are not adapted for rowing, or running on the surface of the water.

*

Rostrum straight, more or less inclosed in a sheath. Eyes of ordinary dimensions. Union of the head and thorax not characterized by a narrow neck, or sudden restriction. The body is usually membranous in whole or in part, and is generally extremely flat. This group of genera composes the major part of the primitive genus *ACANTHIA* of Fabricius, which the author himself afterwards dismembered.

GENUS SYRTIS, Fab. Anterior feet formed of a monodactyle claw like that of the Crustacea, and serving them in like manner to seize their prey. Antennæ terminated by an oval mass or enlarged articulation, and lodged in a groove of the head and thorax.

The species of this genus feed on flies and other insects, which they seize with their fore legs, after the manner of the *Mantides*. They live in woods. The *S. crassipes* (Wolf, *Icon. Cimic.* tab. 9, fig. 82) measures about three lines and a half in length. The head and thorax are brownish red; the abdomen of a deeper hue as far as the centre,—the sides and towards the base being paler. The antennæ, under parts of the body, and feet, are reddish yellow. This is a European species. Most of the others occur in South America.

GENUS TINGIS, Fab. Body extremely flat. Antennæ with the third articulation much longer than the others, and terminated by a button.

These insects live on plants, of which they pierce the leaves and flowers, not unfrequently producing great injury to their vegetation. The species found on the pear-tree, and known to the continental horticulturists under

¹ See *Règne Animal*, t. v. p. 193-4.

² See *Règne Animal*; *Encyc. Méthod.* t. x.; and the *Systema Ryngotorum* of Fab.

³ *Ibid.* and *Genera Crustac. et Insect.* iii. p. 126.

⁴ From *xyris*, bug.

Hemiptera the name of *tiger*, is extremely destructive. It is the *T. pyri* of Lat. and is distinguished by a white reticulated thorax, the edges raised, and inflated in the centre. The scutellum is foliaceous. The elytra are white, with two black bands. The larva of *T. clavicornis* inhabits the flowers of *Teucrium Chamædrys*, and, by piercing the petals, causes them to thicken,—thus preventing their healthy development. The puncturings of the perfect insects of this genus sometimes produce a kind of gallnut.

GENUS ARADUS, Fab. Body formed like that of Tingis; but the antennæ are cylindrical, with the second articulation almost as long or even longer than the third.

These insects occur chiefly on the trunks and beneath the bark of trees, where they congregate during the winter. They show themselves more actively in spring. The *A. corticalis* of Wolff (*Cimic. fasc. iii. t. ix. fig. 81*) serves as a type of the genus.

GENUS CIMEX, Lat. Resembles the preceding genera in the form of the body; but the antennæ are almost setaceous, composed of four articulations, of which the first is shorter than the others, the second thick and long, the third also lengthened and more slender than the others, the last scarcely increasing in thickness at the extremity. Elytra extremely small. No true wings.

Of this genus the *C. lectularius* or bed-bug (Plate CCXXIX. fig. 7) is probably too well known in many quarters to require particular description. It deposits its eggs in the month of May. The larvæ differ from the perfect insects in wanting the elytra. This species, though mentioned by Dioscorides, is said to be not an original inhabitant of Europe. It is also believed to have been unknown in London prior to the great fire in 1666, after which calamity it was transported thither in timber from America. It is said sometimes to acquire wings, and infest young pigeons, swallows, and other birds. Latreille however is of opinion that the kind attached to the last-named birds is of a distinct species from that which troubles the lords of the creation. The best means of extirpating bugs are care and cleanliness.

* *

Rostrum exposed, arched, sometimes straight, but with the labrum projecting. The head suddenly restricted behind, so as to form a neck-like portion.

Eyes not remarkably large. Neck apparent.

GENUS REDUVIUS, Fab. Rostrum short, but sharp and piercing. Thorax distinctly lobed. Elytra at least as long as the abdomen. Tarsi triarticulated. Antennæ with four articulations, setaceous, and extremely slender at the extremities.¹

The species which form this genus are predaceous, and greedily attack other insects, sucking out their juices with their sharp-pointed beaks. The *R. personatus* is about eight lines in length, and of a blackish-brown colour, without spots. It is common in France. This species, which inhabits the interior of houses, covers itself with ordure, or the sweepings of apartments, and, thus disguised, lies in wait in some obscure corner for its prey. No sooner does a fly or other feeble insect approach within a calculated distance, than it suddenly darts upon it, and sucks it to death. Sometimes it may be seen approaching its victim by slow and cautious steps, till the fly, thrown off its guard by this insidious show of peace, is instantaneously captured by one deadly spring. Its bite is so severe as to produce the immediate death of its captive; and indeed we are informed that our venerated friend Latreille

Hemiptera Heteroptera. having been bitten on the shoulder by a Reduvius, experienced a great swelling of the entire arm, and suffered severe pain for several hours. It is chiefly in the larva and nympha states that these insects disguise themselves in the manner just mentioned. Entomologists are acquainted with a great many species of this genus, few of which, however, are native to Europe. The rest are spread over Asia, Africa, and America.

We shall here briefly notice a few of the genera which in recent times have been formed by dismemberment of the genus Reduvius as originally constituted by Fabricius. In the genus HELOPTILUS of Lepel. et Serv. the antennæ have only three articulations, of which the last two are garnished with long hairs, disposed in two rows, and verticillated on the terminal joint. In the genus PETALOCHEIRUS of Palisot de Beauvois,² the two anterior legs are singularly expanded into oval plates or shield-like dilatations. These insects are of African origin. The *P. rubiginosus* is blackish-brown, with the antennæ and feet of a rust colour. The thorax is spiny on either side, and surrounded by a line of yellow. The scutellum is surmounted by a straight spine. The only other species with which we are acquainted is the *P. variegatus* of the author last named. In the genus ZELUS the form of the body is linear, and the legs very long, slender, and similar to each other. The genus PLOIARIA is characterized by the same linear body, and the like length and tenuity of limb; but the two anterior legs have the haunch elongated, and formed, as in Mantis, for the seizure of their prey.

† †

Eyes remarkably large. No apparent neck.

The insects of this subdivision run swiftly along the margin of waters, making occasionally little leaps.

GENUS LEPTOPUS, Lat. Rostrum short, arched, and spiny beneath. Antennæ setaceous. Anterior thighs large and spiny.

This genus was established by Latreille upon *L. littoralis*, a small insect about two lines in length, of an obscure ash colour, with some spots upon the elytra, and the margins of these parts whitish. Their membranous appendages are pale, with obscure nervures. The feet are pale yellow. This species was discovered in Spain by Leon Dufour; and another nearly allied to it, *L. lapidicola*, has been taken by Basoches in the department of Calvados.

GENUS ACANTHIA, Lat. Rostrum long, straight, with the labrum projecting beyond the sheath. Antennæ filiform, or slightly enlarged towards the extremity. Form of the body oval.

This genus is composed of insects belonging to the genus *Salda* of Fabricius, such as *S. striata*, *zosteræ*, *littoralis*, &c. We may regard as its type the *Lygæus saltatorius* of Fab., a species which dwells by the banks of rivers, and runs and leaps with agility. Certain species, of which the antennæ are much shorter than usual, and bent over the eyes, the body shorter and more rounded, with the scutellum rather large, form the genus PELOGONUS of Latreille. These Hemiptera approach those of the genus *Naucoris* in their nature, and seem to conduct towards them in common with the following.

b.

Four posterior feet slender and long, inserted on the sides of the chest, and distant from each other at their points of articulation. The hooks of the tarsi are very small, indistinct, and placed in a fissure of the lateral ex-

¹ The first joint is often united to the second, and that to the third, by means of a very small article or rotule. (*Règne Animal*, v. 202.)

² *Insectes recueilli. en Afr. et en Amer. fasc. i.*

Hemiptera tremity of the tarsus. The feet are adapted for rowing or walking on the water. These characters are proper to the genus *Hydrometra* of Fabricius, which Latreille has divided into three, as follows.

GENUS HYDROMETRA,¹ Lat. Antennæ setaceous. Head prolonged into a muzzle, and receiving the rostrum, of which the articulations are by no means obvious, in an inferior groove.

These insects dwell in moist places, and run upon the surface of waters. (Plate CCXXIX. fig. 8.) Their bodies are narrow, thin, linear. Their eyes are large and globular, and are placed towards the centre of the lateral parts of the muzzle, or rather muzzle-shaped head. The best known species is *H. stagnorum*, which measures about five lines in length. It is of a black or blackish-brown colour, with the feet of a redder hue. The elytra are very short, with two nervures on each. This species is common throughout Europe. The *H. fossarum* of Fab. is a native of the East Indies. We are inclined to regard it as belonging to the next genus.

GENUS GERRIS, Lat. Antennæ filiform. Rostrum with three articulations. Anterior feet serving the office of pincers. Second pair distant from the anterior, and as long again as the body. (Plate CCXXIX. fig. 9.)

These insects have elongated bodies, are usually of a blackish colour, and are met with on the surface of still waters, on which they advance as it were by starts. Their under surface seems covered by a peculiar coating, of a black or silvery hue, according to the position in which the insect is held, and which probably protects it from the influence of the subjacent liquid. They appear rather to row than to walk upon the surface. The species are insectivorous, and prey upon such of their own class as they can master, and especially upon any land species that have fallen accidentally into the water, and are naturally inactive in that element. These they immediately seize upon with their anterior feet. The *G. lacustris*, Lat. (*Hydrometra lacustris*, Fab.), figured on the plate above referred to, is of a blackish-brown colour, greenish above. The feet are brown. The body is terminated by a projection. This species presents some peculiarities worthy of notice. There are two varieties of it, one of which is winged, the other apterous. The former of these constitute the *punaies aquatiques très-allongées ailées* of Degeer, the latter correspond to the *punaies aquatiques très-allongées non ailées* of that author.² Such as make their appearance in spring, and which have without doubt passed the winter beneath the ice, or under cover of the frozen banks, are all apterous, but resemble perfect insects in every other part of their structure. Sexual intercourse takes place among them. It was this latter circumstance which induced Geoffroy to believe that they offered a remarkable exception to a general rule, and that fecundation took place in the state of nymph or larva. Degeer, in combating this opinion, maintained that these apterous insects were of a distinct kind, and perfect in their way. M. Audouin, on the other hand, is of opinion that they may be regarded as individuals of the ordinary kind, proceeding from larvæ of the preceding year, of which the development has been checked by the rigours of the winter season, and the consequent condition of torpidity. He conceives that the wings are not, in these aquatic insects, organs of the first importance, and that the influence of surrounding causes is on that account the more likely to prove effectual, and that thus they remain rudimentary, when the other parts of the

body, and the generative system in particular, have attained the maximum of their development. He illustrates this point by reference to the genera *Lampyrus* and *Drilus*, in which (in the females) the organs of flight of the perfect insects are scarcely if at all more developed than in the larva state, while all the interior parts of structure are fully and functionally completed. The apterous individuals, then, of *G. lacustris*, which are observed to fulfil the offices of the perfect insect, are larvæ only so far as regards the undeveloped condition of the wings.³

General Hardwicke has described a new species of this genus from Nepal, under the name of *G. laticaudata*. The extremity of the abdomen is remarkable for certain processes like teeth or claws.⁴

GENUS VELIA. Antennæ filiform, as in Gerris; but the rostrum has only two apparent articulations, the legs are much shorter than in that genus, and are inserted at nearly equal distances from each other.

Like the preceding species, these insects live on the surface of water. Their motion, however, is more like running than swimming. The *V. currens* is blackish-brown, with the superior edges of the abdomen fulvous, spotted with black. The *V. rivulorum* is black spotted with white, the abdomen fulvous.

FAMILY II.—HYDROCORISÆ.⁵

Antennæ inserted and concealed beneath the eyes, shorter than the head, or not exceeding it in length. Tarsi composed of only two articulations. Eyes for the most part remarkably large. These Hemiptera are aquatic and carnivorous. They prick severely with their rostrum, and seize upon other insects with their anterior feet, the joints of which are bent upon themselves, so as to form a kind of pincer. Their heads appear as if sunk into or intimately united to the thorax. The rostrum is short. Their metamorphoses do not differ from those of the other Hemiptera.

TRIBE 1ST, NEPIDES.

We here place the species of the unrestricted genus *Nepa* of Linnæus, commonly called *water scorpions*. They have the anterior legs in the form of hooks or nippers,—composed of a thigh, sometimes large, sometimes elongated, with a groove on its under surface for the reception of the tibia, and of an extremely short tarsus, which forms as it were a hook or crotchet with the tibia. The form of the body in some is oval and much depressed, in others it is more linear. Latreille divides this tribe into the following genera.

GENUS GALGULUS, Lat. All the tarsi similar to each other, cylindrical, with two distinct articulations, of which the terminal is provided with two hooks. The antennæ do not appear to have more than three articulations, of which the last is the largest, and of an ovoid form.

The only species of this genus with which we are acquainted, *G. oculatus*, Lat. (*Hist. Nat. des Crust. et des Insect.* xii. 286, pl. 95, fig. 9) was placed by Fabricius in the genus *Naucoris*. It is of a dull ashy brown, with some paler spots upon the elytra. The thorax is unequal. The legs are pale brown, with deeper spots. This odd-looking insect was brought by Bosc from Carolina. Its body is short and rough. The head has little length, but is pro-

¹ From ὕδωρ, water, and μέτρον, measure.

² *Mem. sur les Insectes*, iii. 311.

³ *Diction. Class. d'Hist. Nat.* vii. 337.

⁴ *Linn. Trans.* xiv. 134, pl. 6.

⁵ From ὕδωρ, water, and κοῖς, bug.

Hemiptera
eterop-
tera. }
longed laterally into two angles which support the eyes. The prothorax is lobed posteriorly, and placed before a triangular scutellum, on each side of which are inserted the short and coriaceous elytra. The thighs of the anterior legs are swollen and dentated beneath, and the tibiæ and tarsi are applied close to them when the insect is in a state of repose. We are not aware that any thing is known of the habits of this insect, further than that it is aquatic.

GENUS NAUCORIS,¹ Geoff. Labrum exposed, large, triangular, and covering the base of the rostrum. Antennæ simple, and consisting of four articulations. Tarsi of the anterior feet terminating in a simple point or crotchet. The middle and hinder pair of legs ciliated,—their tarsi with two articulations, terminated by a pair of hooks.

Of this genus the body is usually depressed, almost ovoid, with the head rounded anteriorly, and the eyes lengthened and depressed. The abdomen is dentated around its edges. The species are extremely active, and swim with great ease and swiftness, making use of their hinder legs as oars. They sometimes quit one pool of water for another, and they then make good use of their wings. They are extremely voracious, and destroy a great number of other insects. The larvæ and nymphs inhabit the same situations as the perfect insects, and differ from them chiefly in the absence of wings. The nymphs indeed exhibit the rudiments of these organs enclosed in a kind of case, from which they expand at the period of the completed metamorphosis. The *N. cimicoides* (*Nepa cimicoides*, Lin.) measures about six lines in length. It is of a greenish-brown, with the head and thorax paler and spotted. The eyes are blackish. The margins of the abdomen are strongly dentated. It is common throughout the fresh waters of Europe.

GENUS BELOSTOMA, Lat. Labrum sheathed. Antennæ semi-pectinated. All the tarsi with two articulations. Abdomen terminated by a pair of setæ.

The *B. grandis* (*Nepa grandis*, Fab.) may be regarded as the type of this genus. It is a very large insect, measuring nearly three inches in length. It is of a greyish colour, spotted with brown. The legs are likewise spotted. The thorax is smooth. It is common in collections of foreign insects.

GENUS NEPA.² Labrum and setæ as in the preceding genus. Rostrum curved beneath. Anterior tarsi with only one articulation,—the middle and posterior pair with two. Antennæ appearing forked. Haunches of the anterior legs short, and the thighs much broader than the other parts.

The body in this genus is almost elliptical, and narrower and more elongated than in the preceding genera. The head is small, and partly lodged in a notch of the thorax. The setæ, which terminate the abdomen, serve, according to some authors, for the purposes of respiration in the moist and muddy places in which they dwell. The Nepæ, in their various states, inhabit the quiet waters of ponds, lakes, and marshes. They swim more leisurely than many of their congeners, and often proceed along the surface of the mud below, in search of the minute insects of which they make their prey, and which they seize with their anterior feet. Their eggs are of an oval form, and, when examined with a microscope, are seen to be crowned by an aigrette of seven small threads. Swammerdam anatomized these insects, and has given us some curious details regarding the arrangement of the

eggs in the ovaries. They are so disposed that the crown-like threads of the one which is next the orifice embraces the one which follows, and so on consecutively. The generative system of the male is singular, and very complicated. The larvæ leave the eggs in midsummer. They differ from the perfect insects chiefly in wanting the wings and setæ. The nymphs acquire, as usual, rudimentary wings inclosed in sheaths, and placed on each side of the body. The perfect insect frequently quits its subaqueous abode during the dewy night, and flies about with great agility. The genus is by no means numerous in species, although these seem pretty extensively distributed over the waters of the earth.

The *N. cinerea*, Lin. (Plate CCXXIX. fig. 10), is nearly an inch in length, of an ash colour, the upper part of the abdomen red, the tail shorter than the body. We owe to M. Leon Dufour some curious and excellent observations on the anatomy of this species, and on that of *Ranatra linearis*.³ These insects present a peculiar organ, which the French observer regards as a kind of pectoral trachea, communicating with those of the ordinary kind. It forms in *R. linearis* a pair of elegant *panaches*, or feather-like bunches, of a pearly whiteness, composed of numerous little branches, and situated in the centre of the muscular mass of the breast. In *N. cinerea* the pectoral tracheæ appear to offer the vestiges of a pulmonary organ. They consist of two oblong bodies, placed immediately below the region of the scutellum, clothed by a fine membrane, smooth, and white as satin. They are almost as long as the chest, free except at their extremities, and are filled with a substance like tow, which, when examined under the microscope, presents a homogeneous tissue, formed by vascular arbusculæ. The nervous system appears to consist of two large ganglions, the one placed beneath the œsophagus, the other in the chest betwixt the first and second pair of feet, and throwing out two remarkable cords, divided into two or three threads at their extremities. Only two biliary vessels have been yet observed.

GENUS RANATRA, Fab. differs from the preceding chiefly in the linear form of the body, in the rostrum being directed forwards, and in the character of the anterior legs, of which the haunch and thigh are slender and elongated.

These insects do not excel as swimmers. They frequently leave the water in the evening, and are good flyers. They are very voracious. The *R. linearis* occurs throughout Europe. It is pale cinerous, with a yellow tinge; the abdomen reddish beneath. It measures about an inch in length, and the setaceous appendages are as long as the body. The aigrette upon the eggs of this species consists of only two setæ. The genus is by no means numerous in species, but it occurs in the East Indies and America, as well as in Europe.

TRIBE 2D, NOTONECTIDES.

In this group the two anterior legs are simply curved underneath, with the thighs of the usual size, and the tarsi pointed and thickly ciliated, and resembling those of the posterior legs. Their body is ovoid or nearly cylindrical, and thickish, or less depressed than in the preceding tribe. Their posterior legs are much ciliated, and resemble oars. They are terminated by two small indistinct hooks. They swim or row with great swiftness, and frequently turn upon their backs. They correspond to

¹ From *navis*, boat, and *κοίς*, bug.

² Supposed by some to have been originally a misprint for *Hepa*, a Latin word applied to the scorpion.

³ *Annales Gen. des Sciences Physiques*, t. vii.

Hemiptera the genus *Notonecta* of Linnæus, which Latreille divides
Heterop- as follows.
tera.

GENUS CORIXA, Geoff. Rostrum very short, triangular, transversely striated. Anterior legs very short, with eiliated compressed tarsi, furnished with a single articulation. The other legs are elongated, and the middle pair are terminated by two very long hooks. Elytra horizontal. Scutellum not apparent. *Sigara* of Fab.

These insects are of an elongated form, the body somewhat flattened, the head large and vertical, the eyes triangular, the prothorax more developed transversely than in a longitudinal direction, but prolonged backwards to a point. They walk defectively, but swim and fly well. We think they never swim upon their backs, like the species of the following genus, but are usually seen as it were suspended by their extremity from the surface of the water, and prepare to dive instantly on the approach of danger. When seized they endeavour to pierce the skin of the captor with their sharp-pointed rostrum; and if they succeed in that effort, pain accompanied by swelling not unfrequently ensues. The genus is not extensive. We may here name, as the most frequent in the fresh waters of Europe, the *C. striata* (*Notonecta striata*, Linn.), which measures about five lines in length, brown, with numerous spots or little rays of a yellowish hue. The head, legs, and under parts of the body, are likewise of the latter colour.

We may here note, that Dr Leach assumes the *Not. minutissima* of Fabricius as the type of his genus *Sigara*. It resembles the preceding genus in many respects, but the body is rather ovoid than linear or cylindrical, and the thorax is provided with a scutellum.¹

GENUS NOTONECTA,² Geoff. Fab. Rostrum articulated and in the form of an elongated cone. All the tarsi with two articulations. The four anterior legs geniculate, with simple cylindrical tarsi. Elytra declined. Scutellum distinct.

The Notonectæ properly so called are characterized by the singular practice of swimming upon their backs, with their bodies somewhat inclined, their heads being elevated during their upward progress, and the contrary while they either rest suspended at the surface or descend towards the bottom of the pool. When these insects are in the act of swimming, they make use only of the middle and posterior pairs of legs, the anterior being applied closely to the chest; but when they walk at the bottom, or over the herbage of aquatic plants, in search of insect prey, they then bring the latter into active service, and merely trail the former after them, or alongside. The females deposit their eggs, which are long and white, on the stalks and foliage of water-plants. The young are produced in spring, and resemble the perfect insects, except in the want of wings. The nymphæ are equally active, and exhibit these organs in a rudimentary state. They are all, of whatever sex, age, or condition, predaceous in their disposition, and, in the absence of more ordinary food, will seize upon and cruelly devour their own species. We are acquainted with about a dozen of the genus, of which about a third inhabit Europe. The others occur in Asia, Africa, and America. The most familiarly known in this country is the *N. glauca* of Linn. (*Nepa notonecta*, Dejeer, *Mem. Insect.* iii. p. 382, No. 5, tab. 18, fig. 16, 17), figured on Plate CCXXIX. fig. 11. It is about half an inch in length, of a greenish black beneath, the front of the head of a pale green, the upper and anterior portion of the thorax whitish, the posterior half ob-

scure. The elytra are of a yellowish-grey, with a tint of brown, their sides spotted. The scutellum is black. This insect varies considerably in its external aspect. Those with brown elytra, varied with reddish, may be regarded as *N. maculata* of Lat.

The *N. minutissima* of Linn. must not be confounded with the species so called by Fabricius. The former constitutes the genus *Plea* of Dr Leach, and differs from *Notonecta* in having the third point of the antennæ larger than the others. The articulations of the anterior tarsi are also of equal length, and the hooks of the posterior legs are large. The form of the body, and texture of the elytra, likewise present some disresemblances.

HOMOPTERA, LAT.

In this second great division of the hemipterous order, the rostrum or sucker originates from the inferior part of the head, close upon the chest, or even from between the two anterior legs. The elytra (almost always inclined) are semimembranous, and of the same consistence throughout. They are sometimes scarcely distinguishable in their texture from the inferior wings. The three component segments of the thorax are united as it were *en masse*, and the first is always shorter than the one following.

The genera of this section are quite dissimilar in their habits to those with which we have been previously engaged. They feed on the juices of plants. Many of the females are provided with a scaly sheath or ovipositor (called *oviscapte* by M. Marcel de Serres). This is usually composed of three dentated blades, lodged in a bivalvular groove. They use it as a kind of saw, with which to produce notches or other excavations in various plants, for the purpose of depositing their eggs in safety.

FAMILY I.—CICADARIÆ.

The genera composing this family present three articulations in the tarsi,—the antennæ are usually very small, conical or awl-shaped, and consist of from three to six portions, including the attenuated seta by which they are terminated. We owe to MM. Ramdhor, Mareel de Serres, Leon Dufour, and Straus, many excellent observations on the internal structure of these insects. According to Dufour, the stomach, or chylific ventricle, is of remarkable length. It commences by an oblong dilatation, either curved or straight, and decreases into an intestini-form canal, which returns upon itself, and opens near the origin of the ventricle, alongside the insertion of the hepatic vessels, and not far from the origin of the intestine. They are all provided with four biliary vessels. In the Cicadæ the ventricle has what Dufour calls “la forme d’une anse,” the right portion being dilated into a large lateral, and frequently plaited pouch. Its superior extremity is united to the œsophagus by an upper ligament, and the other leads to the narrow, tubular, very long, reflexed prolongation, with the form of an intestine, which, after its circumvolutions, re-ascends to unite with the pouch near the insertion of the hepatic vessels. This truly singular disposition of the chylific ventricle, which, after several convolutions, finally discharges into itself, by the completion of a circle traversed throughout by the alimentary fluid, is doubtless a circumstance not easily explained in a physiological point of view. It is, however,

¹ On the Classification of the natural tribe of Insects Notonectides, with Descriptions of the British Species, Linn. Trans. xii. p. 10.

² From νωτος, back, and νωτος, swimmer.

³ From ἴσος, equal, or the same, and πτερον, wings,—in reference to the similar texture of the organs of flight.

Hemiptera
Homoptera.

not the less a well determined fact, and one which constitutes the most characteristic feature in the anatomy of the Cicadæ and other Cicadariæ.¹ In the *Ledra aurita* of Fabricius, the inflated portion of the chylic ventricle is placed immediately after the crop; and there is but a single cluster of salivary sacks on each side, a character likewise observable in *Cercopis spumaria*, or Frog-spittle; while in Cicada there are two on each side. In *Membracis cornuta* the *anse duodenal* of Dufour is replaced by a short pouch, likewise attached to the œsophagus by a suspensory filament, a character peculiar to these insects.

1ST, STRIDULANTES.

Antennæ composed of six articulations. Three simple eyes. This division includes the *Manniferæ* of Linnæus (*Tettigonia*, Fab.), and forms the

GENUS CICADA of Oliv. and Lat. Head transversal. Eyes large. Prothorax broad or transversal, with a straight posterior margin; the mesothorax large, with the form of an X on its posterior edge. Elytra generally vitreous. A large scaly operculum covers a cavity on each side of the base of the abdomen in the males.

These insects differ from those that follow, not only in the structure of the antennæ and the amount of the simple or stemmatic eyes, but also in their being all destitute of the faculty of leaping. The males are musical, that is, during the heat of summer, they produce, by a peculiar structure, a loud and continuous cry or stridulation, called by courtesy a song. When we examine the lateral base of the abdomen of a male Cicada, we perceive two large scaly plates of a rounded figure, approaching that of a demi-oval cut through its smaller axis; so that each plate presents a side which is rectilinear, while the remaining portion exhibits a rounded outline. It is by the straight side that each plate is fixed without articulation, on the metathorax, of which it forms a portion. When we lift up these plates we discover a cavity on each side of the abdomen, divided into two principal chambers by a horny triangular septum. When viewed from the side of the abdomen, each cell presents anteriorly a white and plaited membrane; and lower down there is another membrane, thin, light, and transparent as glass, called *le miroir* by Réaumur. Some authors have regarded this as a kind of drum or tambour, and the seat of sound; but that organ has yet to be described. If we open the mirror from above, we perceive on each side of it another plaited membrane, moved by a very powerful muscle, composed of a great number of straight parallel fibres, and arising from the horny septum. This latter membrane is the tymbal or drum, on which the muscles act by contraction and relaxation, alternately tightening and restoring it to its original state. This is the true origin of the sound, which in fact may be produced even after the death of the insect, by jerking the muscle.² We may add, that M. Chabrier has perceived a stigmatic opening, not noticed by Réaumur, at the inferior junction of the mesothorax and metathorax; while Latreille has discovered on the posterior part of each tymbal a distinct hole, which, he thinks, serves for the egress of the air. Chabrier, however, is of opinion that the air makes its escape through the two stigmata placed at the base of the opercula before mentioned.³ Further investigation will probably show that the analogues of this singular structure exist in other insects. Indeed, the principal pieces have been already recognised, though much more feebly developed, not only in the female Cicadæ, but also in certain species of the orthopter-

ous genera *Acrydium* and *Truxalis*. In the opinion of Audouin, the plates or shutters (*volets*) are merely large prolongations of the *epimera* of the metathorax.⁴

Hemiptera
Homoptera.

The Cicadæ dwell on shrubs and trees, of which they suck the juices. The females, which are provided with ovipositors, lay their eggs in holes, which they form in the small branches or twigs of trees. The parts thus attacked are easily recognised by little irregularities, formed by a portion of the wood which has been raised. These elevations are placed in a row, one after the other, upon the same side of the branch. The different holes have a diameter nearly equal. Their depth is from three to four lines. They commence in an oblique direction; but as soon as they reach the pith, they become nearly parallel with the twig itself. The ovipositor does not pierce beyond the pith; and the number of eggs placed in each hole varies from four to ten. They are white, oblong, and pointed at both ends. The larvæ are white, and furnished with six feet. They soon quit their sylvan nurseries, and make their way under ground, where they gnaw the roots of plants. Their anterior legs are short, with strong dentated thighs, and are well adapted for digging. They increase rapidly in size, and are ere long transformed into nymphs. These are of a dingy-white colour, and are chiefly remarkable for their very short and inflated fore legs, which are dentated, and serve them to penetrate the earth. After living for about a year in this state, they leave the ground during the prevalence of warm weather, and, climbing up the stems of trees, their skin first hardens, and then bursts all along the centre of the dorsal line. The perfect insect then escapes from its exuviae. It is at first very soft, and of a greenish colour; but it soon attains a firmer consistence, and various external markings make their appearance, according to the characteristic aspect of the different kinds.

These insects were well known to ancient writers, and their so-called song has been celebrated by poets from the highest antiquity. To ourselves it appeared monotonous and fatiguing, although heard not seldom among the leafy groves which shadow the fair white walls of the "Etrurian Athens." The Cicada is the insect so frequently and fondly commemorated by the Greek poets under the name of *τεττιξ*,—which our translators have generally though erroneously construed *grasshopper*. Linnæus, with his accustomed propriety, applied the term *Gryllus* to the locust and grasshopper tribes, and that of Cicada to the "beloved of the Athenians." The name of tree grasshopper, however, which is sometimes used, applies with sufficient accuracy to the latter, and indicates one of its characteristic habits, that of usually perching upon trees. The true grasshoppers are ground insects. The Cicadæ are scarcely known in Britain, although the species attached to ash-trees (*C. orni*) is recorded as an English insect, in common with *C. hæmatodes*. They abound in Italy and other southern parts of Europe. The Italians call them *Cicale* and the French *Cigales*, both words being no doubt derived from the Latin. They are frequently mentioned by the modern Italian poets; and Lord Byron somewhere alludes to the "shrill Cigala, people of the pines," thus recognising their *arboreous* disposition. Although held in the highest estimation as *children of the soil* by the Athenians, who used to wear golden images of them in their hair, there is no doubt that they were also regarded by the Greek nations under a less intellectual aspect. Aristotle mentions that they were used as food, and that they were particularly esteemed just before

¹ Règne Animal, v. 211. See also *Recherches Anatomiques sur les Cigales*, in the 5th vol. of the *Ann. des Sciences Nat.*

² Règne Animal, v. 214.

³ *Essai sur le Vol des Insectes*.

⁴ *Dict. Class. d'Hist. Nat.* iv. 125.

Hemiptera the conclusion of the nympha state. The insect which Homoptera- he mentions under the name of *Tettigometra*, or mother of the Cicadæ, is in fact merely that intermediate condition of nymph, prior to the development of the organs of flight. In that state, as well as when under the form of larva, it lives upon the ground, or even beneath it, feeding on herbage and the roots of plants; but when about to undergo its final metamorphosis, it climbs a tree, its outer garment bursts asunder and is thrown off as exuviae, the wings expand their folds "voluminous and vast," and we have then the perfect insect or tree grasshopper, the Cicada of the Latins, and Tettix of the Greeks, so beautifully addressed by Anacreon:—

We deem thee blest, thou grasshopper, as on the highest trees,
Having sipp'd a little dew, thou sitt'st, like a monarch, at thine ease;

For every thing before thee, whate'er the fields produce,
And the fruits of every season, are intended for thy use.
Thou art the friend of husbandmen, since harmless are thy ways;
By mortals held in reverence, sweet seer of summer days.
The muses love thee dearly, to Phœbus art thou dear,
Who with that voice hath gifted thee, so musical and clear.
Song-skilled, earth-born, song-loving one, old age to thee's no load;
Fleshless, bloodless, passionless, thou almost art a god.

A great variety of opinion seems to prevail regarding the musical accomplishments of these celebrated insects. Virgil accused the Italian Cicadæ of bursting the very shrubs with their noise—"Et cantu querulæ rumpent arbusta Cicadæ;" and Dr Shaw in his Travels calls it, alluding to its shrilly cry, "the most troublesome and impertinent of insects." Kirby and Spence tell us that in some countries it is execrated for its deafening din. Yet some one who desired to compliment Plato, asserted that his voice was as sweet as a grasshopper's; and we may all remember the story of the rival musicians (Eunomus and Ariston), one of whom gained the victory in consequence of a Cicada settling on his harp, and supplying the place of a broken string. Even at this day the song of the *Tettigonia Tibicen* of Surinam is supposed so greatly to resemble the sound of a musical instrument, that the insect itself is called the *Harper*. The following is Mr Elton's translation of Meleager's invocation.

O shrill-voiced insect! that with dew drops sweet,
Inebriate, dost in desert woodlands sing;
Perched in the spray-top with indented feet,
Thy dusky body's echoings harp-like ring:
Come, dear Cicada! chirp to all the grove,
The Nymphs and Pan, a new responsive strain;
That I, in noonday sleep, may steal from love,
Reclined beneath the dark o'erspreading plane.

We shall here conclude our general sketch of these insects by observing that the substance used in medicine, and known by the name of *manna*, is an exudation from certain species of ash (*Fraxinus rotundifolia et ornus*) which flourish in the south of Europe. It has been observed to be frequently produced by the puncturing of the Cicadæ, which feed on the juices of those saccharine trees. The largest insect of the genus in Europe is *C. plebeia* of Linn. Its cry is very strong and shrill; and as it is well known in Italy, there can be no doubt of its being the species mentioned by Virgil. If identical with the Athenian Cicada, its voice does certainly by no means correspond in musical intonation to what might be inferred from its recorded character as a lyrist among the ancient Greeks. The pleasure produced may however depend upon association; for, as Cowper says,

Sounds inharmonious in themselves, and harsh,
Yet heard in scenes where peace for ever reigns,
And only there, please highly for their sake.

It is said that the males alone are musical, which may perhaps be one reason for their continued cheerfulness; for, as the Rhodian Xenarchus has it,

Happy the Cicadas' lives,
Since they all have voiceless wives.

The amount of species in the genus Cicada is considerable. They are spread over almost all the regions of the earth, especially in the warmer latitudes.¹ The greater number are foreign to Europe. Our bounds will not admit of more than a brief notice of a very limited number of species. The *Cicada Orni* is a European insect, common in France and Italy. It is about an inch long, yellowish, paler beneath, but mixed with black on the upper portions. The margins of the abdominal segments are reddish. There are two rows of blackish spots on the upper wings, those next the inner margin being the smallest. Its voice is hoarse, and does not extend so far as that of several other species. This is the kind which, by wounding the tree from which it derives its specific name (a species of wild ash), causes a peculiar and honey-like fluid to flow from it. It afterwards dries and hardens, and in that state is used medicinally under the name of manna. The *C. plebeia*, Lin. (*Tettigonia fraxini*, Fab.), figured on Plate CCXXIX. fig. 13, is the largest species found in France. It is black, with some spots on the first segment of the thorax, its posterior margin, the raised and arched portions of the scutellum, and several veins on the elytra, reddish. Its cry is strong and shrill. The *C. hæmatodes* is black, with the front of the thorax and legs spotted. The edges of the abdominal segments, and the reticulations of the elytra, are red. This species occurs in the south of France, but is rare in the vicinity of Paris. Its voice is weaker than that of the preceding species. Olivier has described sixty-six species in all.² We are indebted to Stoll for a monograph of the Cicadæ, already referred to in a subjoined note.

2D, MUTÆ.

Antennæ with only three distinct articulations. Two ocelli or simple eyes. Legs, in general, adapted for leaping. Neither sex provided with organs of sound. The elytra are frequently coriaceous and opaque, and the females of many species are observed to envelop their eggs in a white and cottony substance.

A. *Fulgorellæ*.

Antennæ inserted immediately beneath the eyes, and the front frequently prolonged into a muzzle, of variable figure according to the species.

GENUS FULGORA.³ Front of the head prolonged or expanded into a muzzle. No appendages beneath the antennæ. Thorax of two apparent segments,—the posterior margin of the first straight, of the second triangular.

These insects are remarkable for the varied and beautiful markings of their elytra and wings, and for the singular form of their expanded muzzles, from which a luminous or phosphoric emanation proceeds during the night. Hence several of the species are known (in common with *Elater*, *Lampyrus*, and other coleopterous kinds) under the name of fire-flies. The greater number of the species are exotic, and inhabit the sultry regions of Cayenne, Guadaloupe, Senegal, the East Indies, and China. They

¹ *Encyclopédie Méthodique*, t. v. p. 742. See also Stoll's *Représentations exactement coloriée d'après nature des Cigales et des Punaises*.

² In *Encyclop. Méthod.* v. 742. See also Latreille's *Gener. Crust. et Insect.* iii. 154; and the *Syst. Rhyng.* of Fabricius, genus *Tettigonia*.

³ From *fulgor*, splendour.

Hemiptera dwell on trees, but their special manners are but slightly known. We shall here indicate a few of the more noted species.

Hemiptera dwell on trees, but their special manners are but slightly known. We shall here indicate a few of the more noted species.

F. laternaria, Linn. is a large and remarkable insect from South America, drawn and described in most illustrated works on entomology. Its muzzle is nearly straight as to its direction from the head, but it is vesicular and inflated, or swollen out and rounded, at the sides and extremity. The ends of the under wings are pleasantly varied with black and yellow, in the form of an expanded spot, resembling the eye of a peacock's feather. Madame Merian informs us, that from the head or front of this species a light is seen to shine during the darker hours, so clear and brilliant that it is easy to read by its rays. She adds, that during the day it is transparent as a bladder, and radiated with red and green. The indefatigable and accurate Réaumur, desirous to ascertain by anatomical investigation the proximate cause of this curious phenomenon, opened one of these vesicular expansions, but he found it empty, except of air, and containing no organic structure. We must bear in mind, however, that the individual examined was in a state of desiccation. The species is common at Guadaloupe and Cayenne, where it is known by the name of fire-fly. It flies well, and hovers habitually about the summits of the tallest trees. Its luminous faculty has been sometimes called in question, especially by M. Richard, who captured many at Cayenne, but never saw them shine. Yet the testimony of Madame Merian, and the general application to the species of the name of *mouche à feu*, notwithstanding the fruitless results of Réaumur's examination, suffices to establish that fact. It is probable, however, that the phosphoric emanation from this and other species is only perceptible at certain seasons of the year, and this consideration may explain the discrepancy arising from M. Richard's observations. *F. candelaria*, Fab. (Plate CCXXIX. fig. 12), is a native of China and other eastern countries, and is very abundant in collections. It is known among us by the name of *Lantern fly*, and may be easily recognised by its long cylindrical snout, arched in an upward direction, its greenish reticulated elytra, and orange-yellow wings with black extremities. At night this insect glitters by thousands among the dark recesses of the Banyan tree, which

.....to Indians known,
In Malabar or Deccan spreads her arms,
Branching so broad and long, that in the ground
The bended twigs take root, and daughters grow
About the mother-tree, a pillar'd shade
High overarch'd, and echoing walks between.

And they are likewise observed to dance in perpetual motion around the outmost branches of the spreading tamarind, producing a brilliant and singularly beautiful effect. *F. Europæa*, Lat. (Stoll, *Cigales*, pl. xi. fig. 51), occurs in the south of France, Italy, and the islands of the Mediterranean. Its front assumes the form of a conical advancement, with three raised lines above and five below. The elytra and wings are transparent, with green reticulations. There are three raised lines on the thorax.¹

GENUS OTIOCERUS, Kirby. Muzzle advanced. Simple eyes wanting. Two small appendages beneath each antenna.

GENUS LYSTRA, Fab. Head transverse, and without any prolongation in the form of muzzle. Two simple

eyes. Second articulation of the antennæ granular, and almost round.

The species of this genus at first sight resemble small *Cicadæ*. The extremity of the body, in the females, is furnished with little bundles of cotton threads, beautifully white, with which, it is presumed, they surround their eggs. We are acquainted with many species from China, the East Indies, and South America. We shall here mention only *L. lanata*, Fab. (*Cicada lanata*, Lin.), of which the sides of the front are red, and the extremities of the elytra black, with points of blue. We receive it from Cayenne and the Antilles.

We shall here indicate a few genera, into the detailed history of which we cannot enter. The CYXII of Latreille resemble Lystræ, but the second joint of the antennæ is smooth and cylindrical. Under the appellation of TETRI-GOMETRA, Latreille has separated certain insects analogous to the preceding, but with the antennæ lodged between the posterior and lateral angles of the head, and those of the anterior extremity of the thorax. The eyes are not projecting.² The preceding genera are provided with simple eyes; but in such as follow, these organs are wanting.

The species with large elytra, and the prothorax shorter in the middle than the mesothorax, compose the genus PÆCILOPTERA of Latreille and Germar (*Flata* of Fabricius).³ In ISSUS, Fab. the prothorax is as long at least as the mesothorax; and the elytra, scarcely longer, or sometimes shorter, than the abdomen, are dilated at their base, and then narrowed.⁴ Sometimes the antennæ are at least as long as the head, and are most frequently inserted in an inferior emargination of the eyes. The genus ANOTIA of Kirby resembles Issus in the insertion of the antennæ.⁵ In ASIRACA of Lat. (*Delphax* of Fab.) the antennæ are inserted in an inferior emargination of the eyes, and are as long as the head and thorax united. Their first joint is usually longer than the second, and is compressed and angular. In DELPHAX, as constituted by Latreille, the antennæ are similar in their insertion, but they are never much longer than the head, and their first joint is much shorter than the following one, and without ridges. The simple eyes are apparent. The genus DERBE of Fab. is allied to Anotia. The species are little known. They are all exotic, and most of them come from South America.

B. Cicadellæ.

Antennæ inserted between the eyes. Latreille subdivides this portion of the family of Cicadariæ into the following genera.

He commences with the species which, with the exception of a few (the LÉDRÆ), formerly composed the genus *Membracis* of Fabricius. The head is much inclined or lowered anteriorly, and prolonged to an obtuse point, or under the form of a clypeus, more or less semicircular. The antennæ are always very small, terminated by an inarticulate seta, and inserted into a cavity beneath the margin of the head. The prothorax is sometimes dilated and horned on either side, prolonged and restricted posteriorly to a point or spine, either simple or compound, sometimes elevated longitudinally along the back, compressed into a sharp edge or crest, and sometimes projecting and pointed forwards. The legs are scarcely spiny.

¹ For the other species of this genus see the works of Stoll and Fabricius, last cited, and the *Encyclop. Méthod.* article *Fulgore*.

² Germar, *Magazin der Entomologie*, iv. 7.

³ *Gener. Crust. et Insect.* iii. 165; *Mag. der Ent.* iii. 219, iv. 103-4.

⁴ *Linn Trans.* xiii. pl. i. figs. 9, 10, 11, 15.

⁵ *Systema Rhyngotorum*, p. 199.

Hemiptera
Homop-
tera.

a.

No apparent or exposed scutellum properly so called.

*

Tibiæ, especially the anterior, strongly compressed and foliaceous. Upper part of the head always forming a kind of semicircular clypeus.

GENUS MEMBRACIS, Fab. Prothorax elevated, compressed, and foliaceous along the middle of the back.

Of this pretty numerous genus we shall notice only *M. foliata*, Fab. (Plate CCXXIX. fig. 14), which is of a blackish brown, the front advanced, flattened, the thorax marked by an arch and band of white. The latter part is greatly elevated, flattened laterally, forming a salient crest, advancing over the head, which it almost entirely covers, and terminated posteriorly by a point prolonged beyond the abdomen. The elytra are oval, longer than the wings. The legs are elongated, flattened, rather broad. The anterior tibiæ are shorter, of an oval form, and flattened. The native country is Cayenne.

GENUS TRAGOPA, Lat. Prothorax presenting on each side a horn or salient point, without any intermediate elevation, and prolonging itself posteriorly into an arched projection of the length of the abdomen, and occupying the place of the scutellum.

This genus is composed of certain species from Brazil, which M. Latreille regards as analogous to *M. glabra*, *albinacula*, and *xanthocephala* of Germar.

* *

Tibiæ of the ordinary form, not foliaceous.

GENUS DARNIS, Fab. Posterior prolongation of the prothorax covering almost the whole, or the greater portion, of the upper part of the abdomen and elytra, and forming an elongated and arched triangle.¹

GENUS BOCYDIUM, Lat. Elytra entirely or in greater part exposed, the posterior and scutellar prolongation of the prothorax being narrow, and more or less lanceolate or spiniform.

The *Centrotus horridus*, *trifidus*, *globularis*, *clavatus*, and *claviger*, of Fabricius, belong to this genus.

b.

Scutellum partially exposed, even although the prothorax is prolonged;—the posterior extremity of the latter offering a transverse suture, which distinguishes it from the scutellum.

GENUS CENTROTUS,² Fab. Similar to *Membracis*, but the thorax is dilated horizontally, and covers only a part of the body.

C. cornutus, Fab. (*Cicada cornuta*, Linn. Plate CCXXIX. fig. 15), is of a blackish-brown, the thorax with a horn on each side, and prolonged posteriorly to a sinuated point of the length of the abdomen. This species measures about four lines in length. It occurs in France, and other parts of Europe, in woods, on ferns, &c. and is known by the name of *petit diable*. *C. genistæ*, Fab. is of an obscure brown, the thorax without horns, but terminated posteriorly by a straight sharp point, as long as the half of the abdomen. It is only half the size of the preceding, and occurs on the broom. It is called *demi-diable* by the French.

M. Latreille now proceeds to those species of which the head, if not upon a level with, is scarcely lower than, the prothorax, and is horizontal or slightly inclined when seen from above. The prothorax is neither elevated in the centre, nor posteriorly prolonged, and offers at most some lateral dilatations. The mesothorax presents itself under the form of an ordinary-sized triangular scutellum.

The elytra are always entirely exposed, and the posterior tibiæ at least are spinous.

In several genera the thorax bears the form of an irregular hexagon, prolonged and narrowed posteriorly, and terminated by a truncation, serving as a support to the base of the scutellum, which it frequently receives into itself,—the truncated portion being concave or emarginate. In the genus LEDRA, Fab. the vertex is triangular, and bears the ocelli. The antennæ are inserted upon or above an ideal line drawn from one eye to another. The head is very flat before the eyes, in the form of a transverse clypeus, arcuated and terminated in the centre of its anterior margin by an obtuse angle. All the under parts of the head are plane, or on the same level. The sides of the prothorax are raised in the form of rounded horns. The posterior tibiæ are much compressed, and as if margined exteriorly by a dentated membrane. The *Cicada aurita* of Linn., or *grand diable* as it is called by Geoffroy, belongs to this genus. In the genus CERCOPIS, Fab. the third joint of the antennæ is conical, and terminated by an inarticulate seta. Of this genus *C. sanguinolenta* is a well-known and ornamental British species, as is also *C. spumaria*, Linn. of which the larva inhabits a white foam frequent on the leaves and stalks of various plants, and called *frog-spittle* in England—*gowk-spittle* in our northern parts of the kingdom. The latter species is by some classed in the genus *Tettigonia*.

In other genera of Cicadariæ, which terminate our present family, the prothorax is scarcely if at all prolonged posteriorly, and terminates, at the height of the origin of the elytra, by a nearly straight line, the length of which is nearly equal to the breadth of the body. The scutellum, measured at the base, occupies a great proportion of that breadth. Here are ranged the genera EULOPEA, EUPELIX, PENTHIMIA, JASSUS, and TETTIGONIA properly so called.³

FAMILY II.—APHIDII.

These singular insects are distinguished from those of the preceding family by the tarsi, which have only two articulations, and by the antennæ, filiform or setaceous, longer than the head, and composed of from six to eleven articulations. Such as possess organs of flight have always two elytra and a pair of wings. The species are usually very small,—their bodies generally of a soft consistence, the elytra and wings nearly alike, or differing merely in size and thickness. They lay a prodigious number of eggs, and their mode of production is in other respects very remarkable.

In some the antennæ consist of from ten to eleven articulations, of which the last is terminated by a couple of setæ. These are leaping insects, and compose the genus PSYLLA of Geoffroy (*Chermes*, Linn.). They are known under the title of *faux-puceron* to the French naturalists, as distinguished from the true Aphides after mentioned. They live on trees and various plants, by the juices of which they are nourished. Both sexes are winged. The body of the larvæ is usually very flat, the head large, the abdomen rounded posteriorly. Their feet are terminated by a small membranous vesicle, furnished beneath with a couple of hooks. The nymphs are distinguishable by four broad flat dorsal portions, which constitute the sheaths of the incipient wings and elytra. Several species are covered during both of those immature conditions

¹ For the species, see the *Systema Rhynogotorum* of Fabricius.

² See the fourth volume of Germar's *Magazin der Entomologie*, and the *Règne Animal*, t. v. p. 222-3.

³ From *κεντρον*, spine, and *στυς*, ear.

Hemiptera
Homop-
tera.

Hemiptera by a white and cottony substance, disposed in flakes. Their fæces form threads or masses of a gummy and saccharine nature. Several species, by the wounds which they occasion to plants while sucking their juices, occasion the growth of peculiar excrescences on the buds and leaves, resembling gallnuts. Of these is *Psylla buxi* (*Ch. buxi*, Linn.), which is green with yellowish-brown wings. Mr Stephens has named a great many British species as belonging to this genus.¹ Latreille has founded the genus *LIVIA* upon a species which dwells among rushes (Plate CCXXIX. fig. 17). The antennæ are much thicker near the base than towards the extremity.

In other Aphidii the antennæ have only from six to eight articulations, of which the last is not terminated by a couple of setæ. Some have the elytra and wings linear, fringed with hairs, and placed horizontally upon the body, which is of an almost cylindrical form. The rostrum is very small or indistinct. The tarsi are terminated by a vesicular article, unfurnished with hooks. The antennæ consist of eight granular articulations. Such are the species which form the genus *THRIPS* of Linn. (Plate CCXXIX. fig. 18). These insects are very small, extremely active, and seem to leap rather than fly. When teased, they raise and recurve the extremity of the abdomen, after the manner of the Staphylinidæ. They live among flowers and other parts of plants, and beneath the bark of trees. We may add, that although Latreille did not perceive in the organization of the mouth of these insects any characters essentially different from such as distinguish that organ among the other component parts of the homopterous Hemiptera,—yet M. Straus, who has studied the subject very laboriously, and with his wonted intelligence, is of opinion that the genus *Thrips* belongs in fact to the orthopterous order.

Others have the elytra and wings oval or triangular, without fringe, and inclined or tectiform. The rostrum is distinct. The tarsi are terminated by two hooks. The antennæ consist of from six to seven articulations. Such are the species which compose the great genus *Aphis* of Linn. which is now divisible as follows.

In the genus *APHIS* properly so called, the antennæ are longer than the thorax, of seven articulations, of which the third is elongated. The eyes are entire, and the abdomen is furnished with two horn-like projections at its posterior extremity. The species dwell together in society on various trees and plants, of which they suck the juices. They walk very leisurely, and cannot leap. The two horn-like processes just mentioned are hollow tubes, from which a drop of transparent liquid frequently exudes. It partakes of the property of sugar, and is much sought after by ants, who suck it with avidity from the living Aphides. This curious fact was first noticed by M. Bois-sier de Sauvages, and has since been amply confirmed by M. P. Huber. The desired liquor seems to be given out voluntarily by the aphid, when solicited so to do by a gentle tap from the ant's antennæ. A single aphid may be sometimes seen surrounded by three or four ants, all in the act of deriving from it a plentiful and nectareous meal.² The congregations of the Aphides consist, in spring and summer, of apterous individuals, and of nymphæ with undeveloped wings. All of these are females, which give birth to *living young, et sans accouplement préalable*. The males, which consist both of winged and apterous insects, are produced towards the end of summer, or during the autumnal season. They fecundate the last broods produced by the females first mentioned; which broods consist of apterous females, differing from their progenitors in requiring impregnation prior to the continuance of their kind. They lay *eggs* soon after the sexual intercourse, and these remain in the crevices of trees, &c. throughout the winter, and in spring produce the broods above alluded to, which are capable of producing living young, without assistance from each other. “L'influence d'une première fécondation s'étend ainsi sur plusieurs générations successives. Bonnet, auquel on doit le plus de faits sur cet objet, a obtenu, par l'isolement des femelles, jusqu'à neuf générations dans l'espace de trois mois.”³ M. Duvau has recently added some observations to those of Bonnet and Réaumur on this singular subject.⁴ By this extraordinary process of production, vast multitudes are brought forth during a favourable season, and the injury to vegetation, by the absorption of the juices, and the obstruction of the natural pores, is consequently great. Réaumur calculates, that in the course of five generations, a single mother may be the means of producing 5,904,900,000! But fortunately they are liable to the attacks of numerous enemies, and are greedily devoured by many other insects. The larvæ of the genus *Hemero-bius*, those of different dipterous species, and of the *Coccinellæ* or lady-birds, make the helpless Aphides their constant prey. We cannot here describe the species, but shall content ourselves by naming a few familiar examples. *Aphis rosæ* (Plate CCXXIX. figs. 19 and 20) is a small green species, very abundant on the younger shoots of roses, the flowering of which it seems to damage or destroy. Its hordes may be killed by dipping the affected branch into soapy water. *A. quercus* occurs on the oak, and is remarkable for the great length of its beak, which is at least three times as long as the body. It is of a brown colour. *A. fagi* is attached to the beech tree, and covers itself, as do many other species, with a white and cotton-like down, which exudes from its body. Including the genus *Eriosoma* of Leach, we have above fifty species of aphid in Britain. In the genus *ALEYRODES*,⁵ Lat. (*Tinea*, Linn.), the antennæ are short, composed of six articulations, and the eyes are emarginate. *A. Chelidonii* of Lat. (*T. prolella*, Linn.) is found upon the celandine (*Chelidonium majus*), and other plants. It resembles a little moth. The larva is oval, flat, and shaped like a small scale. The nymph is fixed and enclosed in an envelope, so that its transformations differ from those of its congeners. Indeed the somewhat anomalous character of this insect has been the cause of its being described under a great variety of names.⁶ Mr Stephens enumerates five British species, including the one just mentioned.⁷

FAMILY III.—GALLINSECTA.

The insects of this family seem to have only one articulation to the tarsi, and are generally so described. It

¹ *Systematic Catalogue*, part ii. p. 361.

² The viscous drops so frequent on the foliage of many trees, and commonly known by the name of *honey-dew*, is this secretion from the Aphides. We have seen it falling from a willow tree like a gentle and continuous shower, and ascertained its origin by discovering at the same time millions of these insects incrusting the upper branches, and each giving out from time to time a minute drop of nectareous fluid.

³ *Règne Animal*, t. v. p. 227.

⁴ *Ann. des Sciences Nat.* t. v. p. 224.

⁵ From *αλευρος*, *flour*, in allusion to the farinaceous powder by which these insects are often covered.

⁶ See Geoffroy, *Hist. des Insect.* t. ii. p. 172; Réaumur, *Mem.* 7th, t. ii.; and *Dict. Class. Hist. Nat.* t. i. p. 211.

⁷ *Systematic Catalogue*, part ii. p. 367.

Hemiptera is the opinion, however, of M. Dalman, that those parts consist of three joints, with a single hook at the extremity.¹ The males want the rostrum, and have only two wings laid horizontally on the body; their abdomen is terminated by a pair of setæ. The females are winged and provided with a rostrum. The antennæ are filiform or setaceous, and consist, for the most part, of eleven articulations. There are only nine in the males of the species described by M. Dalman. These creatures form the noted genus *Coccus* of Linn. commonly called cochineal insects. They are also known by the name of *Chermes*,² and their history and attributes are sufficiently remarkable.

We may frequently perceive on the branches of various trees multitudes of small oval or rounded bodies resembling scales, adhering closely to the wood, and presenting no indications of any external organs. These are insects of the genus *Coccus*, the *progalinsectes* of Réaumur. Their history was for a long period extremely obscure, and the species employed in commerce was even at one time regarded as a kind of grain. It was only towards the termination of the seventeenth century that M. Plumier clearly established their insect origin. We are indebted to Réaumur for a complete history of the life and transformations of the European kinds. The larvæ of both males and females, on first quitting the egg, are tolerably active, and run about among the leaves and branches. They are, however, so extremely small at that period, as not to be distinctly discernible without the aid of a microscope. They are flat, ovular, apterous, with short and indistinctly articulated antennæ. The males have no apparent organs of manducation, although the females are furnished with a small, extremely short, almost conical beak, inserted between the first and second pair of feet, nearly perpendicular in its direction, and composed of a four-jointed sheath containing a sucker of three pieces. It is with this instrument that they pump the juices of the leaves and tender stems. They also fix themselves from time to time for the purpose of changing their skin, and after arriving at a certain size, they become definitely fixed in some chosen spot, usually at the bifurcation of a branch, where they form a little nest, protected by a tapestry of cotton. They then attain the perfect state, and are apterous (we speak of the females) even in that otherwise complete condition. Their head is semicircular, their mouth is still formed of the beak which existed in the larva state, and the eyes are small. The thorax is not easily distinguished from the abdomen, the segments of which are distinct. When the insect has attained its full growth, its abdomen is found filled with a multitude of minute eggs. The larvæ of the males, though by no means rare, are much less numerous than those of the other sex. Their mode of sustenance, owing to the want of the sucker, is not distinctly known; but they increase in size, and after a time their skin hardens, and serves as a cocoon, in which they undergo their transformation to the nymphæ state. In the latter condition they are remarkable for the anterior pair of legs being directed forwards. Towards the beginning of spring these cocoons open at their posterior portion, and the perfect male insect comes forth stern foremost. It is of a more elongated form, with a round head furnished with two small eyes and a pair of rather long antennæ. The thorax is rounded, and has attached to it a pair of long wings, folded horizontally one over the other, and very delicately veined. (For a male *Coccus* see Plate CCXXIX. fig. 16; the fe-

male is shown by figures 21 and 22). The male is less than the female, and more active, although it uses its wings very sparingly. As soon as it attains the perfect state, it sets off in search of the other sex, which still remains fixed in the nest, as formerly mentioned. The oviposition of the female is another remarkable peculiarity in the history of these insects. Though excluded from the body, the eggs do not appear externally, but are made to pass beneath the abdomen, and between it and the cotton tapestry above alluded to. In proportion as the insect becomes empty, the lower surface of the abdomen approaches the upper one, so as to leave beneath the body a kind of arch or cavity for the reception of the eggs. The perfect female never stirs a step in the course of her life, but having laid her eggs she dies, and her body shrivels up and hardens, and thus forms a cocoon or covering for the incipient young. These, as soon as hatched, work their way from beneath the dead body of their parent, making their escape by its posterior extremity.

These curious insects are certainly hurtful to vegetation, by causing a too abundant transudation of their juices; and they consequently excite the jealousy of those who cultivate the finer trees, such as the peach, the orange, the olive, and the fig. Certain species attack also the roots of plants. But, upon the whole, the advantages which we derive from this genus of insect amply counterbalance whatever injuries it may occasionally inflict upon us. The species are very numerous. We shall here notice only a few of the more remarkable.

Of the kind called Kermes, is that known to naturalists by the name of *Coccus Ilcis*, of which the female attains to the size and form of a pea. It is of a violet-black colour, covered by a whitish powder. This species is common over the south of Europe on the evergreen oak, and appears to be widely distributed over many of the southeastern countries of the ancient world. It occurs abundantly in Spain, where it attaches itself chiefly to the twigs and leaves of a small species of spiny-leaved oak, frequent in the southern parts of that romantic kingdom, especially on the slopes of the Sierra Morena. Many of the inhabitants of Murcia have no other means of subsistence than those procured by collecting the Kermes. Women are usually so employed, and they scrape the adhesive insects from the trees by means of their nails. Though supplanted over the greater portion of Europe by the introduction of the more famous cochineal (*Coccus cacti*), which is an American species, it is still extensively used in India and the Persian dominions.³ It has been employed from time immemorial to impart a blood-red or crimson dye to cloth, and was known to the Phœnicians by the name of *Thola*. It was called *coccus* (Κοκκος) by the Greeks, and kermes or alkermes by the Arabians. According to Beckman, the epithet *vermiculatum* was applied to it during the middle ages, when its insect origin came to be generally understood, and hence is derived our English word vermilion. The French term *cramoisi* is evidently from the Arabic. It is supposed to have been by means of this substance that the curtains of the tabernacle (Exodus, xxvi. &c.) were dyed of a deep red (which the word scarlet then implied, rather than the colour so named in more modern days, which was unknown in the reign of James I. when our Bible was translated); and from the same source have been derived the imperishable reds of the Flemish tapestries. The scarlet afforded by cochineal was unknown in its highest perfection till the

¹ See his Memoir in Swedish,—*Om några svenska arter af Coccus*, Stockholm, 1826.

² Be it remembered, however, that the genus *Chermes* of Linn. corresponds to *Psylla* of Lat. already described, and not to our present species, which are the true *Kermes* of Geoffroy, Réaumur, and Olivier.

³ Kirby and Spence's *Introd. to Ent.* and Bochart's *Hiéozoic.*

emiptera year 1630, when the singular power of the oxide of tin in exalting its colours was discovered in Holland; it was soon after communicated to one of the celebrated MM. Gobelins of Paris, and may have contributed to the perfection of their tapestries.¹ Since the preparation of Morocco leather has been established in this country, cochineal has been employed to produce the beautiful colour of what is called red morocco; but in Persia, Armenia, Barbary, and the Greek islands, a similar colour was originally produced by the use of either kermes or lac.² The colouring matter of kermes is regarded by Dr Bancroft as identical with that of cochineal, but combined with some astringent matter derived from the tree on which it feeds.

The substance called *lac* is also the produce of an insect of the *Coccus* kind. It is collected from various trees in India, where it is used in the fabrication of beads, rings, and other ornaments of female attire. When mixed with sand it forms grindstones; and, added to ivory black, and previously dissolved in water with a little borax, it composes an ink which, when dry, is said to be capable of resisting a considerable degree of damp or moisture. In this country, according to the different states in which it is imported, it is called stick-lac, seed-lac, lump-lac, or shell-lac. It is chiefly used in the making of varnishes, japanned ware, and sealing-wax, although during late years it has been applied to a still more important purpose, as originally suggested by Dr Roxburgh, that of a substitute for cochineal in dyeing scarlet. The first preparations from it with this view were made in consequence of a hint from Dr Bancroft; and large quantities of a substance termed *lac-lake*, consisting of the colouring matter of stick-lac, precipitated from an alkaline lixivium by alum, were manufactured at Calcutta, and sent to this country, where at first the consumption was so considerable, that in the three years previous to 1810 the sales at the India house equalled in point of colouring matter half a million of pounds weight of cochineal.³ "More recently, however, a new preparation of lac-colour, under the name of *lac-dye*, has been imported from India, which has been substituted for the lac-lake, and with such advantage, that the East India Company are said to have saved in a few months L.14,000 in the purchase of scarlet cloths dyed with this colour and cochineal conjointly, and without any inferiority in the colour obtained."⁴ The only mordant formerly used with kermes was alum, and the colour communicated was blood-red; but Dr Bancroft ascertained, that with the solution of tin used with cochineal it was capable of imparting as brilliant a scarlet as that dye, and one perhaps more permanent. It must be borne in mind, however, that as ten or twelve pounds of kermes contain no more colouring matter than a single pound of cochineal, the latter at its ordinary price is, after all, the cheapest.

Several other curious and valuable products are obtained from insects belonging to the genus *Coccus*, or to one nearly allied in its natural character and attributes. The *pe-la*, for example, or white wax of the Chinese, is derived from an insect, apparently a *Coccus*, described by the Abbé Grozier; and a non-descript Indian species produces a wax analogous to *pe-la*, first noticed by Dr Anderson under the name of white lac. It is obtained in great quantities in the vicinity of Madras; but Dr Pearson's ex-

periments do not countenance the idea, at one time rather sanguinely entertained, that it might be advantageously used for making candles.⁵ Geoffroy long ago attributed to a species of kermes the faculty of producing a sugary substance, of a white colour, resembling manna; and Captain Frederick has described an article of that nature under the name of *Gez*, found in Persia and Armenia; but he seems doubtful whether to attribute to it an animal or a vegetable origin.⁶ More recently, however, General Hardwicke has described an Indian insect, under the name of *Chermis mannifer*, of the size of the domestic bug, and of a flattened oval form, with a rounded tail. From its abdomen a quantity of saccharine substance is exuded, and assumes the form of a bunch of feathers, with a consistence like that of snow. These insects are found on the branches and leaves of trees in millions, and they there produce this feather-like secretion, till it becomes elongated, and, dropping on the leaves, hardens upon them into a substance resembling the most beautiful wax.⁷

Of the European species, in addition to *C. Ilicis*, already described, we may mention *C. adonidum*, now naturalized in our hot-houses, where it is very destructive, and *C. polonicus*, which yields a colouring matter almost as beautiful as the Mexican cochineal; it attacks the roots of *Scleranthus perennis*, and other plants, and is still used as a dye in Russia.

Before closing this branch of our subject, we must devote a few lines to the cochineal insect properly so called, the *Coccus cacti* of naturalists (Plate CCXXIX. figs. 16, 21, 22). This species, so important in a commercial point of view, and in relation to our arts and manufactures, is a native of Mexico, where it was assiduously cultivated at a period long anterior to the European conquest of that country. We shall not describe its appearance, as that will be better understood by an inspection of the figures just referred to. There are several varieties, named in general from the provinces where they are bred; and of these, that called *Mastique* or *Mèsteque* is regarded as the best. It is cultivated on a tree called *Nopal* by the Indians (*Cactus cochenilifer*, Linn.) and its colour is by some attributed to the juices of that plant. It is the female insect that is so highly valued for the incomparable beauty of its colour. It is imported to Europe in the form of a little grain, convex on one side, concave on the other, and exhibiting traces of the abdominal segments. In the year 1736 there was sent to Europe about 700,000 pounds weight of this minute creature, a quantity worth L.700,000 sterling. Humboldt states the quantity imported about the period of his inquiries to have been 32,000 arrobas, worth in South America L.500,040 sterling,⁸—"a vast amount to arise from so small an insect, and well calculated to show us the absurdity of despising any animals on account of their minuteness."⁹ Dr Bancroft calculates the annual consumption of cochineal in Great Britain at about 750 bags, or 150,000 pounds weight,—worth L.375,000 sterling at recent prices. The natives of those districts in which the cochineal is reared form plantations of the *nopal* tree near their dwelling-houses. It grows freely from cuttings, and the latter are fit for the reception of the insect in eighteen months. Eight or ten females are put into a small nest formed of tufts of a thread-like substance collected from a species of palm,

¹ Quarterly Review, vol. ix. p. 210.

² Experimental Researches concerning the Philosophy of Permanent Colours, &c. by Edward Bancroft, M. D. vol. ii. p. 167.

³ Bancroft, ut supra.

⁴ Introduct. to Ent. vol. i. p. 318.

⁵ Linn. Trans. 1794.

⁶ Transactions of the Bombay Literary Society, vol. i.

⁷ Description of Gez or Manna, in the Asiatic Researches, vol. xiv. p. 182.

⁸ Political Essay on New Spain.

⁹ Introduct. to Ent. vol. i. p. 316.

Hemiptera or of any other cottony matter. These nests are attached to the spines of the nopal, upon the side facing the rising sun, and the insects are placed in them about the middle of October, a period at which good weather usually commences in Mexico after the rains. The eggs are soon laid and hatched, and the progeny spread in vast numbers over the plant, each female producing upwards of a thousand young. According to M. Thierry de Menonville,¹ six generations are produced in a year, and they might be collected at all seasons, but for the destruction produced among them by the periodical rains. The first collection takes place about the middle of December, and the last in the month of May. They are detached by means of a knife with the edge blunted, to prevent injury to the nopal tree. When the first gathering is made, the nests are taken away, and the dead females (those placed on the nopal in October) are likewise picked off. These are lighter and less valuable than such as are taken off alive and full of young; the former losing three fourths, the latter two thirds, during the process of drying. As soon as dried, however, both kinds may be kept for any length of time, without any further loss of either weight or colour. They are killed by different processes. Some put them in a basket, which they dip in boiling water, and afterwards dry them by exposure to the sun; others place them in an oven, or on plates of heated iron. The various external colours of the insect, as we afterwards see it in Europe, depend upon the mode of putting it to death. Those which have been killed by being dipt in hot water (the method regarded as the best), lose a portion of the white powder with which they were previously invested, and acquire a brownish-red colour. When so treated, they pass under the name of *renagrida*. When killed in an oven they retain the white powder, remain externally of a grey colour, and are called *jarpeada*. Such as are placed on plates of heated iron become of a blackish hue, and are then named *negra*. When cochineal insects are forced from the tree, they speedily die, even if no further violence is offered them; because their sucker, being fixed in the wood, is unavoidably dislocated and broken off by the act of removal. It is necessary, however, to put them to death, because they might otherwise live for a short time, and meanwhile produce their young, the loss of which would diminish the quantity of colouring matter.

The other most frequent variety of cochineal is called *sylvester*, on account of its being commonly collected from a species of cactus which grows wild, or without culture. It is of smaller size, and much less valuable in relation both to the amount and quality of the colour which it yields. We have not yet ascertained to our own satisfaction whether it is a mere variety or a distinct species. Although it occurs naturally upon a wild spiny cactus, it is also cultivated upon the nopal or garden species, for the sake of the greater facility of collection. So great indeed is the difference in this point, that in one day a single labourer will gather from the latter a quantity which, when dry, will amount to the weight of three pounds,—whereas from the former the most persevering hand will not obtain in that time much more than a couple of ounces. Moreover, when cultivated on the garden nopal, the *sylvester* cochineal attains to as large a size as the *mastique*.

Various attempts have been made to introduce the culture of the cochineal into our eastern possessions, although

these, so far as we are informed, have not yet been attended with any marked success. The old Spanish government manifested great jealousy on the subject; and we are not aware that the true kind has been yet imported, although the court of directors at one period offered a reward of L.6000 to whoever should effect its introduction to India. Colonel Bory St Vincent informs us that attempts have recently been made, and with a fair prospect of success, to effect its cultivation near Malaga, in Spain.² We shall conclude our sketch by observing that considerable care is requisite to preserve these insects from the attacks of their natural enemies, of which one of the chief is the larva of a species of *Coccinella*, which sucks them to death, and leaves nothing but the skin. A very destructive foe is also described as being a caterpillar, of an inch in length, and the thickness of a crow-quill, which, it is said, would soon destroy the race if allowed to continue its attacks without any interference on the part of the higher powers.³ It is said that a species of *Ptinus* also feeds upon them freely. Besides these direct enemies, there is another insect, with the exact nature of which we are not acquainted, which lives in common with the cochineal upon the juices of the nopal, and by so doing greatly interferes with the health and progress of the more valuable species. Among its larger, if not more formidable enemies, we may mention a mouse, which is said always to prefer the *mastique* or finer cochineal to the *sylvester* or wild species, because the cottony matter with which the latter is invested produces discomfort by entangling in its teeth. Both kinds are moreover subjected to the attacks of numerous birds.

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ORDER IV.—NEUROPTERA.⁴

Distinguished by four naked or transparent wings, reticulated or interlaced by a delicate network, and usually of the same size as well as texture. The mouth is adapted for mastication, that is, furnished with mandibles and true maxillæ, and never assumes the tubular form. The abdomen does not possess a sting, and is rarely provided with an ovipositor. The antennæ are usually setaceous, and composed of numerous articulations. The head is furnished with two or three simple eyes. The thorax is formed of three segments, intimately united to each other, though perceptibly distinct from the abdomen; the first of these segments is usually very short, and in the form of a collar. The number of joints of the tarsi varies. The form of the body is for the most part elongated, and its texture rather soft and delicate. The abdomen is always sessile. Many of the species are carnivorous, both in the larva and perfect state.

This beautiful and very varied order has been divided into two by Mr Kirby, by the separation of the genus *Phryganea* of Linn., which the English naturalist raises to the rank of an order under the name TRICHOPTERA. It might also have simplified the characters of the order if we had left in it only those which possess reticulated wings; but as some of the latter exhibit a difference in the texture of the organs of flight, it is difficult to assign rigorous characters to the neuropterous tribes, if we attach a high importance to the wings. “Of all the Linnean orders,” says Mr Kirby, “this appears to consist of

¹ *Traité de la Culture du Nopal*, 2 vols. 8vo, Paris 1787. This author endeavoured to introduce the Spanish American cochineal into St Domingo, but they perished for want of care.

² *Annal. des Sciences Nat.* t. viii. p. 105.

³ We scarcely think that the creature above alluded to can be a caterpillar properly so called, that is, the larva of a lepidopterous insect.

⁴ Odonata, and the majority of Synistata, of Fabricius.

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the most discordant tribes; so that it seems next to impossible to construct a definition that will include them all, unless indeed we admit M. Latreille's idea, adopted by Mr Macleay, that a varied metamorphosis is its essential character; or, to speak more largely, variety itself seems the characteristic of the insects composing it in every state, and there is scarcely a common distinctive character in their perfect state, upon detecting which in any individual, you may exclaim—this is a neuropterous insect.¹

The neuropterous species, however, may be readily distinguished from the orthopterous and hemipterous kinds by the greater difference of consistence in the two latter between the upper and under wings. The Hymenoptera, again, have generally much longer maxillæ—serving rather to suck the juices than to bruise the more solid portions of the substances on which they feed. The scale-covered wings of the lepidopterous order prevent their being confounded with our present subjects; while the Diptera are easily distinguished by the absence of the lower wings, and the different structure of the organs of manducation.

The mouth in the neuropterous order is generally composed of a labrum and a labium, of two mandibles, and a pair of maxillæ. The latter organs are very sharp and strong among the *Libellulæ*, which prey on other insects, but extremely small or almost imperceptible in the *Ephemera*, which, as their name implies, are very short-lived, and take no nourishment in the perfect state. The palpi are very short in the former tribes, but exceedingly long among the *Myrmeleones*. Although the antennæ, in the majority, are filiform or setaceous, they are terminated by an elongated club in those last named; while in the genus *Ascalaphus* they are very long and slender, and terminate in a little button, resembling those of many Lepidoptera. The wings are sometimes tectiform or incumbent, sometimes stretched out horizontally. Though frequently alike in size, they occasionally differ from each other. Thus in the genus *Nemoptera* the under pair are very long and narrow, while in some *Ephemera* they are almost obliterated.

In the larva and nymphæ states these insects are either terrestrial or aquatic, according to their kinds. In the former case some dwell beneath the bark of trees, others move about on twigs and branches, making an unresisting prey of Aphides; while a certain number inhabit sandy soils, where they excavate insidious pit-falls, and seize upon whatever insects venture within the circle of their treacherous toils. The aquatic species dwell in their earlier states in ponds and marshes, and in the shallower and more sheltered parts of lakes and rivers. They then respire by means of organs which exhibit a strong analogy to the gills of fishes, but which Latreille recognises only as exterior tracheal appendages, named false branchia. Many construct very ingenious cases of small stones, shells, and twigs of water-plants, in which they move about in their watery element.

The Neuroptera are, in general, insects of an extremely elegant deportment. They fly with great facility, and are not unfrequently adorned by agreeable and varied colours. Though almost all carnivorous as larvæ, their habits differ greatly in the perfect state. Some undergo a semi-metamorphosis,—others are completely changed,—but all the larvæ are provided with six-hooked feet, which they usually employ in their search for food. Latreille divides the order into three families, which present the following succession of natural affinities. 1st, Carnivorous insects, subject to a semi-metamorphosis, with aqua-

tic larvæ; 2d, carnivorous insects, subject to a complete metamorphosis, with terrestrial or aquatic larvæ; 3d, carnivorous or omnivorous insects, terrestrial, with semi-metamorphosis; 4th, herbivorous insects, subject to a complete metamorphosis, with aquatic larvæ, which construct portable domicils. He terminates with such as have the wings the least reticulated, and which bear a resemblance to Phalenæ or Tineites.

Neuroptera.

FAMILY I.—SUBULICORNES, LAT.

These consist of the *Odonata* of Fabricius, and the genus *Ephemera*. The antennæ are subulate or awl-shaped, scarcely longer than the head, and consist at most of seven articulations, of which the last is scitiform. The mandibles and maxillæ are entirely covered by the labrum and labium, or by the anterior or prolonged portion of the head. The wings are always much reticulated, separate, sometimes horizontal, sometimes raised perpendicularly. The inferior pair, though often as large as the superior, are in some instances much less, or even entirely wanting. The real eyes are large and projecting, and have from two to three stemmatic eyes placed between them. They feed on living prey, and pass their earlier states beneath the waters. The larvæ and nymphs exhibit a form somewhat similar to that of the perfect insects, and respire by particular organs placed along the sides or at least the extremity of the abdomen. They creep up the stalks of plants, or otherwise leave their moist abodes, before undergoing their final transformation.

In the great genus *LIBELLULA* of Linn. (Plate CCXXX. figs. 1, 2, 3, 4, 6), the mandibles and maxillæ are corneous and very strong, and are covered by the labrum above and by the labium below. The tarsi have three articulations. The wings are nearly of equal size, and the posterior extremity of the body is terminated simply by hooks or by foliaceous appendages.

The light and graceful form of these insects, their beautiful and varied colours, their large and lustrous wings, and the hawk-like velocity with which they pursue their flying prey, render them objects of our frequent attention, and easy to be recognised. Our present observations apply to all the component parts of the great and unrestricted genus just named. We shall afterwards give the specialities of the minor groups. The eyes of the *Libellulæ*, or dragon-flies in general, are large and lateral; the stemmata are placed upon the vertex. The antennæ are inserted on the front, behind a vesicular elevation, and are composed in the greater number of from five to six articulations, or at least of three, of which the last is composite, and attenuated in the form of a style. The labrum is arched and semicircular; the mandibles are of a scaly texture, very strong and toothed; the maxillæ are terminated by a piece of the same consistence, dentated, spinous, and ciliated on the inner side, with a palpus of one articulation on its back, representing what is called the *galea* in the orthopterous tribes. The labium is large, arched, and trifoliate, the two lateral foliæ being in fact palpi. There exists a kind of epiglottis, or vesicular and longitudinal tongue, in the interior of the mouth. The abdomen, always considerably elongated, varies in its contour, being in some cylindrical, in others compressed, and occasionally flattened. It is terminated in the males by two lamellar appendages, which likewise vary in form according to the species. The legs are short, and directed forwards. “Le dessous du second anneau de l'abdo-

¹ *Introduc. to Ent.* vol. iv. p. 371.

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men renferme, dans les mâles, leurs organes sexuels, et, comme ceux de la femelle sont situés au dernier anneau, l'accouplement de ces insectes s'opère différemment que dans les autres. Le mâle, planant d'abord au-dessus de sa femelle, la saisit par le col, au moyen des crochets de l'extrémité postérieure de son ventre, et s'envole ainsi avec elle. Au bout d'un temps, plus ou moins long, celle-ci se prêtant à ces desirs, courbe en dessous son abdomen, et en applique l'extrémité sur les parties du mâle, dont le corps est alors courbé en forme de boucle. La copulation a souvent lieu dans les airs, et quelquefois encore sur les corps où ces insectes sont posés.¹ The female deposits her eggs on aquatic plants, by plunging her posterior extremity beneath the water.

The larvæ and nymphs are aquatic. The former have no wings, the latter exhibit them in a rudimentary state (Plate CCXXX. figs. 1, 3). The head in these early stages is remarkable for the singular piece which corresponds to the labium. It assumes the form of a mask, and covers the mandibles, the maxillæ, and almost all the under parts of the head. It is composed of, 1st, a principal triangular piece, sometimes arched, sometimes flat, named *mentonnière* (or chin-cloth) by Réaumur, which articulates by means of a hinge with a pedicle or kind of handle attached to the head; 2d, of two other pieces inserted at the lateral and inferior angles of the preceding, moveable at their base, transverse, and either in the form of wide and dentated plates, resembling shutters in their nature, and the mode in which they close the mouth, or analogous to little hooks or claws. To that portion of the mask where the *mentonnière* is articulated with its pedicle, or the knee, and which appears to terminate it inferiorly when the mask is bent or folded upon itself, Réaumur applied the term *mentum*. The insect unfolds and extends this peculiar apparatus with great promptitude, and seizes its prey with the pincers of the superior portion. These creatures live for ten or eleven months in the water, during which period they several times cast their skin. When the nymphs are ready to assume their final change, the form and position of the wing-cases undergo an alteration. They then leave the water, become dry and crisp, the skin of the thorax bursts asunder, and the winged insect issues forth under a different and much more ornamental aspect. The name of *Demoiselles*, by which many of them are known to our continental neighbours, attests the impression produced by their graceful forms or elegant movements. These *Demoiselles* always come out of the water head foremost; but no sooner have they burst their casements than they turn themselves round, and hang for a time with their head downward, being prevented from falling by the hinder segments of the abdomen being still entangled in and adhering to the skin of the nymph. After a time the young aspirant again turns round, and seizing the anterior portion of the cloven skin with its claws, it finally succeeds in dragging itself forth from its former dwelling. The wings, however, are as yet narrow, thick, and closely folded, just like a leaf during the bursting spring. After another hour or two they become firm, consistent, and extended both in length and breadth, and the gay and gorgeous creature, launching buoyantly into the air, becomes the tyrant of the insect world.

M. Poe, who paid particular attention to the entomology

of Cuba, informed Latreille that, at a certain season of the year, the northern winds sweep an innumerable host of a species of dragon-fly into Havannah and its environs.²

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The Linnæan genus *LIBELLULA* is now divided into three.³ In *LIBELLULA*⁴ proper (Plate CCXXX. fig. 2), the wings are extended horizontally in repose, the head is almost globular, with the eyes contiguous or approximate. There is a vesicular elevation, with a stemmatic eye on each side upon the vertex; the other stemmatic eye is larger, and placed anteriorly. The central division of the labium is much smaller than the lateral ones, which unite above by a longitudinal suture, and exactly close the mouth. The abdomen is usually ensiform, and flattened. The larvæ and nymphs (ibid. fig. 1) have five appendages to the posterior extremity of the abdomen, which combine to form a pointed tail; their body is short, and the part named *mentonnière* by Réaumur is arched in the form of a helmet, with the two lateral pieces in the form of shutters. We may mention *L. depressa*, Linn. (the species figured), as a British example of the genus. In *ÆSHNA*, Fab. the species resemble the preceding in the position of the wings and the form of the head, but the posterior stemmatic eyes are placed upon a simple transverse elevation or keel. The intermediate lobe of the labium is also larger, and the other two are distant, and armed with a very strong tooth, and a spinous appendage. The abdomen is always narrow and elongated. The form of the larvæ and nymphs is also more lengthened than that of the same states in *Libellulæ*. The mask is flat, and the two pincers are narrow, with a moveable nail at the end. The abdomen, in their early states, is also terminated by five appendages, one of which, however, is truncated at the point. *L. grandis*, Linn. the largest and one of the swiftest and most powerful and predaceous of the British species, belongs to this genus. In *AGRION*,⁵ Fab. (Plate CCXXX. fig. 6), the wings are held perpendicularly in repose, the head is transversal, and the eyes distant. The form of the labium is analogous to that of *Æshna*, but the middle lobe is divided into two as far as its base. The third joint of the lateral lobes is in the form of a membranous ligula. The antennæ seem to be composed of only four joints. The front presents no vesicle, and the stemmatic eyes are of nearly equal size, and disposed triangularly on the vertex. The abdomen is very slender or even filiform, and, in some foreign species, of extraordinary length. That of the female is furnished with serrated laminæ at its posterior extremity. The form of the body in the larva and nymph states of this genus is likewise long and slender, and the abdomen is terminated by three fin-like plates (ibid. fig. 3). The mask is flat, the upper extremity of the *mentonnière* being raised to a point in some, and forked or sloped in others; the pincers are narrow, but terminate in several dentations resembling hands. The species are very numerous. *A. virgo* has dark-coloured wings, and a lustrous metallic body, varying from golden green to greenish blue. Its flight is irregular and rather heavy. To this genus also belong the small pale-coloured kinds, annulated with black, and presenting a considerable range of variation even among individuals of the same species, besides the more fixed distinctions of a sexual character.

¹ *Règne Animal*, t. v. p. 237.

² The structure of the eyes in dragon-flies is described by Cuvier in the *Mém. de la Soc. d'Hist. Nat. de Paris*, t. i. In addition to the ordinary systematic works, the student of the species should attend particularly to a monograph on European *Libellulæ*, published in the *Horæ Entomologicæ* of M. Toussaint de Charpentier, another monograph on the same by M. Vander Linden, and a memoir by the latter author on the species which occur in the territory of Bologna.

³ Named probably from the Latin *Libellus*, a little book, on account of the page-like expansion of the wings.

⁴ From *ἀγῆλος*, cruel or ferocious.

⁵ *Ibid.* t. v. p. 238.

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tera.

In the other Neuroptera of the family Subulicornes the mouth is entirely membranous or very soft, and composed of not very distinguishable parts. Their tarsi consist of five joints. The inferior wings are much smaller than the upper ones, and are even sometimes wanting. The abdomen is terminated by two or three setæ. They form the old genus *EPHEMERA*¹ of Linn., Plate CCXXX. figs. 5, 7, and 9.

In these frail and fleeting insects the body is very soft, long, and tapering, and terminates as above mentioned. Their antennæ are very small, and composed of three articulations, of which the last is very long, and in the form of a conical thread. The anterior portion of their head projects in the manner of a clypeus, is frequently carinated and emarginate, and covers the mouth, of which it is difficult to distinguish the structure, on account of the slight development of its parts, and the softness of their texture. The Ephemera in repose carry their wings almost always in a perpendicular position, or a little inclined backwards. The legs are slender, with very short tibiae, frequently confounded with the tarsi, which often exhibit only four joints, owing to the evanescence of the first; the two hooks of the last are much compressed into the form of a little pallet. The two anterior legs are much longer than the others, inserted almost beneath the head, and extended forwards. These insects usually make their appearance in the winged state towards the evening in fine summer weather, and sometimes in such abundance, that in certain districts of France cart-loads of them have been gathered from the ground, and employed as manure. *E. allipennis*, in particular, a species, as its name implies, remarkable for the whiteness of its wings, sometimes rises and falls in such quantities by the banks of rivers, as to thicken the air and whiten the surface of the ground,—reminding one, even in the verdurous and leafy summer, of

The flaky weight of winter's purest snows.

The males are distinguished from the females by a pair of articulated hooks, and their fore legs and caudal appendages are likewise longer. Although strictly ephemeral in their final state, they have rather a more extended term of life than usual in their subaqueous abodes, where they are said to live and prosper for two or three years. In the larva state the antennæ are longer than afterwards; the stemmatic eyes are wanting; the mouth presents two horn-like projections, which are regarded as mandibles; the abdomen is furnished on each side with a range of laminæ or leaflets, usually united at the base in pairs. These last-named parts are a kind of false branchia, on which the tracheal ramifications are extended, and which serve not only for the purposes of respiration, but also for those of locomotion. The tarsi have only a single hook at their extremity. The abdomen is terminated by setæ, of the same amount as in the perfect insect. The nymphs differ from the larvæ chiefly in being possessed of little sheaths or wing-cases (Plate CCXXX. fig. 10). When ripe, they leave the waters, and undergo their final transformation, pretty much after the manner of the Libellulæ already described, although more rapidly. One singular characteristic, however, attends their winged condition, from which the other tribes are free; they cast off a complete envelope or skin, including that even of the limbs, setæ, and antennæ, almost immediately after they have attained the perfect state, or at least what Mr Curtis has well named the *pseudo-imago*. While following the delightful pursuit of angling, both along our own unrivalled streams,

and by the banks of foreign waters, we have frequently had our fishing panier and the rims of our hat covered by a pearly layer of these ghost-like exuviae, and it proved extremely interesting to witness what we had often previously perused in the accurate pages of Réaumur. Swammerdam, who had long ago observed and described this singular moulting, seems to think that the male sex is alone subjected to it. The manners and metamorphosis of these insects have been minutely detailed by the laborious author just named, in his *Biblia Naturæ*, as well as by Réaumur and Degeer, in their respective *Mémoires* on the natural history of insects. The angler recognises them under the name of May-flies,—an imitation of which, during the early part of the trouting season, is deemed a lure not to be resisted by the finny race. We cannot here describe the species in detail. We have figured several different kinds on Plate CCXXX. Some have four wings, figs. 5 and 9; others have only two, fig. 7. Of the latter the eyes are sometimes very singularly constructed, being double, or two on each side, one above the other, as shown by fig. 8 of the same plate.

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tera.

FAMILY II.—PLANIPENNES.

Latreille here includes those neuropterous species of which the antennæ, always composed of a great number of articulations, are considerably longer than the head, without being styloform or awl-shaped. The mandibles are very distinct, and the under wings, almost equal to the superior ones, are extended, or simply folded beneath at their inner margin. The wings are very generally much reticulated and naked, with the maxillary palpi for the most part filiform, or a little larger at the extremity, shorter than the head, and composed of from four to five articulations. These insects are divisible into five sections, which compose, in relation to their natural habits, an equal number of small sub-families, as follows.

SECTION 1ST, PANORPATÆ.

Characterized by five articulations to all the tarsi, and by having the anterior extremity of the head prolonged and narrowed, in the form of a beak or proboscis. These constitute the old genus *Panorpa* of Linn., commonly called scorpion-flies, probably from the peculiar turning up of their tails (Plate CCXXX. figs. 13 and 20). The antennæ are setaceous and inserted between the eyes. The clypeus is prolonged into a corneous lamina, arched beneath for the reception of the mouth. The mandibles, maxillæ, and labium, are almost linear (Plate CCXXX. fig. 16). The palpi, varying in number from four to six, are filiform; those of the maxillæ do not distinctly present more than four joints. The body is elongated, the head vertical, the first segment of the thorax usually very small, and in the form of a collar. The abdomen is conical or almost cylindrical. In several species the sexes are very dissimilar. Naturalists do not as yet appear to have acquired any knowledge of their transformations. They are now divided into the following genera: NEMOPTERA,² (Plate CCXXX. fig. 11), BITTACUS, PANORPA proper (ibid. fig. 13), and BOREUS. The type of the last-named genus, and the only species known, is the *Panorpa hyemalis* of Linn. a small insect scarcely a line in length, of a cupreous black colour. It lives among moss in the northern parts of Europe, and is also found in the Alps, not far from the region of perpetual snow.

¹ Named, in allusion to the seeming shortness of their lives, from *εφημερος*, that which lasts a day.

² From *νημα*, a thread, and *πτερα*, wings.

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SECTION 2D, MYRMELEONIDES, Lat.

These are also characterized by five articulations to all the tarsi; but they differ from the preceding in not having the head prolonged in the form of a beak or proboscis. The antennæ are gradually enlarged, or have a globular or button-like termination. The head is transverse, vertical, and exhibits no stemmatic eyes. The ordinary organs of vision are round and projecting. The mouth is furnished with six palpi, of which the labial are usually longer than the others, and somewhat inflated at the extremity. The palate of the mouth is raised in the form of an epiglottis. The first segment of the thorax is small. The wings are equal, elongated, tectiform, or incumbent. The abdomen is generally long and cylindrical, with two projecting appendages at the extremity in the male sex. The legs are short.

These insects affect warm places, and are consequently more frequent in the southern countries of Europe than in the chilly regions of the north. They rest on plants, and generally remain quiescent during the day. The nymphs are inactive; but the generality of the perfect insects are well endowed with the power of flight. They form the old genus *Myrmeleon* of Linn., which Fabricius and Latreille have divided into two.

In MYRMELEON¹ proper (Plate CCXXX. fig. 12), the antennæ are short, gradually thickened or almost fusiform, and hooked at the extremity. The abdomen is long and linear. The singular larva of one of these insects (ibid. fig. 14) has been attentively studied by Poupert, Vallisnieri, Roesel, Réaumur, and others. It is rather more than half an inch in length, of an oval depressed form and greyish colour. It feeds chiefly on Solomon's emblem of industry, and has hence received the name of *Formica-Leo* or lion-ant. Its head is very small, but armed with two strong and lengthened mandibles, serrated on the inner side, and pointed at the end. These parts look rather like a pair of horns than organs of manducation; but it is with them that the larva seizes upon its prey; and as they are pierced at the extremity, they no doubt also act as suckers. As its form does not admit of active locomotion, nature has made amends by endowing this insect with admirable instinctive skill and cunning. It constructs, in a dry or sandy soil, a funnel-shaped excavation, the sides and edges of which are loose and crumbling, and at the bottom of which, with body closely covered, but with ever-ready jaws projecting upwards, the insidious larva lies concealed. No sooner does an industrious ant, laden perhaps with its republican provision, approach the edge of the unsuspected slope, to it as dangerous as a volcanic crater or avalanche of snow, than the finely poised sand immediately gives way, and the persevering citizen, rolling to the bottom, is instantly seized and sucked to a shadow by the lurking tyrant. The dead body is ere long tossed by a jerk of the head beyond the immediate boundaries of the dwelling, probably because it is by this time useless, or, as some French naturalist has expressed it, "pour que son cadavre n'épouvante pas les autres fourmis qu'il attend." There are tartars, however, among Myrmeleons as well as men; and it sometimes happens that a large and vigorous winged insect, such as a wasp, bee, or beetle, tumbles head foremost into the pit. "When Greek meets Greek, then comes the tug of war;" and when a lion-ant has the tail of a wasp in his mouth, there is no saying exactly how the combat may end. The one is furnished with

jaws tenacious as well as strong,—but he bears no "charmed life;" while the other is armed with a weapon which the dews of heaven cannot rust, and compared with the keenness of which the brightest sword in Damascus is as a broken foil. In these doubtful, though, to one or other of the parties, eventually disastrous circumstances, the result at last is, that either the lion-ant is dragged out of his den and stung to death, or dropped upon the ground and left a prey to birds, or that the winged insect is maimed, disabled, drawn into the sand, and slain. If an insect incapable of flight, or from its situation unable to use its wings, but of larger size than the Myrmeleon deems it prudent at once to seize upon, chances to fall into the snare, it is overwhelmed in its attempts to re-ascend, by repeated showers of sand, which its enemy directs upon it with unerring aim. No sooner, however, is the strength of the toiling and exasperated Sisyphus at least in part exhausted, than he too is seized upon, and sucked to death. The lion-ant makes use of its head as a catapult or instrument of war, with which to shower the sand upon its astonished prey. This singular larva is capable of enduring a very long-continued fast. When it has attained to the natural term of its increase, which requires the lapse, it is said, of nearly a couple of years, it weaves a white cocoon, by means of two spinners placed at the posterior extremity of the body, of a rounded form and satin lustre, but covered with grains of sand. In this it undergoes its transformation to the nymph state (Plate CCXXX. fig. 15). The perfect insect bursts from its silken tomb in the course of from fifteen to twenty days. We are acquainted with many species of the genus. Besides the one of which we have just now sketched the history, and which is the *Myrmeleon formicarium* of systematic writers, another noted species, named *M. Libelluloides*, occurs in the south of France. It is a very large insect, measuring from four to five inches between the tips of the extended wings, and was described as a *Hemerobius* by Linnæus. It is the *Libella turcica* of old Petiver, and the *Musca rarissima* of Ray. We were once nearly drowned in trying to capture it by the side of a muddy stream. The flight of both of these insects, and of all belonging to the genus, is slow and heavy. They seldom fly far, and seem to end their lives near the places where they had their birth,—even to the last "loving the spots which once they gloried in." They are unknown in Britain.²

In the genus ASCALAPHUS,³ Fab. (Plate CCXXX. fig. 19), the antennæ are very long, and terminate somewhat abruptly in a club or expansion. The wings are proportionably broader than those of Myrmeleon. The flight of these insects is rapid and light. They occur chiefly in the warmer parts of Africa and America, although a few are found in Europe. Of these *A. Italicus* occurs in France as far north as the environs of Fontainebleau. We have no very precise knowledge of their transformations. They do not occur in Britain.

SECTION 3D, HEMEROBINI.

The component parts of this group resemble those of the preceding in the general form of the body and wings; but the antennæ are filiform, and the palpi only four in number. They form the old genus *Hemerobius* of Linn. and Fab. which has since been subdivided as follows:—

In HEMEROBIUS proper (of Lat.) the first segment of the thorax is very small, the wings incumbent, and the last article of the palpi is the thickest, ovoid, and pointed.

¹ From *μυρμίζ*, an ant, and *λεων*, a lion.

² *M. formicarium* holds a nominal place as a British insect; but we have never felt assured of its existence as an indigenous species.

³ *Ασκαλαφός* is the ancient mythological name of a bird. We do not know for what reason it was applied to the above genus.

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Neuroptera. The larvæ are terrestrial, that is, not aquatic. They wander about from place to place, committing great havoc among Aphides, their favourite food,—for which reason they are named *lions des pucerons* by Réaumur. These they seize by means of their horn-like mandibles, and speedily suck to death. Some of the perfect insects are exceedingly beautiful, especially a well-known British species called *Hemerobius perla*, which is of a pale yellowish green, with delicately transparent yet lustrous wings, and brilliant golden eyes. Its flight is feeble. The females lay their eggs on leaves, to the number of twelve or sixteen in a group. They are whitish and oval, and are supported and secured by a long hair-like stalk or pedicle, which some botanists, less versed in edible fungi than Dr Greville, have mistaken for a species of *mushroom*! (See Plate CCXXX. fig. 21.)

Other allied species have the first segment of the thorax large, with the wings usually placed upon the body in a horizontal position. The palpi are filiform, with the last article conical, or almost cylindrical, and frequently shorter than the preceding. The larvæ are aquatic. These insects were placed by Fabricius, along with the species of the genus *Perla* of Geoffroy (from which, however, they differ in the number of articulations of the tarsi), under the genus *SEMBLIS*, which is itself composed of *CORYDALIS*, *CHAULIODES*, and *SIALIS*, of Latreille.¹

SECTION 4TH, TERMITINÆ.

This group comprises such Neuroptera as are subject to a semi-metamorphosis, and are active and carnivorous, or rather omnivorous gnawers, in all their states. With the exception of the Mantispæ, which, in regard to their anterior legs, resembling those of the Mantides, are peculiar in their order,—the tarsi have at most four articulations, in which they differ from the preceding genera of the family with which we are still engaged. The mandibles are always corneous and strong.

Some possess tarsi consisting of from five to three articulations, with very distinct and projecting labial palpi. The antennæ are generally composed of more than ten joints, the prothorax is large, in the form of a corselet, and the wings are of equal size, and much reticulated.

In the genus *MANTISPA* of Illiger (*Rhaphidia*, Scopoli, Linn.; *Mantis*, Fab. Oliv.), all the tarsi have five articulations, and the anterior legs, like those of Mantis, are adapted for prehension. The antennæ are very short and granose, the eyes large, the prothorax very long, thickened anteriorly, and the wings incumbent. This genus consists of not more than five or six species, only one of which, *M. pagana*, is found in Europe. In the genus *RAPHIDIA*,² Linn. Fab. (Plate CCXXX. fig. 24), the tarsi have only four articulations. The wings are incumbent when at rest, the head elongated, and narrowed posteriorly, the thorax long, narrow, and almost cylindrical. The abdomen of the female is terminated by a long exterior oviduct, formed by a couple of laminæ. The species figured on the plate referred to is well known in Britain. It lives in woods. Both the larva and imago feed on other insects. The former is lively in its movements when disturbed. It lives in the fissures of trees, and has the form of a little serpent. In the genus *TERMES*, which contains the famous white ant (Plate CCXXX. figs. 17, 18, and 23), the tarsi are likewise composed of four joints, but the wings are very long, and are horizontally spread upon the body. The head is rounded, and the thorax almost square or semicircular. The body of these insects is depressed, and the antennæ, at least in the females, are short, and

formed like a chaplet. The mouth resembles that of the orthopterous order, and the labium is quadrifid. There are three ocelli, one of which, placed upon the front, is indistinct, and the other two are placed laterally, near the internal margin of the ordinary eyes. The wings are usually rather transparent, colourless, with fine and close-set nervures, but not very distinctly reticulated. There are two small conical biarticulated points at the extremity of the abdomen. The legs are short. A good monograph of this singular and destructive genus is still a desideratum in Entomology. Several species, inhabiting widely distant countries, have been described under the general name of *Termes fatale*, but we have still an insufficient knowledge of their actual and distinguishing characteristics. So confused was the acquaintance of our immediate predecessors with these insects, that the larvæ of *T. flavicolle*, Fab. were placed by Linnæus among his *Aptera*, while the perfect insects formed a part of his genus *Hemerobius*. These Termites are for the most part peculiar to countries placed between or near the tropics. The individuals named neuters or labourers among the white ants (commonly so called) are the wingless larvæ (fig. 17), and in that state their powers of destruction are quite appalling. They live together in assemblages so vast as almost to defy calculation, and excavate galleries under ground, in trees, tables and all kinds of furniture, as well as in the timber of dwelling-houses. Dr M'Murtrie saw a beautiful edifice in the Isle of France that had been abandoned within a few months after its completion, on account of the attacks of these destructive creatures. The whole building was a mere shell.³ Whatever ligneous bodies are mined by them, retaining little but a superficial bark, soon crumble into dust; and where the roof of a house, or heavy lintel stone, depends on such support, the insecurity may be as easily imagined as described. They sometimes construct external tunnels or covered ways, which conceal them from view while passing to and from their subterranean dwellings. Sometimes their habitations are raised pyramidally above the surface, in other instances they resemble turrets, with an eave-like expansion on the top. Some are broader and extremely solid; and when constructed, as they often are, in groups, they exhibit the appearance of a little village. They are so strongly built, that when raised to only half their height, they are capable of supporting such wild bulls as mount upon them to act as sentinels while the rest of the flock is feeding. When at their full height of ten or twelve feet, they are used by men as stations from which to look across the country, the grass itself being in those regions of equal height. Smeathman, to whom we owe a curious and often-quoted narrative of their history, has frequently stood with four companions on the top of one of their buildings, employing it as a watch-tower by the shore, from which to obtain sight of whatever vessels might lie in sight. Besides the larvæ or workers, we find another set of inhabitants, of which the nature is not yet clearly known, although their functions are obvious. They are known by the name of soldiers or neuters, and were erroneously regarded by Fabricius as the nymphs. They defend the habitation. When a breach is effected with a pick-axe, they make their appearance, and snap about in all directions with their mandibles,—apparently in a state of considerable indignation. When the attack has ceased, the soldiers retire, and are succeeded by the labourers, who speedily repair the breach. They are still attended, however, by a few soldiers, who seem to act as superintendents of the work. The nymphs bear the rudi-

Neuroptera

¹ See *Règne Animal*, t. v. p. 252.

² From *εαφις*, *idos*, a needle.

³ Cuvier's *Animal Kingdom*, American edition, vol. iv. p. 73.

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tera.

ments of wings; in other respects they resemble the larvæ. No sooner do they become perfect, by acquiring the organs of flight, than they wing their way from their original dwellings, during the evening, or the stillness of night, and in incalculable numbers. At sunrise, however, by a singular law of nature, they lose their wings, which dry up, become shrivelled, and fall to the ground. In this defenceless state they become the prey of many reptiles, and of insect-eating birds. Indeed they seem not to be despised in that respect even by man himself; for not only are they greedily devoured by Hottentots and negroes, but have been often eaten by Europeans with delight. Mr Smeathman found them "delicate, nourishing, and wholesome, without sauce or other help from cookery, than merely roasting them in the manner of coffee." He indeed discoursed with various friends on the taste of white ants, and on comparing notes, they agreed that these insects were "delicious and delicate eating." One gentleman compared them to sugared marrow, while another thought they tasted like "sugared cream and a paste of sweet almonds."¹ Although prodigious numbers perish in consequence of this migratory instinct, such are their vast powers of fecundity, that old colonies are soon replenished, or new ones formed. According to Smeathman, the provident larvæ seize upon all the winged couples they can find, and shut them up in a roomy cell or nuptial chamber, where they supply them with abundant food; "mais j'ai lieu de présumer," says Latreille, "que l'accouplement a lieu, comme celui des fourmis, dans l'air ou hors de l'habitation, et que les femelles occupent seules l'attention des larves, dans le but de former une nouvelle colonie." The abdomen of the pregnant female (Plate CCXXX. fig. 23) becomes so greatly dilated as to exceed the rest of her body by 1500 or 2000 times, and she is then about a thousand times heavier than her husband. Indeed well she may, if, as is reported, she is endowed with the power of laying *thirty-one million five hundred and thirty-six thousand* eggs in the course of a year. Those fond of arithmetic may try to discover how many grandchildren she is likely to possess by the termination of the ensuing season.

Certain Termites (*T. arborum*) live on trees, where they build nests as large as sugar casks, and from seventy to eighty feet above the ground. These are formed of particles of gnawed wood cemented by a gluten either secreted by themselves, as silk is by caterpillars, or gathered from gummiferous trees. They are so strongly attached to their supporting branches as to resist the violence even of those tornadoes which so often in tropical countries level alike the palaces of kings, and "huts where poor men lie." Indeed they cannot be detached except by being hewn in pieces. The genus *Termes* is not unknown in Europe. *T. lucifugum* of Rossi (*Faun. Etrusc.*) occurs in the southern provinces of France, where it dwells in the interior of various trees. It has so greatly multiplied in the workshops and storehouses of the navy-yard of Rochefort that it cannot be extirpated, and is the cause of constant damage. *T. flavicollis* proves extremely injurious to the olive trees in Spain. Our "favoured isle" is fortunately free from these and many other continental pests,—if an entomologist may so express himself regarding species which would no doubt be highly prized as *British* by many a fond collector.

The remaining Termitinæ are characterized by their bi-articulate tarsi, and their short and indistinct labial palpi. The antennæ consist of about ten joints; the anterior segment of the thorax is very small; and the inferior wings are less than the superior. They form the genus *Psocus* of Latreille, which consists of very small species with short soft bodies, often hunched or inflated, with a large head, setaceous antennæ, projecting maxillary palpi, and incumbent wings, slightly reticulated or but simply veined. These are active insects, living beneath the bark of trees, in wood, straw, &c. Some occur among books and in collections of plants and insects. They seem peculiar to Europe. *P. pulsatorius* derives its name from the sound, resembling the ticking of a watch, which, in common with some other insects, it utters in our apartments. Its anatomy is described by Germar.² We have many British species.

SECTION 5TH, PERLIDES.

Of these the tarsi are furnished with three articulations, and the mandibles are almost always partly membranous and small, with the inferior wings wider than the superior, and doubled on themselves at their inner edge. The genera are *PERLA* of Geoffroy, and *NEMOURA*³ of Latreille (*Phryganea*, Linn.).⁴

FAMILY III.—PLICIPENNES.

The insects of this family have no perceptible mandibles. Their inferior wings are usually broader than the upper ones, and longitudinally plaited. They compose the genus *PHRYGANEA*⁵ of Linn. divided by Latreille into *SERICOSTOMA*⁶ and *PHRYGANEA* proper (see Plate CCXXX. fig. 26). In the larva state (figs. 22 and 25) they live in tubes or cases of their own construction, made of a great variety of substances, according to the species. Latreille regards them as simply herbivorous, although other authors maintain that, in addition to aquatic plants, they prey upon the larvæ of gnats and dragon-flies.

We shall conclude our sketch of this order by observing that the characters and habits of the genus *PHRYGANEA* being very peculiar, the species have in recent times been separated from the neuropterous tribes, and erected into an additional order, *TRICHOPTERA*, Kirby, so called from *τριχος*, *τριχος*, *hair*, in allusion to the usual roughness of the wings. Both Réaumur and Degeer had previously observed that they were allied to the lepidopterous order. "Although some other insects," Mr Kirby has remarked, "*(Myrmeleon and Hemerobius)*, placed in the *Neuroptera*, do not agree with the rest in their metamorphosis, yet in their perfect state they exhibit the principal characters of the order, and therefore are properly retained in it; but *Phryganea* differs from the rest both in metamorphosis and characters. Its metamorphosis is very peculiar, the larva imitating many of the *Tineæ*, in constructing, of various materials, a kind of case for its habitation, from which circumstance they are commonly called *case-worms*; and the pupa, which is *incomplete*, and at first quiescent, just before its final change, by a wonderful provision of an all-wise Creator, becomes locomotive, that it may place itself in a situation of security out

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¹ *Phil. Trans.* vol. lxxi. p. 169, note. The reader will find a good summary of their history in a more accessible work, "Insect Architecture," in the *Library of Entertaining Knowledge*.

² *Magazin der Entomologie*, vol. iv.

³ See *Gen. Crust. et Insect.* t. iii. p. 210; *Règne Animal*, t. v. p. 258; *Encyclop. Méth.* art. NEMOURE; and *Mémoire sur les Larvées de Nemoures*, par F. T. Pictet, in the *Ann. des Sciences Nat.* t. xxvi. p. 369.

⁴ From *φρυγανιον*, a faggot, in allusion, we presume, to the usual aspect of their dwellings while aquatic larvæ.

⁵ From *σπινθηρ*, silk; and *στόμα*, the mouth.

⁶ From *νημα*, a thread, and *ὄψα*, tail.

Hymenoptera. of the water before it casts its exuviae; and for this purpose the antennæ and the four anterior legs are not confined under the general envelope, though each has its peculiar integument, so that the animal can use them when the time comes for it to emerge from the water, and commence a denizen of the air. The imago exhibits few or none of the characters of the other *neuropterous* genera. The wings are veined in a peculiar manner, without reticulations, in some degree like those of *Lepidoptera*. The antennæ resemble much those of the *Tinea* tribe, and the tibiæ of many of them are armed with the two pair of spurs observable in so many of the moths; but they have no spiral tongue, the wings, though hairy, have no scales, the under wings are folded longitudinally, and the head, besides the usual compound eyes, has three stemmata. If these remarks appear to entomologists well founded, and it be thought right to consider *Phryganea* as constituting a new order, I think it might be distinguished, since the names of all the known species are hairy, by the name of *Trichoptera*.¹

ORDER V.—HYMENOPTERA.²

This order, of more direct utility to man than many others, in as far as it contains the species which yield us wax and honey, is characterized, like the preceding one, by the possession of four membranous and naked wings. The mouth consists of mandibles, maxillæ, and an under and an upper lip. The organs of flight, however, differ from those of the *Neuroptera*, in being simply veined rather than reticulated; and the upper wings are always somewhat larger than the under pair. The abdomen of the female is terminated either by an ovipositor or sting. Besides the ordinary visual organs, these insects are all provided with three small stemmatic eyes. The antennæ are variable, not only in different genera, but in different sexes of the same species. In the majority, however, they are filiform or setaceous. The maxillæ and the labium are generally long and narrow, fixed in a deep cavity of the head by lengthened muscles, semi-tubular at their lower portion, often folded at their extremity, and serving rather for the transmission of nutritive juices than for mastication properly so called. Indeed

in several these parts unite to form a kind of trunk or sucker. The ligula is membranous, whether widened at the extremity, or long and filiform, with the pharynx at its anterior base, and frequently covered by a kind of sub-labrum or epipharynx. The palpi are four in number, two labial and two maxillary. The thorax as usual consists of three segments, of which the foremost is very short, and the two remainder are intimately united. The wings cross each other horizontally over the body, and the upper pair have a little rounded convex knob at their base. The abdomen is composed of from five to nine segments, the number being frequently six in the females and seven in the males. It is usually suspended, as it were, to the thorax by a small and slender pedicle; in which case its second articulation seems to be the first, the latter being in fact confounded with the metathorax. The ovipositor and the sting (both being constructed on the same model) are composed, in the generality, of three long and slender pieces, two of which serve as a sheath for the third, which is itself, when under the form of a sting, composed of a pair of pieces joined in one. The tarsi are composed of five articulations, none of which is divided.

The structure of the wings of Hymenoptera has served as the basis of a noted method for their classification, made known by M. Jurine.³ This method is founded on the nature and number of the nervures of the wings, and of the cells or intermediate diaphanous spaces formed by their ramification. The nature of our present treatise, which we have already extended to the proposed limits (and we are still far from our conclusion), will not, however, admit of our entering fully into such details.⁴

The digestive system of Hymenoptera consists in general of two stomachs, of which the second is elongated; of a short intestine, terminated by a widened cloaca; and of numerous biliary vessels, inserted near the pylorus. In regard to their tracheal apparatus, M. Leon Dufour has remarked, that all the Hymenoptera which he has examined exhibit a greater degree of perfection in that part of their structure than any other order of insects. Instead of being composed of cylindrical and elastic vessels, of which the diameter decreases by successive divarications, they present constant dilatations, or determinate vesicles, favourable to the greater or less continuance of air, and capable of being distended or otherwise, accord-

¹ *Linæ. Trans.* xi. p. 87, note.

² *Nouvelle Méthode de classer les Hyménoptères et les Diptères*, 1 vol. in 4to, Geneva, 1807. See also, by the same author, *Observations sur les Ailes des Hyménoptères*, in the 24th vol. of the *Mém. de l'Acad. des Sciences de Turin*.

³ When we examine a hymenopterous insect with a glass, or even by means of the unaided sight, we shall observe that the external or anterior margin of the upper wings presents two strong approximate parallel nervures, deriving their origin from the thorax,

and united by means of a strong expansion of the membrane of the wing. The external nervure is called the *radius*, fig. 1, *a*; the internal the *cubitus*, fig. 1, *b*. Each of these terminates in a dark-coloured expansion called the *stigma*, fig. 1, *c*. Besides these larger nervures, which some call *primitive*, several others spring likewise from the base of the wing, and are named *brachial*, fig. 1, *g*. All these principal branches give rise to shorter intersecting nervures, the interlacement of which partitions the wing as it were into membranaceous departments, designated by the name of cells. Several of these, by reason of their constancy of disposition in each genus of hymenopterous insects, have been used with advantage by Jurine for the purposes of classification. A nervure, called the *radial* (fig. 3, *a*), usually springs from the middle of the stigma, and attaining the tip or anterior angle of the wing, leaves between itself and the anterior margin a membranous space, known as the *radial cell* (fig. 4, *a*). If

there should, moreover, spring from the stigma a lesser nervure, dividing the cell into two parts, we recognise a pair of radial cells. In this case, however, the larger nervure does not derive its origin from the central line of the stigma, but farther back, or from its basal portion (fig. 1, *d*). It sometimes also happens that the radial nervure, proceeding from the stigma, encounters, before it gains the margin of the wing, a small intersecting nervure, itself proceeding from that margin. The radial cell is then said to be appendaged (*appendicée*), fig. 2, *a*.

Another range of cells, of some importance, has received the name of *cubital* (fig. 1, *e*). It is formed by the posterior edge of the radial nervure, and by another nervure named the *cubital*, which springs from the extremity of the cubitus, near the stigma, and

Hymenoptera. ing to the quantity of their contents. On each side of the base of the abdomen there is a large oval vesicle of the kind alluded to, of a dull milky white, giving rise here and there to radiating bundles of vascular tracheæ, which distribute themselves to the neighbouring organs. On entering the thorax it becomes restricted, is again dilated, and ends insensibly in a tube, of which the subdivisions are lost in the head. Behind these two abdominal vesicles the respiratory organ is prolonged in the shape of two filiform tubes, which give off an infinity of little air-bearing branches, and become confluent towards the anal extremity.¹

Hymenopterous insects undergo a complete metamorphosis. Most of the larvæ resemble little worms, unprovided with feet. At least those of the second and following families answer that description. Those of the first family, however, have six feet, furnished with hooks; and besides these they frequently possess from twelve to sixteen others of a simply membranous texture. These latter larvæ are named by the French *fausses chenilles*. Both kinds are provided with a scaly head, with mandibles, maxillæ, and a labium, at the extremity of which is a *spinner* for the passage of that silky substance which is ere long employed in the construction of the nymph's cocoon. Some live on vegetable substances; others, and these are the footless or apodal kinds, feed on insects, with which they are supplied by the provident attention of their mothers, which either carry food to their admirably constructed dwellings, or, as among the Ichneumonides, deposit their eggs at once on living larvæ, of which the excluded young soon become the tenacious and destructive parasites. Among bees a vast number of individuals of ambiguous or undeveloped sex are charged, among other arduous labours, with the sustenance of the helpless young, a task performed with a propriety and precision which, with their many additional attributes of instinctive skill, render their proceedings worthy to be classed, if not as standing miracles of nature, at least as deserving the careful contemplation of the wisest minds.

Happy if full of days—but happier far,
If, ere we yet discern life's evening star,
Sick of the service of a world that feeds
Its patient drudges with dry chaff and weeds,

We can escape from custom's idiot sway,
To serve the sovereign we were born to obey.
More sweet to muse upon his skill display'd
(Infinite skill) in all that he has made!
To trace, in nature's most minute design,
The signature and stamp of power divine,
Contrivance intricate, express'd with ease,
Where unassisted sight no beauty sees,
The shapely limb, the lubricated joint
Within the small dimensions of a point,
Muscle and nerve miraculously spun,
His mighty work, who speaks—and it is done,
The Invisible in things scarce seen reveal'd,
To whom an atom is an ample field:
To wonder at a thousand insect forms,
These hatch'd, and those resuscitated worms,
New life ordain'd and brighter scenes to share,
Once prone on earth, now buoyant upon air,
Whose shape would make them, had they bulk and size,
More hideous foes than fancy can devise;
With helmet heads and dragon scales adorn'd,
The mighty myriads, now securely scorn'd,
Would mock the majesty of man's high birth,
Despise his bulwarks, and unpeople earth.²

Hymenoptera.

In the winged or perfect state, hymenopterous insects generally occur on flowers, and they may be regarded as more abundant in southern than in northern regions. We shall not here dilate upon the generalities of the order, as it is our intention to notice all the more remarkable historical facts, in our sketch of the principal tribes and genera. We shall merely remark, that notwithstanding the numerous and always delightful observations of Réaumur, Degeer, Huber, Latreille, Walkenaer, and others, the hymenopterous order still presents a vast and fruitful field of discovery to the zealous cultivator of entomological science. Christus has combined in a special work³ a great deal of excellent information; but his labours are imperfect in relation to the present condition of the subject. The *Systema Piezatorum* of Fabricius is merely a descriptive catalogue of species, assembled together without any precise notion of sexual distinctions, not seldom inaccurate in the exposition of generic characters, and extremely incomplete in relation to the European species. Jurine has carefully distinguished the sexes, and his groups are an improvement on those of his predecessors. Lepelletier de St-Fargeau,⁴ Serville, Klug,⁵ and, last though not least,

directs itself towards the tip of the wing (fig. 3, *b*). This range is frequently divided into two, three, or four lesser cells, by means of intersecting nervures (fig. 4, *c*, and fig. 1, *c*). If two of these cells are much developed, and the second one, on the contrary, is so circumscribed that it cannot reach the margin of the radial nervure, we have then a peculiar character. The two developed cells, instead of being separated from each other by the entire interval of the second cell, are kept apart, for a space, only by a simple nervure, the length of which is proportional to the curtailment of the second cell; and in this way the latter has no other connection with the radial cell above it, than that it adheres to, or depends from it, as it were, by a kind of pedicle or stalk,—for which reason it is then named *petiolated* by Jurine (fig. 2, *b*). If it happens that the cubital nervure does not attain to the extreme margin of the wing, the spaces which it partly forms are regarded as *incomplete*.

It has been already stated that, besides the large nervures named cubitus and radius, Jurine has distinguished others, which also spring from the base of the wing, as at fig. 1, *g*. These produce others of a secondary kind, which mount towards the cubital cells, sometimes attaining to the first and second, sometimes to the second and third, and sometimes only to a single cell. These have received the name of recurrent nervures (fig. 1, *f*). By anastomosing among themselves, and with the cubitus, the brachial nervures and their branches form several cells, which Jurine has named the *humeral* (fig. 4, *h, h, h, h, h*). Of these Latreille distinguishes as *discoïdal*, such as are situated in the centre of the wing (fig. 2, *i, i*). The recurrent nervures always concur in their formation. Among lepidopterous insects, the cell situated in the centre of the wing is prolonged uninterruptedly as far as the base.

Since we have entered into these details, we may here also mention briefly a few additional particulars, relating chiefly to the nomenclature of the outline of the wings. The *base* is that part which articulates with the thorax (fig. 1, *a, b, g*). The *point, summit, or anterior angle*, is that part which is most directly opposed to the base (fig. 1, *h*). The external, anterior, or upper margin of the wing extends from the base to the summit (fig. 1, *a, c, d, c, h*). The posterior, inner, or anal angle, is formed by the point of union of the posterior and inner margins (fig. 1, *i*). The posterior margin commences at the anterior angle or summit, and ends at the posterior or inner angle (fig. 1, *h, f, i*). The internal margin extends from the posterior angle to the base of the wing (fig. 1, *i, g*).

In addition to the works mentioned in a preceding note, see also the article *AILES* in the *Diction. Class. d'Hist. Nat.*; the article *RADIALES* in the *Encyclop. Méth.*; and M. Chabrier's elaborate *Essai sur le Vol des Insectes*.

¹ *Journal de Physique*, Sept. 1828.

² Cowper's *Retirement*.

³ *Naturgeschichte, Klassifikation, und Nomenclatur, der Insecten vom Bienen, Wespen, und Ameisengeschlecht*, von J. L. Christ. Frankfurt, 1791.

⁴ In various articles and treatises in the *Encyclop. Méth.*

⁵ *Monographia Siricum Germaniæ, atque Generum illis adnumeratum, cum tab. æn. col.* Berlin, 1803; several memoirs regarding *Hymenoptera*, in the *Recueil* of the Society of Naturalists of Berlin; a critical review of the genera of Fabricius, derived from *Apis* of Linn. in Illiger's *Magazin für Insektenkunde*, &c.

menop- our own inestimable Kirby,¹ have published valuable though
tera partial additions to our knowledge of the history and clas-
sification of the hymenopterous tribes.²
prebran- Latreille divides our present order into two primary
tia. sections.

TEREBRANTIA,³

In which the Females are provided with an Ovipositor.

FAMILY I.—SECURIFERA.⁴

Abdomen sessile, or united by the entire breadth of its base to the thorax, of which it appears a continuation, without distinct or separate power of movement. The females have an ovipositor (*tarière*), generally in the form of a saw, and which serves not merely for the deposition of the eggs, but also for the construction of a proper place for their reception. The larvæ have always six scaly feet, and frequently several others which are membranous. This family forms two tribes.

TRIBE 1ST, TENTHREDINETÆ, OR SAW-FLIES.

Of these the mandibles are lengthened and compressed. The ligula is divided into three, as if digitated. The ovipositor is composed of two plates, toothed like a saw, pointed, united, and lodged in a groove of the posterior extremity. The maxillary palpi are always composed of six articulations, and the labial of four. The latter are always the shorter. Both pairs of wings are divided into numerous cells. This tribe corresponds to the great genus *TENTHREDO* of Linnæus.

The abdomen of these insects is cylindrical, rounded posteriorly, composed of nine segments, and so united to the thorax as to appear almost like a uniform continuation of that part. The wings appear as if rumpled, and there are two little grain-like coloured bodies behind the scutellum. The form and composition of the antennæ vary. The mandibles are strong and toothed. The extremity of the maxillæ is almost membranous, or at least of a less coriaceous consistence than the base. The palpi are filiform, or nearly setaceous, and composed of six articulations. The ligula is straight, rounded, divided into three parts, of which the central is the narrowest; its sheath is usually short. The abdomen of the female is provided at its lower extremity with a double moveable ovipositor, scaly, serrated, pointed, and enclosed within two other concave plates, which serve it as a sheath. It is by the action of the teeth of this instrument that the insect perforates the stalks and other parts of plants, in which she lays her eggs. These she afterwards imbues with a peculiar frothy liquor, which seems to prevent the parts of the plant from reuniting, and even causes the formation of a concave chamber, or of ligneous parts resembling galls, in which the excluded larvæ dwell, either in a state of solitude, or in company, according to their kind. After undergoing its final metamorphosis, the perfect insect makes its es-

cape by gnawing a circular overture. The larvæ of many species, however, live exposed upon the foliage of trees and plants. They bear a great resemblance to caterpillars in their general form and colouring, but they present either from eighteen to twenty-two feet, or only six; whereas in caterpillars properly so called, these parts range merely from ten to sixteen. They frequently continue in the larva state for several months, or throughout the winter, and remain but a short time in the nymphal state, previous to the assumption of which they spin a cocoon. We shall briefly notice the principal genera into which these insects are now divided.⁵

In *CIMBEX* of Olivier and Fab. (Plate CCXXXI. fig. 1) the antennæ are alike in both sexes, and terminate in a button-like expansion. The larvæ have twenty-four feet, and some of them when tormented will spout out a greenish liquid to the distance of a foot. In *HYLOTOMA*, Lat. (ibid. fig. 2), the antennæ exhibit only three distinct articulations, of which the last is in the form of an elongated prismatic or cylindrical club, more slender, ciliated, and sometimes forked in the males. A well-known species (figured as above), the *Tenthredo rosæ* of Linn. belongs to this genus. In the genus *TENTHREDO* properly so called (ibid. fig. 3), the antennæ are composed of nine articulations, which are simple in both sexes. The larvæ have from eighteen to twenty-two feet. In the perfect insects the number of teeth of the mandibles varies from two to four. The amount of radial and cubital cells of the wings also varies in different species. Hence the formation of the genera *Allantus*, *Dolerus*, *Nematus*, &c. by Jurine, Leach, and other naturalists. The genus *CLADIUS* of Klug has also nine joints in the antennæ, but those parts are pectinated on one side in the males. In *ATHALIA* of Leach the body is short and thick, as in *Hylotoma*, but the antennæ, simple in both sexes, have from ten to fourteen articulations. The genus *Pterygophorus* of Klug are remarkable for their antennæ, composed at least of sixteen articulations, being pectinated or fan-shaped in the males, and serrated in the females. In *LOPHYRUS* of Lat. (Plate CCXXXI. fig. 4) the antennæ are doubly pectinated in the males, and resemble a triangular plume (fig. 5); they are shortly serrated in the females (fig. 6).⁶ In all the preceding genera the labrum is quite apparent, and the four posterior tibiæ are either unfurnished on their inner side with spines, or exhibit only one. But in the following the labrum is concealed, or but slightly projecting, and the inner side of the four posterior tibiæ exhibits before its extremity two, and frequently three spines. Such are *MEGALODONTES*, Lat. in which the antennæ are serrated or pectinated, and *PAMPHILUS* of the same author, in which those organs are simple in both sexes.

The concluding *Tenthredinetæ* have the ovipositor prolonged beyond the groove, and projecting posteriorly. The antennæ are simple, and always composed of a great number of articulations. They constitute the genera *XYLELA*, Dalm., *CEPHAS*, and *XIPHYDRIA*, Lat. Of the last named the antennæ are inserted near the mouth, and become attenuated towards the termination (Plate CCXXXI. fig. 7).

¹ In his *Monographia Apum Angliæ*, "ouvrage," says Latreille, "qui a immortalisé son auteur."

² Consult also the article *HYMENOPTERES* in the *Diction. Class. d'Hist. Nat.* t. viii. pp. 458-62.

³ From *trebro*, to bore or pierce.

⁴ From *securifer*, a hatchet-bearer, in allusion to the wood-cutting instrument with which these insects are armed,—which, however, happens to be a saw.

⁵ For the details, see Lepelletier de St Fargeau's *Monographia Tenthredinctarum Synonymia Extricata*; Klug's *Entomologische Monographien*; Leach's *Zoological Miscellany*, vol. iii.; and *Règne Animal*, t. v. p. 271, &c.

⁶ *Lophyrus pini*, the species figured on the plate referred to, has become much more common of late years in Scotland, since the plantation and growth of larch forests.

Hymenop-
tera
Terebran-
tia.

TRIBE 2D, UROCERATA.¹

The insects of this tribe are distinguished from those of the preceding by their mandibles, which are short and thick, by their ligula, which is entire, and by the ovipositor of the female, which is sometimes projecting and composed of three thread-like parts, sometimes spirally rolled within the abdomen, and of a capillary form. They compose the old genus *SIREX* of Linn.

The antennæ of these insects are filiform or setaceous, vibratory, and composed of from ten to twenty-five articulations. The head is rounded and nearly globular, the labrum very small, the maxillary palpi filiform, consisting of from three to five articulations, and the labial of three, of which the last is largest. The body is almost cylindrical. The anterior or posterior tarsi, and in several species the colour of the abdomen, differ according to the sexes. The females deposit their eggs in ancient trees, generally in those of the pine tribe. The ovipositor is lodged at the base of the abdomen, between two valves, which form a protecting groove.

In the genus *ORYSSUS*, Lat. (Plate CCXXXI. fig. 9), the antennæ are inserted near the mouth, the mandibles are without teeth, the maxillary palpi are long and five-articulate, the posterior extremity of the body is almost rounded and slightly prolonged, and the ovipositor is capillary and spirally rolled in the interior of the abdomen. There are only two species found in Europe, both of which are exceedingly active, and occur on trees in spring. We have figured *O. coronatus*, the sole British species. In *SIREX* properly so called (*Urocerus*, Geoff.), Plate CCXXXI. fig. 8, the antennæ, inserted near the front, consist of from thirteen to twenty-five articulations, the mandibles are toothed on their inner side, the maxillary palpi are very small, almost conical, of two articulations, and the extremity of the last segment of the abdomen is prolonged in the form of a tail. The ovipositor consists of three threads. These insects are of rather large size. They inhabit more particularly forests of pine and fir, in cold and mountainous countries, and during flight produce a buzzing noise, like that of an humble-bee. The larvæ have six feet, with the posterior extremity of the body terminating in a point. It lives in the interior of wood, where it spins a cocoon, and undergoes its metamorphosis. Our most noted species is the *S. gigas* of Linn. The male has a yellow abdomen, with a black extremity; the female is black, with a yellow spot behind each eye, and the second and three terminal rings of the abdomen also of the latter colour. Owing to the disparity of aspect of the sexes, they have been not unfrequently described by naturalists as distinct species.

FAMILY II.—PUPIVORA.²

The various groups which compose this family are distinguished by the abdomen being attached to the thorax by a simple portion of its transverse diameter, or even in many instances merely by a slender thread or pedicle, so that its mode of insertion is distinct and obvious, and admits of a separate movement. The larvæ are apodal, and for the most part parasitical and carnivorous. Latreille divides them into six tribes, as follows.

TRIBE 1ST, EVANIALES.

In these the wings are raised, and the upper at least are areolated. The antennæ are filiform or setaceous, and composed of from thirteen to fourteen articulations. The mandibles are dentated on the inner side. The maxillary palpi consist of six, and the labial of four articulations. The abdomen is implanted on the thorax,—in some, just beneath the scutellum. The ovipositor is usually projecting, and composed of three setæ.

The following are the principal genera: *EVANIA*, Fab. (*Sphex*, Linn.) Plate CCXXXI. figs. 10 and 13; *PELECINUS*, Lat., ibid. fig. 12; *FÆNUS*, Fab. (*Ichneumon*, Linn.) ibid. fig. 14; *AULACUS*, Jur. and *PAXYLLOMA*, Brébisson.

TRIBE 2D, ICHNEUMONIDES.

In these the wings are also veined, and the superior always exhibit on their disc closed or completed cells. The abdomen takes its rise between the two posterior legs. The antennæ are generally filiform or setaceous (very rarely clubbed), and composed of a great number of articulations. In the majority the mandibles have no tooth on the inner side, and terminate in a bifid point. The maxillary palpi, always apparent or projecting, have usually not more than five articulations. The ovipositor consists of three threads or setæ.

Such is a brief exposition of the technical characters of a tribe of insects which embraces almost the whole of the great genus *ICHNEUMON* of Linnæus, and of which the natural economy and habits are so remarkable that we shall here take leave to extend our observations on their history. Perhaps we could not better illustrate the complex nature of the modern science of Entomology than by stating, that what we must here pass over in the space of a few columns, and which, even in the publications of comparatively recent writers, does not form a very important or greatly enlarged feature, occupies, in a work to which we have lately devoted our attention, upwards of 2800 pages.³

The general term *Ichneumonides* comprehends an extensive series of insects, important on account of the purposes to which they are subservient in the economy of nature, and deriving considerable interest from the peculiar manner in which these purposes are effected. They differ from most of the other members of the class to which they belong, in their mode of providing for their young,—presenting this peculiarity, that they deposit their eggs in the living bodies of other insects. In a tribe of such extent, considerable variety of external appearance necessarily prevails; but a genuine *Ichneumon* may in general be known by its elongated form, attenuated, and in most cases petiolated abdomen, terminated frequently in a long fissile seta; and by its filiform, porrected, often recurved and annulated antennæ, to which a constant vibratory motion is imparted. The European species vary in size from a fraction of a line to fifteen lines; those of tropical countries, however, greatly exceed these dimensions, a few of them ranking even among the largest insects. Upwards of 1300 species have been described as natives of Europe, of which number a great many hundreds exist in Britain.⁴ The frequency of their occurrence, and singular habits of life, which often force them unexpectedly on the notice of naturalists while engaged in the study of insect

¹ From *ovpa*, tail, and *κερας*, horn.

² From *pupa*, and *voro*, to devour, in allusion to their destruction of other insects by depositing eggs in their bodies, which usually destroy the pupæ.

³ We allude to the complete and careful *Ichneumonologia Europæa* of Professor Gravenhorst of Breslau, in three very thick volumes 8vo, 1829.

⁴ In the *Systema Naturæ* (12th edition), Linnæus describes only seventy-seven species of *Ichneumon*.

Hymenop-
tera
Terebran-
tia.

ymenop- transformations, have secured some degree of attention for
tera this tribe, even from the earliest periods. The word
erebran- Ichneumon occurs in the natural history of Aristotle, by
tia. whom it is applied to a species of Sphex. Ray appears
to be the first who used it to designate the tribe of insects
to which it has ever since been restricted. Little, how-
ever, was known regarding the structure or habits of these
creatures till the time of Frisch, who subjected them to
an anatomical examination, and described the parts of the
mouth, and formation of the wings, with great accuracy
and minuteness. He was the first who employed the
form and relative position of the cells of the latter to as-
sist in distinguishing genera. Much valuable information
resulted from the observations and experiments of Réau-
mur, whose work may be referred to for many interesting
details regarding the manners and habits of the Ichneu-
monides.¹ Degeer also contributed materially to eluci-
date their history, and proposed a new arrangement of
the family, characterized by his usual accuracy of discrimi-
nation.

In the numerous works on Entomology which appeared
during the latter half of the eighteenth century, our know-
ledge of these insects kept pace with the increased zeal
manifested towards the study of natural history during
that important period. Linnæus, Scopoli, Fabricius,
Schrank, Panzer, and others of inferior name, applied
themselves successfully to investigate their history—re-
ducing the information derived from their predecessors to
a more systematic form, and greatly increasing the amount
of known species. In 1807 Jurine published his new method
for the classification of Hymenoptera, already mentioned.
The application of his principles to the Ichneumonides
afforded less satisfactory results than in most of the other
tribes. Like all systems founded on a partial view of or-
ganic structure, it led, in many instances, to the violation
of natural order, by separating cognate species, and asso-
ciating others having no positive affinity. But though
Jurine failed to establish an efficient mode of arrange-
ment, he rendered important service to subsequent inquir-
ers, by describing minutely, and furnishing with a suitable
terminology, the variously modified forms of the organs
of flight, which are found to afford characters of consid-
erable value for the discrimination of genera. Latreille
at different times published arrangements of this tribe,
and by the number of his sectional divisions, generally
founded on obvious characters, greatly facilitated the iden-
tifying of species.² But the amount of these had increas-
ed to such an extent, and they were found to approximate
so closely to each other in external characters, that a
comprehensive division, and a more detailed description of
specific difference, became indispensable. This desidera-
tum has recently been supplied by the publication of an
extensive and elaborate work on the Ichneumonides by
Professor Gravenhorst; an individual eminently qualified
to unravel the complexities of this difficult tribe. An ex-
tensive intercourse with men of science enabled him to
amass a large collection of these insects from all parts of
Europe; while habits of minute observation and patient
research, combined with just views of systematic arrange-
ment, and an accurate perception of the affinities of con-
secutive groups, qualified him to employ to the best ad-
vantage the ample materials thus obtained. The result
of his labours appeared in 1829, as specified in a note on
our preceding page. The arrangement adopted is funda-
mentally the same as that previously published by him-
self and Nces ab Esenbeck.³

The body of the Ichneumonids is more or less elongated,
and in most instances naked and shining, seldom rough
or impressed with punctures. It is occasionally covered,
particularly on the head and thorax, with a pubescence
composed of slender erect hairs, or it is somewhat seri-
ceous and opaque, with a soft decumbent pubescence.
The prevailing colours are rufous, black, and yellow, va-
riously intermingled with lines and patches of white. In
the great majority of species, there are one or two spots
of the latter colour on the thorax, at the insertion of the
wings. The scutellum is most frequently white. The
feet are very often of a reddish colour, at times red and
black; but they are never entirely black, the anterior fe-
mora being always pale on the under side. The head is
prominent, generally orbiculate or subovate anteriorly, in
many instances a little narrowed towards the neck, and
nearly of the same breadth as the thorax. The forehead
is sometimes armed with one or two short erect horns,
placed between the antennæ and stemmata. The latter
are three in number, and disposed in a triangular form.
The antennæ in the greater number of species are shorter
than the body; in a few they are of the same length, very
rarely longer, porrected, generally curved or involuted
after death, especially in the females, filiform or setaceous,
sometimes slightly compressed at the middle, as in some
species of *Phygadeuon*, distinctly compressed in the *Bary-*
cerotes, much compressed and dilated in the *Eucerotes*, and
clavate in the *Hellwigia*. They consist of from eigh-
teen to sixty articulations, of which the first or radicle is
small, globose, and sunk in the head; the second or scape
sub-cylindrical or sub-clavate, rarely ovate, very rarely
sub-globose, always thicker than the rest (except in the
antennæ of the *Barycerotes* and the *Eucerotes*), and longer
than the two following; the third and fourth very short,
rather stout, and often so closely united that they may be
regarded as one joint; the fourth always shorter than the
third, which is at times very inconspicuous; the fifth long,
cylindrical; the remainder gradually decreasing in length,
so that the apical joints often appear transverse. Such is
the general appearance of the antennæ; but they are lia-
ble to numerous modifications. The mandibles are cor-
neous, more or less arcuate, generally broadest at the
base, and narrowed towards the apex; in a few instances
they are straight, and in others linear, or even dilated at
the extremity, where they are furnished with two teeth,
except in a very few species, which have the apex entire
or tridentate. The maxillæ consist of two parts, of which
the basal portion, or stipes as it has been called, is usually
of a corneous consistence and somewhat lanceolate form;
the other portion (mala) is of a membranaceous substance,
and bifid or bipartite. The palpi are four in number, elon-
gate, filiform, and unequal; the maxillary are rather long,
and consist of five joints, very rarely of four. They have
been described by Fabricius and Panzer as having six
joints. The third joint is generally the longest; the
first, second, and fourth, very short; sometimes, however,
one or other of these, or the fifth, is longest, and in a
very few cases the third is shortest; in some species all
the articulations are of equal length. The labial palpi
are rather short, and consist of five joints, very rarely of
three.

The Ichneumonides, like the rest of the Hymenoptera,
are provided with four wings, composed of thin mem-
brane, and of corneous ribs. These ribs are generally deno-
minated nerves or nervures; and the various spaces into
which the wing is divided by their intersection are called

¹ *Mémoires*, tome ii. iv. et vi.

² *Histoire Naturelle, générale et particulière, des Crustacés et des Insectes*, tom. iii. et xiii.; see also *Règne Animal*, t. v. p. 281.

³ The arrangement alluded to appeared in 1813, in the 9th volume of *Novorum Actorum Academiæ Naturæ Curiosorum*.

Hymenoptera
Terebrantia.

cells or arcolets. The base of the wing (*radix*), or that portion of it which is inserted into the thorax, is of a substance intermediate between corneous and membranaceous, and is always more or less coloured. It is partially covered with a hard convex scale (*squamula*), which, however, may more properly be regarded as an appendage of the thorax. The anterior wings (fig. A) are longer than the posterior, narrow throughout a considerable portion of their length, and gradually dilated towards the extremity. The *stigma* (*a*) is distinctly marked, and varies

much in size. The thick rib of the anterior margin, extending between the stigma and the dorsal angle of the wing, is called the *radius* (*b*). By the anastomosing of the nerves, ten or eleven cells are formed, of which the three at the base of the wing are named humeral (*humerales*), 1, 2, 3; one radial (*radialis*), 4; two or three cubital (*cubitales*), 5, 6, 7; two lying under these discoidal (*discoidales*), 8, 9; and two towards the margin posterior (*posticae*), 10, 11. When the cells are viewed in relation to the breadth of the wing, the three situate at the apex or posterior margin are said to be external (5, 8, 10); those next the humeral cells internal (7, 11); and those between the external and internal cells intermediate (6, 9). Of the humeral cells, that which lies next the radius is named the external (1), that next the margin the internal (3), and that which lies between these two the intermediate (2). The intermediate cubital cell (6) is generally denominated the areolet, and is important on account of the distinctive characters it affords. The interior cubital cell (7) is very large, in consequence of the nerve which ought to divide it into two parts, at least which does so in the other Hymenoptera, having become obsolete. In many species, however, a portion of this nerve is visible (*z*); and in some instances it extends nearly to the centre of the cell; but it is usually very short, or a projecting angle alone indicates the point whence it ought to issue; and in the less typical species all traces of it are obliterated. The areolet likewise is occasionally wanting; different individuals of the same species have it or have it not; and examples occur in which it is distinctly formed in one wing and wanting in the other. In general, however, it is present, and may readily be distinguished from the other cells by its inferior size and angular form. It is either five-angled or quadrangular, triangular or orbiculate. But all these forms are liable to numerous modifications, and one passes into another. The posterior wings (B) are shorter and narrower than the anterior, and nearly of equal breadth throughout. By the anastomosing of the nerves, seven cells are formed, of

which the three at the base of the wing are named internal (1, 2, 3), and four at the posterior margin external (4, 5, 6, 7). In the sub-genus *Pezomachus* the wings are generally absent, and when present are extremely imperfect, and usually unfit for the purposes of flight, although their structure, as far as it can be traced, exactly corresponds to that of the more perfect species. The abdomen, which is very variable in form, is composed of seven or eight segments, the eighth being more or less concealed, and often entirely obsolete. This imperfect development of some of the segments has led authors to give various accounts of their number. In addition to the seven usually enumerated, Audouin is of opinion that there is another of very small size, which unites the abdomen to the thorax. According to Blainville, there are never fewer than ten segments, of which the two at the apex are always concealed. The first or basal segment bears on each side of it a small tubercle, more or less distinct, which forms the outlet to a spiracle. When the tubercles are placed very near the base, and the anterior part of the basal segment is not much narrower than the following segments, and these nearly correspond to the breadth of the thorax, the abdomen is said to be sessile; the posterior part of the first segment being so short that it can with difficulty be distinguished, and the anterior part consequently appearing to adhere immediately to the thorax. If this segment, or the posterior part of it, be gradually contracted towards the base, the abdomen is said to be sub-sessile or sub-petiolate. When the posterior part is narrow and elongated, linear or filiform, that part is called the petiole or footstalk, and the abdomen is said to be petiolate.

The sexes of these insects can with difficulty be distinguished,—few species affording any permanent external marks of sexual difference. The males in some instances differ from the females in having a more slender abdomen, in others the antennae are thicker, and in some species they are more slender than in the females. Many of the latter are distinguished by having a white ring round the antennae,¹ which after death become curved or spirally convoluted. The males may frequently be known by having the colours with which they are adorned clearer and more distinctly defined than in the opposite sex. But the most certain, and often the most obvious mark of sexual distinction, is the ovipositor with which the females are provided. This remarkable appendage varies in its form, in fine accordance with the varied economy of different species. Some Ichneumons deposit their eggs on the bodies of caterpillars; an operation which they accomplish by merely piercing the skin. Others, in order to lodge their eggs in a proper receptacle, are obliged to perforate the nests of insects, and to penetrate to the bottom of crevices too narrow to admit of the whole body. The former are furnished with a short, retractile ovipositor, seldom exerted, and lodged in a groove on the under side of the abdomen. But the ovipositor of the latter is often of considerable length, exceeding in some instances that of the whole body. It is composed of three parts; that in the centre is a slender flexile seta, of a corneous substance, very smooth and shining, generally straight and rounded, rarely arcuate and compressed, and most commonly of a rufous or castaneous colour. It is provided with a longitudinal central canal, through which the eggs are propelled. The apex is often compressed and dilated, and impressed with transverse inequalities; it is frequently compressed throughout its whole length, and occasion-

¹ In regard, however, to this distinctive character between the sexes, Gravenhorst observes in his preface (page 10)—“nonnullarum mares quoque hoc ornamento gaudent.”

Hymenop-ally bent upwards at the extremity. On each side of this
tera central seta is placed another, adapted, by the concavity
Terebran- of the inner surface, to enclose it as in a sheath. These
tia. lateral appendages are generally punctate and pubescent
externally, and somewhat incrassate towards the apex. They issue from the terminal segment of the abdomen; but the central tube or oviduct originates in the interior, and must necessarily be connected with the viscera, to whose contents it forms the outlet.

When a female Ichneumon, furnished with an apparatus of the kind just described, has discovered the retreat of a larva or pupa, in which she wishes to deposit her eggs, she stations herself immediately over the spot, and raising her abdomen to a vertical position, bends the ovipositor under her belly, and thrusts it into the aperture. This operation is much facilitated by the great flexibility of the instrument, and the ease with which it can be accommodated to any circumstances in which it requires to be employed. It penetrates to a considerable depth into the body of the larva, lest the eggs, by being placed near the surface, should be thrown off when the skin is changed. Upon their exclusion from the egg, the parasitical young make their way still farther into the interior of the larva, consuming the fat that surrounds the muscles and viscera, but carefully abstaining from doing injury to the vital organs. In this state they are gregarious, and were found by Réaumur (who has given a figure of a caterpillar so infested) to be arranged in regular rows in the interior of the caterpillar. When they have arrived at maturity, they undergo their destined change either in the body of the larva which served them as a matrix, or, gnawing a passage through its skin, they construct externally their silk cocoons, and are then converted into pupæ, from which, after a longer or shorter period, they emerge in their declared or perfect form.

A still more remarkable method of rearing its offspring is adopted by the *Ophion luteus*, and probably by all the other species belonging to that genus.¹ The eggs of this insect are deposited on the caterpillar of the Puss Moth (*Cerura vinula*), to which they firmly adhere by means of an elongated pedicle or foot-stalk. When the larvæ are evolved, they do not enter the body of the caterpillar, but remain attached to the columnar appendage, through which they extract, by suction, the juices necessary for their sustenance. The caterpillar dies before it assumes the pupa state, but this event in no case proves fatal to the larvæ, as it either does not occur till they require no further nourishment, or they avail themselves of that principle of accommodation to existing circumstances, which insects possess in such a remarkable degree, and undergo their destined changes as soon as their supply of food begins to be withdrawn.

Ichneumons are generally active and rapid in their motions; many of them, particularly those belonging to the genera *Ichneumon* proper, and *Cryptus*, continually vibrate their antennæ, a circumstance which induced the older writers to call them *Muscæ vibratoriæ*; others, such as the *Ophiones*, are of slower habits, and have not been observed to exhibit this peculiarity in the movements of their antennæ. The larger species fly with considerable celerity, and cannot very readily be approached, unless when engaged in depositing their eggs; an operation with which they are so entirely engrossed, that all regard for their own safety appears to abandon them. They occur in flowers, on the trunks of trees, and on plants; also on walls and in houses; but their favourite places of resort are the flowers of umbelliferous plants.

The species furnished with a long ovipositor usually frequent walls and the trunks of trees, for it is in these situations that they find the larvæ on which a singular instinct leads them to deposit their eggs.

Our knowledge is obscure regarding the food of these insects in the perfect state; but it appears to be derived from the vegetable rather than the animal kingdom. We kept one alive, however, during the greater part of a winter on calf-foot jelly. They have often been observed to examine carefully with their mouths the pollen of plants; and it is probable that the pollen, or rather the honey, of flowers, affords them nourishment. Indeed it is expressly affirmed by Fabricius, that it is this material which forms their food. They do not seem to attack or devour other insects, or larvæ, or spiders, but associate with them without offering the least annoyance. It is likely, therefore, that those authors who assert that they are of predatory habits, mistook for Ichneumons certain species of an allied group (*Sphages*), to which they bear resemblance. Whenever they attack a larvæ, it is not for the purpose of employing it as food, but to convert it into a matrix for the reception of their young. But, though they do not devour spiders, as has been asserted, that insidious tribe of creatures is by no means exempted from their destructive visits,—for they oviposit either on the spiders' eggs, or on the dense silky web in which these are frequently enveloped; and the larvæ when excluded consume the substance of the eggs, and are then changed into nymphs and perfect insects within that silken chamber, so carefully constructed for a far different purpose.

The larvæ of the Ichneumonides are without feet. The tissue of their cocoons is of fine silk, usually of a beautiful yellow, or pure white, according to the species. Some, however, are banded with brown and yellow. We have already stated that their positions are various. A remarkable instance is occasionally met with of a *suspended* cocoon. It hangs to the leaves or twigs of the oak-tree, fastened at one extremity by a silken cord. This cocoon is farther remarkable for the manner in which it executes little springs, several inches in height. These are no doubt occasioned by the enclosed larva, which probably has space enough within to admit of its body being bent and retorted, after the fashion of the little worms which we sometimes see vaulting within the hollow walls of an old cheese.

Several Ichneumons are apterous. These Linnaeus placed with the Mutillæ. Degeer describes one which proceeded from a ligneous gall which he found upon the stalk of a species of *Potentilla*. It first attracted his notice by two inflated conical pieces, pointed at the end, attached to the upper and posterior portion of the thorax, and directed backwards. They were moveable at the base, and the insect worked them about in all directions while itself in motion. It was extremely small, and leapt with great activity. As its hinder thighs were not enlarged, Degeer inferred that its springs were produced by curving its abdomen, and then pressing that part forcibly against the plane of its position.

In regard to the situations most favourable for collecting Ichneumonides, we may observe, that wherever other insects, especially in the larva state, abound, there also we may expect to find multitudes of these parasitical depredators. Having so greatly extended our general observations on this interesting tribe, our limits will less easily admit of our entering into descriptive details of genera and species. For these the reader must consult the works to which we have alluded. We shall however

¹ Degeer, ii. p. 850, pl. xxix. fig. 15.

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enumerate the genera adopted by Latreille. They are as follows: STEPHANUS, Jur. (Plate CCXXXI. fig. 15 and 16); XORIDES, Lat.; PIMPLA (ibid. fig. 19); CRYPTUS, OPHION, and BANCHUS, Fab., Helw.; JOPPA, Fab. (ibid. fig. 21); ICHNEUMON proper (ibid. fig. 17); ALOMYA, Fab.; PELTASTES, Illiger (ibid. fig. 18); ACÆNITUS and AGATHIS, Lat.; BRACON, Jur.; MICROGASTER, Lat.; HELCON, Nees d'Es.; SIGALPHUS, Lat.; CHELONUS, Jur.; ALYSIA, Lat.¹

We shall now exhibit a few examples of Gravenhorst's systematic exposition of the Ichneumonides, and these we shall select from British species.

GENUS ICHNEUMON, Grav. Abdomen petiolate, convex; head transverse; scutellum flat or convex; areolet in most instances pentagonal; (ovipositor concealed or sub-exserted).

This genus includes a great many sub-genera, of which we shall choose the first, or that which bears the same name as its principal, viz.

Sub-genus Ichneumon. Abdomen oblong or sub-ovate; the first segment globose, rough, the petiole long, linear, arcuate; areolet pentagonal; antennæ and feet of moderate or medium size; (ovipositor concealed or sub-exserted).

Section 7th of Gravenhorst.

Scutellum pale; the abdomen either with pale markings, or some of the segments entirely yellow, the apical segment black.

I. luctatorius, Fab. Linn. Lat. Grav. Length of the male from five to nine, of the female from five to seven and a half lines. The head of the male, with the mouth and face, yellow; of the female, either entirely black, or, with the interior orbits of the eyes, a lateral spot on the clypeus, the palpi and mandibles, yellow, the apex of the latter fuscous. Antennæ of the male porrect, setaceous, half the length of the body, or a little longer, the first joint yellow beneath; those of the female half the length of the body, curved at the tip, from the ninth to the thirteenth, or from the twelfth to the fourteenth joints, white above, the basal joint sometimes ferruginous beneath. Thorax gibbous; with a yellow line or spot before the wings, and another beneath them, one of which is occasionally wanting; the anterior line, in the female, ascending as far as the neck, of which the upper margin, in the male, is at times yellow; the male has sometimes a yellow spot beneath the scutellum. Scutellum yellow. Wings of moderate size, or rather ample, silaceo-hyaline; the stigma fulvous or ferruginous, rarely fuscous, the radius fuscous or ferruginous; the radix yellow or ferruginous, rarely fuscous; the squamula either yellow or fuscous, with a whitish or rufescent spot; the areolet pentagonal. The feet of moderate size; the anterior femora on the under side, and for the most part at the apex also, yellow, black towards the base, and sometimes entirely black: the intermediate femora, with the apex, sometimes as far as the middle, and in a few cases the whole under surface, yellow; tibiæ yellow, the posterior black or fuscous at the apex; tarsi yellow, or flavo-ferruginous, the posterior with the tips of the joints

sometimes blackish. Abdomen of the male elongated, longer sometimes by one half than the head and thorax, of the same breadth or a little narrower than the thorax, from the second to the third segments nearly of equal breadth, the following gradually narrowed towards the extremity; that of the female oblongo-ovate, a little longer than the head and thorax, and of the same breadth, the apex acute; the second and third segments yellow, in some females mixed with ferruginous and the margins fuscous; the second segment of the males occasionally with a lateral abbreviated fuscous line, the third with a transverse line or two fuscous spots at the base; the fourth generally with a fulvous or rufous spot in the angles at the base, and more rarely the outer margin, or the base, or a lateral mark, rufescent or yellowish; the fifth very rarely with the outer margin yellowish.

The males of this species occur in considerable profusion in Britain, and throughout the greater part of Europe; the females are very rare.² They frequent sides of fields, and open places in woods, and are often to be found on umbelliferous plants during the autumnal months. They are liable to great variation both in size and colouring. Roxburghshire, and near Edinburgh, in considerable plenty.

GENUS TRYPHON, Grav. Abdomen convex, petiolate, or sub-sessile; head transverse; scutellum flat or convex; areolet triangular, or irregular, or absent; (ovipositor concealed, or sub-exserted).

Sub-genus Tryphon. Abdomen oblong, sub-sessile, or sub-petiolate; antennæ slender or middle-sized; feet of moderate length.

Section 4th of Gravenhorst.

Scutellum black, abdomen either entirely rufous, or rufous and black, or yellow and black.

T. elongator, Grav. Fab. Length from two and a half to five lines. The mouth generally rufescent, the apex of the mandibles black, or entirely black. The forehead with an erect horn, variable in length, but never exceeding that of the basal joint of the antennæ. Antennæ setaceous, shorter than the body; the first joint black, very rarely ferruginous beneath; the following generally fulvous or ferruginous, fuscous above, sometimes entirely fulvous or ferruginous. Thorax gibbous. Wings most commonly yellow-hyaline; the stigma and radius ferruginous, or pitchy straw-coloured, the radix straw-coloured, the squamula either black or pale ferruginous; areolet irregular or sub-triangular, sub-petiolate or sessile. Feet rather stout, the coxæ and trochanters black; the anterior femora yellow or testaceous, black externally towards the base; the intermediate femora black, with the apex yellow or testaceous, sometimes almost entirely testaceous on the under side; the posterior femora entirely black; the tibiæ yellow, rarely testaceous, the hinder with the apex and base black; the tarsi rufous or rufo-ferruginous, claws fuscous. Abdomen sub-petiolate, generally longer than the head and thorax, and nearly of the same breadth, sub-clavate, or sub-ovate, or fusiform; first segment canaliculate, gradually dilated towards the apex, about one half longer than broad, generally black, with the margin ru-

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¹ For their characters, see *Règne Animal*, t. v. pp. 285-90.

² It is probable that the predominance in number of one sex over the other, so often alluded to by authors as an anomalous fact in the history of Ichneumons, is more apparent than real, and arises, in some instances, from the distinctive marks of sex being so slight as to elude observation, while in others the sexes are so dissimilar that each of them is received as a different species. The determination of the sexes is impeded by the difficulty of observing their intercourse. "Nunquam mihi successit," says Gravenhorst, "par copula junctum aut copulam parans invenire, licet forsan centum millia individua viva Ichneumonidum, in statu eorum libero naturali, viderim, et per triginta annos omnem operam dederim ut copulam viderem." (Vol. i. page 98.)

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fous or fulvous, sometimes almost entirely rufous or fulvous, with the base black; the second, third, and fourth segments, sometimes also the base of the fifth, yellow or fulvous. Ovipositor very short, black, generally concealed.

This species abounds in most parts of Europe. It is plentiful in England, and is not unfrequent in Roxburghshire and other southern counties of Scotland. It likewise occurs near Edinburgh.

GENUS *ALOMYA*, Grav. Abdomen petiolate, convex; head globose; areolet triangular.

A. ovator, Grav.; *Ich. ovator*, Fab. Lat.; *Ich. elongator*, Gmel. Oliv. Length from five and a half to seven and a half lines. Head sub-globose, somewhat quadrate when viewed from above, with the angles obtuse, sub-transverse; the face sometimes with a slightly elevated tubercle. Antennæ of the male setaceous, shorter than the body, or nearly of the same length, porrect, entirely black; those of the female moniliform, not half the length of the body, incurved at the apex, from the third to the thirteenth or fourteenth joints, ferruginous or testaceous, gradually becoming paler. Thorax very slightly gibbous. Scutellum triangular, flat. Wings of moderate size, hyaline or smoky-hyaline, the stigma ferruginous or fulvous, the radius piceous, the radix piceous or fuscous or ferruginous, the squamula black or fuscous; areolet pentagonal. The feet of the male with the coxæ and trochanters black; the femora of the fore legs ferruginous or fulvous, generally with the apex sub-testaceous and the base black; those of the middle legs generally black, with the apex ferruginous; those of the hind legs entirely black; the tibiæ yellow or testaceous, the hinder occasionally with the apex fuscous; the tarsi testaceo-ferruginous. The legs of the female are shorter and thicker than in the male, the coxæ, trochanters, and femora black, the latter, in the fore legs, for the most part almost entirely, or the apex only, rufous or ferruginous; the tibiæ either entirely ferrugino-testaceous, or testaceous with the apex ferruginous; tarsi fusco-ferruginous. Abdomen petiolate, convex, elongate; that of the male rather more than one half longer than the thorax, and nearly of the same breadth, the segments from the second to the sixth equally broad; the petiole linear and slender; the colour black and rufous, variously intermingled. Ovipositor concealed.

This species is of frequent occurrence both on the continent of Europe and in Britain. Gravenhorst is of opinion that *Alomya victor*, Curtis, *Ent. Brit.* 120, is a variety of this species.

GENUS *CRYPTUS*, Grav. Abdomen petiolate, convex; head transverse; scutellum flat or convex; (ovipositor exserted.)

Sub-genus Pezomachus, from *πεζομάχος*, a fighter on foot, because the species, from the imperfect development of the organs of flight, are unable to attack larvæ on the wing. Body small; abdomen petiolate; wings wanting or very small; ovipositor exserted, short, or of ordinary length.

P. Hopei, Grav. *Supplementa Partis* ii. vol. i. p. 715. Length from two and a fourth to two and a half lines. Head black, palpi rufous. Antennæ slender, curved, rather more than half the length of the body; from the first to the fifth joint rufous, the sixth or the sixth and seventh fuscous, from the eighth to the eleventh white, rufous beneath, the remainder rufous, fuscous above. Thorax and scutellum rufous; metathorax with two very short obtuse spines. Wings shorter than the thorax. Feet somewhat slender, rufous; the apex of the hinder femora, and sometimes of the tibiæ, black, the base of the latter whitish. Abdomen scarcely longer than the head and thorax, and a little broader, oblong-ovate; the three

basal segments rufous; the fourth, with the sides and sometimes the base, also rufous; the fifth and sixth black; the seventh white. Ovipositor rather more than half the length of the abdomen, the sheath black, the tube rufous.

This insect, hitherto found in Britain only, occurs not unfrequently in oak coppices in Roxburghshire, near Minto, Cavers, &c. It is named by Gravenhorst after a distinguished English collector, our honoured correspondent, the Rev. F. W. Hope, by whose effective practical researches the *Ichneumonologia* has been enriched by many new species.

GENUS *PIMPLA*, Grav. Abdomen convex, sessile; scutellum triangular or sub-orbicular; (ovipositor exserted).

Sub-genus Lissonota, from *λίσσος*, smooth, and *νότος*, the back, in allusion to the smooth upper surface of the abdomen. The abdomen in most smooth, shining; the apical segments of the female entire on the under side; areolet either wanting or triangular; (ovipositor long).

Section 1st of Gravenhorst.

Scutellum and abdomen black; the latter sometimes with the apical margin of the segments castaneous.

L. setosa, Grav.; *Ich. setosus*, Oliv.; *Ich. immaculatus*, Gmel.? Length from seven to nine lines. Labrum sometimes obscurely ferruginous. Antennæ subfiliform, somewhat incurved and tapering towards the apex, half the length of the body, at times nearly of the same length. Thorax slightly gibbous. Wings of moderate size, smoky-hyaline, the stigma and radius nigro-fuscous, the radix piceo-fuscous or piceo-ferruginous, the squamula black or fusco-ferruginous; areolet sessile or sub-petiolate, triangular. Feet elongate, fulvous, the coxæ black, the posterior tarsi for the most part black or fuscous. Abdomen a little longer and narrower than the head and thorax, or of the same breadth, punctate; that of the male sub-cylindric, somewhat narrowed towards the apex; that of the female oblong or sub-cylindric; the margins of the segments elevated, shining; the first segment sub-canaliculate; the third sometimes fuscous. Ovipositor the length of the body; the tube black or fusco-castaneous, rarely fulvous.

This insect is pretty widely distributed over the north of Europe, and is found occasionally in England.

Sub-genus Pimpla. The segments for the most part transversely impressed, the intermediate ones broader than long, those at the apex having, in the females, a longitudinal groove or fissure on the under side; the areolet triangular; (ovipositor of moderate size, rarely long).

Section 6th of Gravenhorst.

Scutellum, thorax, and abdomen black; the latter sometimes with rufous bands; posterior coxæ black.

P. examiner, Grav.; *Cryptus examiner*, Fab.; *Ich. rufescens*, Gmel. Length of the male from one and two thirds to four and a half, of the female from two and a half to six lines. Palpi of the male whitish or yellowish, rarely piceous. Antennæ of the male either entirely black, or ferruginous on the under side towards the tip, with the first and second joints, or the first only, whitish. Thorax of the female, rarely that of the male also, with a whitish or straw-coloured line or spot, sometimes obsolete, before the wings. Wings smoky-hyaline; the stigma and radius black or fuscous, rarely piceous; the radix straw-coloured, in the females for the most part ferruginous or fuscous; the squamula of the male straw-coloured or fuscous, of the female ferruginous or fuscous, generally with a whitish spot, seldom entirely whitish; the areolet irregular, sessile or sub-sessile. Anterior feet rufous or ful-

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vous, the coxæ and trochanters black, in the male sometimes yellow beneath, the tibiæ generally with a pale ring near the base; the posterior legs, with the coxæ, black, having very rarely a rufous mark, or the outer side entirely rufous; trochanters black, the apex in the male generally rufous; femora rufous or rufo-fulvous, the knees sometimes black, the whole outer side in some females black; tibiæ blackish, with a whitish ring near the base, in the male sometimes rufous near the apex; tarsi of the male black, of the female fuscous or fusco-ferruginous. Abdomen of the male longer, and rather narrower than the head and thorax, sub-cylindrical; that of the female a little longer than the head and thorax, sometimes twice the length of the thorax, and of the same breadth, sub-cylindrical or oblongo-ovate; the first segment scrobiculate at the base, the rest with their apical margins somewhat elevated, shining, and generally obsoletely castaneous, in the male sometimes ferruginous. Ovipositor half the length of the abdomen, or a little shorter.

This species usually deposits its eggs on the larva of some kind of moth, and specimens have been obtained from the pupa of *Tinea padella*, and *Bombyx fuliginosa*. It is not a scarce insect on the continent of Europe, and it occurs both in England and Scotland. Near Cavers, Roxburghshire, and in the vicinity of Edinburgh.

Sub-genus Ephialtes. Abdomen long, in most instances tuberculated; the anterior segments, and generally the intermediate ones also, longer than broad, those at the apex with a longitudinal groove on the under side in the females: areolet triangular: (ovipositor long).

E. manifestator, Grav.; *Ich. manifestator*, Linn. Length of the male from six to eleven, of the female from nine to fifteen lines. Palpi fuscous or ferruginous, the labrum sometimes obscurely ferruginous. Antennæ filiform, half the length of the body, or a little longer, porrected, often slightly curved at the tip. Thorax occasionally with a minute testaceous or ferruginous spot at the base of the wings. Wings of moderate size, more or less smoky-hyaline, the stigma more or less obscure; radius fuscous, radix and squamula ferruginous or straw-coloured, areolet somewhat regularly triangular, sessile or sub-petiolate. Feet somewhat slender and elongated, fulvous or rufous; the posterior tarsi and tibiæ, and sometimes the knees, fuscous, the tibiæ for the most part ferruginous towards the base, especially on the inner side. Abdomen more than one half, or three times longer than the head and thorax, of the same breadth as the thorax, or a little narrower, cylindrical, black, very rarely fuscous; the first segment canaliculate, the rest more shining, with an obsolete lateral tubercle and elevated margins, the length of the segments from the first to the fifth exceeding their breadth often by one half. Ovipositor longer than the body, rarely of the same length, the sheath somewhat pilose; the tube fuscous or rufo-castaneous, rarely black or straw-coloured, the apex sub-compressed, lanceolate, faintly impressed with transverse lines.

This insect, which is the largest of the European Ichneumonides, occurs not unfrequently in many parts of Europe. It is found in England; and in Scotland it has been observed in Roxburghshire, and near Edinburgh. "On the first of October," says Gravenhorst, "I observed many females of this species on the decaying trunk of a willow, about to deposit their eggs. They traversed with much assiduity the barkless trunk, which was perforated with numerous holes, inhabited no doubt by the larvæ of other insects; and so free were they from apprehension, that when I touched them with my finger they did not fly off, but only slightly averted their bodies. They searched out and examined the holes by means of their antennæ, which were vibrating incessantly, and ex-

ploring on all sides. When they had selected a hole, they stationed themselves with the four anterior legs over it, and raising the body as high as possible, and the abdomen perpendicularly, bent the ovipositor downward in such a manner that it passed under the belly and thorax, and entered the hole over which they stood. It not unfrequently happened, when the hole was sufficiently large, that the whole abdomen was inserted, and the head, feet, and thorax were the only parts of the insects which remained free. Frequently also a contest took place between two females for the possession of a hole; but they did not employ their mandibles on these occasions, their fighting consisting entirely of violent concussions of their bodies, and strokes of the feet, till the weaker party retreated. When a female had obtained full possession of a hole, no attack could displace her; but she retained her seat even though assailed by a more powerful antagonist."

GENUS METOPIUS, Grav. Abdomen sessile, convex, rough; scutellum quadrangular, the apical angles acute; (ovipositor concealed).

M. necatorius, Grav.; *Peltastes necatorius*, Illiger, Curtis, *Brit. Ent.*; *Ich. vespoides*, Panz. Lat. Length from five to seven lines. Face concave, the margins elevated, either entirely or the sides only yellow, sometimes with a broad black line or spot in the middle; palpi at times yellow or ferruginous. Antennæ filiform, a little shorter than the body, seldom entirely black, with the joints from the third to the fourteenth ferruginous beneath, gradually becoming more dusky; for the most part, however, all of them are ferruginous beneath, except the first, which is either entirely black or yellow on the under side. Thorax gibbous, clothed, especially on the sides, with a fine whitish down; a line before the wings, and another, or a spot, beneath them, yellow; sometimes also two spots on the back of the metathorax, and less frequently a lateral spot on the prothorax, and two small dorsal spots before the scutellum, of same colour. Scutellum seldom entirely black, the apical angles, and sometimes the whole apex, yellow. Wings of moderate size, smoky-hyaline, especially towards the radius, fulvo-hyaline towards the apex; stigma and radius ferruginous or fulvous; radix black, rarely testaceous-piceous; squamula black; areolet transversely triangular, somewhat irregular, sessile or sub-petiolate. Feet of moderate size, the posterior femora incrassate; coxæ black; trochanters generally black, with the apex yellow: the anterior femora usually black, with one of the sides more or less yellow or ferruginous; the middle femora sometimes with the apex only ferruginous, rarely black, with the base and apex yellow; the hinder femora generally yellow at the base, with the apex black, very rarely entirely black; the tibiæ yellow or ferruginous, the anterior rarely fuscous on the outer side; the posterior with the apex more or less blackish, rarely black, with the inner side ferruginous: the tarsi flavo-ferruginous, or ferruginous, the posterior with the joints from the second to the fifth dusky. Abdomen twice the length of the thorax, scarcely narrower, cylindric, punctate; first segment very short, yellow, with the base, and sometimes a longitudinal line in the middle, black; the second with a yellow spot on both sides in the apical angle, sometimes obsolete; from the third to the fifth, and very rarely the sixth also, with the margins, yellow; the terminal segments occasionally somewhat blackish-blue.

This species appears to be pretty generally distributed. It is not unfrequent in England, where it has been observed to issue from the pupa of *Stauropus Fagi*. Mr Curtis conceives this insect to be one of the sexes of *M. dentatus*.

Hymenop-
tera
Terebran-
tia.

menop-
tera
ebran-
ia.

GENUS *BASSUS*, Grav. Abdomen sessile, depressed; the first segment flat, of equal breadth; the terminal segments in the female sometimes compressed.

Sub-genus Bassus. Areolet either absent or triangular; antennæ and feet of moderate size or slender; (ovipositor sub-exserted, sub-erect).

B. flavolineatus, Grav. Length three lines. The head with a facial spot, the palpi and mandibles yellow, the latter with the apex black. Antennæ porrect, rather longer than the body. Thorax with the suture before the wings, and the lateral one between the prothorax and metathorax, together with a transverse line beneath the scutellum, yellow. Scutellum with the apex yellow. Wings smoky-hyaline, iridescent, the stigma and radius black-fuscous, the radius and squamula yellow. Feet rufous; the fore legs yellowish beneath, the base of the coxæ black; the hind legs with the tarsi and tibiæ black, the latter white at the base. Abdomen slightly depressed, the length of the head and thorax, and a little narrower; the first segment of equal breadth, one half longer than broad; the remainder transverse. Ovipositor very short, sub-exserted.

This species has been taken in England by the Rev. F. W. Hope, near Netley.

GENUS *BANCHUS*, Grav. Abdomen compressed or sub-compressed, sessile or sub-petiolate.

Sub-genus Banchus. Abdomen sessile, rarely sub-sessile; areolet sub-rhomboidal, the lower external nerve of the interior cell sub-arcuate. (Ovipositor concealed).

B. falcator, Grav.; *Ich. venator*, Fab.; *Ich. falcatorius*, Fab. Gmel. Oliv. Panzer. Length from five and three fourths to seven lines. Mouth ferruginous, mandibles black at the base and apex, the external orbits of the eyes, rarely the internal also, yellow or ferruginous. Antennæ half the length of the body, or a little longer, slender and incurved towards the apex, beneath rufous or ferruginous, rarely fusco-ferruginous. Thorax gibbous, generally with a short sub-testaceous line below the insertion of the wings. Scutellum tuberculate, rarely sub-acuminate, sometimes ferruginous, very rarely yellow. Wings middle sized, fulvo-hyaline or somewhat smoke coloured; the stigma, radius, radix, and squamula fulvous, rarely ferruginous, the latter sometimes with a fuscous spot. Feet elongate, fulvous, for the most part yellow beneath, the coxæ black, occasionally with a ferruginous mark; the hinder tibiæ black at the apex, the tarsi ferruginous or ferrugino-fuscous. Abdomen longer than the head and thorax; the first segment gradually a little narrowed towards the apex, nearly one half longer than broad; from the first to the fourth segment narrower than the thorax, the back fusiform, the belly compressed; from the fifth to the seventh angular, the back, sides, and belly compressed; the first segment seldom wholly black, the apex being generally brown or rufous or fulvous; the second seldom wholly rufous, or black with a dorsal rufous spot, but most commonly brown or rufous with the base black, or the base rufo-ferruginous, the apex fulvous-yellow; the third with the back either entirely rufous, or the base black or the apex yellow, but more commonly black, with the base and a point at the apex rufous; the fourth sometimes, rarely also the fifth, sixth, and seventh, with the apex of the back, rufous.

The female of this species differs considerably from the male, particularly in the markings of the head and thorax. Neither of the sexes is rare, as they have been taken abundantly both on the continent and in England.

GENUS *OPHION*, Grav. Abdomen compressed or sub-compressed, petiolate; antennæ filiform.

Sub-genus Paniscus. Abdomen sub-petiolate compress-

ed, the back carinate; areolet triangular; the feet and antennæ somewhat slender; (ovipositor short).

P. testaceus. Length of the male from three to nine, of the female from three and three fourths to eight lines. The mandibles black at the apex, the face sometimes yellowish; the eyes and ocelli, sometimes also the hinder part of the head, fuscous or black. The antennæ for the most part obscure or fuscous at the tip; in the male rarely fuscous or blackish, the base testaceous-ferruginous. Thorax sometimes with longitudinal fuscous lines on the back. Wings hyaline or somewhat yellow-hyaline; the stigma testaceous or straw-coloured, in the male sometimes fuscous, the radius fuscous or testaceous, the radix and squamula testaceous; areolet irregular sub-sessile, generally semi-complete, the lower portion of the exterior nerve obsolete. Feet fulvous, rarely ferruginous in the male, the hinder tarsi at times of a paler hue. Abdomen longer, sometimes by one half, than the head and thorax, compressed, the apex in the male obtuse, in the female truncate; testaceous, often fuscous towards the apex, or somewhat fusco-fulvous towards the base; the sixth, seventh, and apex of the fifth segment, very rarely black-fuscous; the first segment gradually dilated towards the apex, five or six times longer than broad, the anterior portion nearly one half longer than the petiole. Ovipositor the length of a fifth or sixth part of the abdomen, black, the tube castaneous or fuscous.

This insect is of frequent occurrence throughout the south of Scotland in the autumn. It is likewise plentiful in England, and on the continent. It deposits its eggs on the larvæ of various moths, and occasionally on those of the genus *Tenthredo*.

Sub-genus Ophion. Abdomen petiolate, compressed, the back carinate; areolet absent, the interior cell receiving the two recurrent nerves; feet and antennæ slender, long; (ovipositor scarcely sub-exserted).

O. luteus, Grav. Fab.; *Ich. luteus*, Linn. Lat. Length of the male from six to nine, of the female from four to nine lines. The head in most individuals entirely rufous, or the internal orbits of the eyes yellow; rarely yellow, with the mouth and face, excepting the internal orbits of the eyes, rufous; very rarely entirely yellow; mandibles black at the apex: eyes and stemmata fuscous or blackish. Antennæ either a little longer or a little shorter than the body. Thorax testaceous or rufous, very seldom rufo-ferruginous, the prothorax with two longitudinal pale lines. Scutellum for the most part pale, sometimes yellow. Wings hyaline or somewhat smoky-hyaline; the stigma, radius, radix, and squamula fulvous or testaceous, the upper exterior nerve of the interior cell very seldom incrassate towards the stigma; in most instances, however, the rudiment of the nerve dividing the interior cell is observable, and it is sometimes produced as far as the middle, rarely beyond the middle of the cell. Abdomen testaceous, seldom rufous, the belly generally fuscous, sometimes also fuscous or blackish towards the apex. Ovipositor scarcely sub-exserted, blackish.

This species is pretty generally distributed over the western parts of Europe, and occurs not unfrequently in England. The female deposits her eggs on the larvæ of *Cerura vinula*, *Noctua præcox*, and other moths. "Ils y sont fixés," says Latreille, "au moyen d'un pedicule long et délié. Les larves y vivent, ayant l'extrémité postérieure de leur corps engagé dans les pellicules des œufs d'où elle sont sorties, y croissent, sans empêcher la chenille de faire sa coque; mais elles finissent par la tuer, en consumant sa substance intérieure, se filent ensuite des coques, les unes auprès des autres, et en sortent sous la

Hymenoptera Terebrantia. forme d'ichneumons."¹ The larvæ of another species, *O. moderator*, Fab. destroy those of its ally *Pimpla strobilellæ*. GENUS HELLWIGIA. Abdomen petiolate, compressed; antennæ clavate.

H. elegans. Grav. Length from five to six lines. Head thick and closely punctate, with two deep irregular foveæ on the forehead, and a longitudinal groove between the antennæ; that of the male yellow, the occiput, foveæ, and apex of the mandibles black; that of the female black, the external orbits of the eyes yellow. Antennæ porrect, dilated at the apex a little more than half the length of the body, and composed of about thirty joints; in the male fulvous, yellowish on the under side towards the base, the first joint fuscous above; in the female rufous, the first three joints black. Thorax short, gibbous; two simple or hook-shaped spots before the neck, a short line under the anterior wings, two points or a single one under the posterior wings, a perpendicular line or point at the sides of the thorax, a point under the scutellum, a large semilunar spot on the metathorax, and another on each side of it, yellow: all these markings in the male are larger and more contiguous. Scutellum yellow. Wings middle-sized, hyaline, the stigma straw-coloured, the radius and nervures piceous or fuscous, the radix and squamula yellow. Feet middle-sized, sub-elongate; those of the male entirely yellow, the posterior tarsi rufescent towards the apex, the joints from the second to the fourth black at the base; the anterior feet of the female yellow, the coxæ black, with a small apical yellow spot, the trochanters black at the base; the hinder feet fulvous, the coxæ black, with a yellow spot, the trochanters yellow, the base black. Abdomen nearly one half longer than the head and thorax; the first segment flaggon-shaped, shining, very smooth, the anterior part scarcely longer than broad, shorter, and one half broader than the petiole; in the male the first segment black, the apex yellow, from the second to the fourth testaceous-rufous or yellow, with the base sub-rufescent, from the fifth to the seventh yellow, the fifth, and sometimes the sixth also, with the base, blackish at the side; in the female the first, fifth, sixth, and seventh segments black, with the margin yellow, the intermediate segments fulvous or rufous, with the margin for the most part yellow. Ovipositor scarcely sub-exserted, black.

The preceding examples will suffice to illustrate Gravenhorst's mode of treating the Ichneumonides. We shall now proceed to

TRIBE 3D, GALLICOLÆ.²

These have only a single nervure on the lower wings; the upper pair offer a few areolets or cells, viz. two at the base—the brachial, of which the internal is usually incomplete or slightly marked,—one radial and triangular,—and two or three cubital,—of which the second, in such as have three, is always very small, and the third very large, triangular, and closed by the posterior margin of the wing. The antennæ are either of equal thickness, or increase towards the termination, but not club-shaped, and are composed of from thirteen to fifteen articulations, the number when different in the sexes being generally greater in the males. These insects form the old genus CYNIPS of Linnæus (Plate CCXXXI. fig. 20).

Their general form is humped or gibbous, with the head small, and the thorax thick and elevated. The abdomen is compressed, carinated, or cutting inferiorly, and truncated obliquely, or obtuse, at the extremity. It is furnished in the females with an ovipositor, which seems to consist of only a single piece, long and delicate, or capillary, spirally rolled at its base, and attached near the origin of the abdomen. It is minutely described by Réaumur.³ With this admirable instrument it deposits its eggs in the leaves and stems of various plants, and on these its punctures produce those peculiar excrescences known by the name of gallnuts, so useful when employed along with a solution of green vitriol, or sulphate of iron, in dyeing blacks. Some of these insects are apterous. "Une espèce," says Latreille, "dépose ses œufs dans la semence du figuier sauvage le plus précoce. Les Grecs modernes, suivant à cet égard une méthode que l'antiquité leur a transmise, enfilent plusieurs de ces fruits, et les placent sur les figuiers tardifs; les Cynips sortent chargés de poussière fécondante, s'introduisent dans l'œil des figues de ces derniers, en fécondent les graines et provoquent la maturité du fruit."⁴ This is the process known abroad by the name of *caprification*.

The genera of this tribe are IBALIA and FIGITES, Lat. and CYNIPS proper (*Diplolepis* of Geoff.). Of the genus last named we have figured *C. rosæ*, its larvæ, and the gall in which the latter dwell (Plate CCXXXI. fig. 20, 22, 23, 26, 27, 28).

TRIBE 4TH, CHALCIDIÆ.

These do not differ very materially from the preceding, except in the antennæ, which, with the exception of *Eucharis*, are geniculate, and form, subsequent to the bend, an elongated or fusiform club, of which the first articulation is not unfrequently lodged in a groove. The palpi are extremely short. The radial cell is usually wanting, and there is never more than a single cubital cell, which is not closed. The antennæ have not more than twelve articulations. The modern genera are very numerous, though all related to the genus CHALCIS of Fab. The species are extremely small, brilliantly ornamented with metallic colours. Many of them are leapers. The ovipositor is generally composed of three threads, like that of the Ichneumons, and is salient. The larvæ likewise resemble those of that tribe in being parasitical, and some of them are so minute as to be able to dwell at large in the interior of insect eggs, themselves scarcely visible to the naked eye.

We shall here mention only two genera of the tribe, of each of which we have figured an example. *Chalcis minuta* (Plate CCXXXI. fig. 25), synonymous with *Vespa minuta* of Linn., is extremely common on umbelliferous flowers. It is black, with yellow feet. Another species, *C. annulata*, Fab., inhabits the nest of the pasteboard wasp of South America (*V. nidulans*), and appears to have been mistaken by Réaumur for the female of that insect. Our other representative, *Leucospis dorsigera* (ibid. fig. 24), is black, with the abdomen almost as long again as the thorax, and marked with three bands and two spots of yellow. There is a transverse yellow line upon the scutellum, and two others of the same colour on the anterior portion of the thorax. The female deposits her eggs in the nests of mason-bees.⁵

¹ *Règne Animal*, t. v. p. 287.

² We now resume the system of Latreille.

³ For the other genera and species, see, besides, *Règne Animal* (t. v. pp. 295-9), Latreille's *Genera Crust. et Insect.* t. iv.; Klug's *Entomologische Monographien*; Dalman's *Analecta Entomologica*, and the Monographs and Memoirs of the same author; Maximilian Spinola's *Mémoire sur les Diplolépaires*; Mr Westwood on *Parasitic Hymenoptera* (*Phil. Mag.* 3d series, No. 3); Mr Halliday's *Essay on the same subject in Entom. Mag.* No. 3; Mr Walker's *Monographia Chalcidum*, published in the initiatory numbers of the last-named periodical; and a similar *Monograph* by M. Boyer de Foscolombe, in the *Ann. des Sciences Nat.* for July 1832.

⁴ *Mém. sur les Insectes*, t. iii. p. 483, et seq.

⁵ *Règne Animal*, t. v. p. 292.

TRIBE 5TH, OXIURI, Lat.

This tribe resembles the preceding so far as concerns the want of nervures in the lower wings, but the abdomen of the female is terminated by a tubular and conical ovipositor, sometimes internal and exsertile, proceeding like a sting from the anal extremity, sometimes permanently external, and forming a kind of tail. The antennæ are composed of from ten to fifteen articulations, and are in some cases filiform or slightly enlarged towards the extremity, in others clubbed in the females. The maxillary palpi in several are long and pendant.

The minor genera which compose this tribe are all more or less related to the genus *BETHYLUS* of Fabricius and Latreille. The only example we have here adduced is that of *Diapria elegans* (Plate CCXXXII. fig. 1), an insect belonging to a genus in which the wings have no cells. The maxillary palpi are projecting, and the antennæ have fourteen joints in the male, and only twelve in the female.¹

TRIBE 6TH, CHRYSIDES, Lat.

This tribe agrees with the three preceding in the want of nervures in the lower wings; but the ovipositor of the female is formed by the terminal segments of the abdomen, which somewhat resemble in their construction the tubes of a telescope, and are terminated by a little sting.² The abdomen, which in the female seems to be composed of only three or four segments, is arched or plain beneath, and is capable of being applied against the chest,—in which attitude the insect assumes the form of a ball. This tribe includes the old genus *CHRYSIS* of Linnæus, and is remarkable for the extreme richness and brilliant lustre displayed by the colouring of many species. In these respects they rival the gorgeous humming-birds, and are known under the name of gilded wasps,—the *guepes dorées* of our continental neighbours. They are lovers of the cheerful sunshine, and during the bright days of early summer may be seen moving about in a state of great vivacity, almost of agitation, on walls, old timber, and other objects exposed to the gladdening influence of heat and light. They are also found on flowers, “beautifying the beautiful,” and adding to their gorgeous petals all that is wanting to complete the glory of the “lilies of the field,”—a burnished or metallic lustre.³

The body of these insects is covered by a very solid integument. Their antennæ are filiform, geniculate, vibratile, and composed of thirteen articulations in both sexes. The mandibles are arched, narrow, and pointed. The maxillary palpi are usually longer than the labial, filiform, and composed of five unequal articulations;—the labial consist of three. The ligula is for the most part emarginate. The thorax is semicylindrical, and exhibits several impressed and transverse lines. The abdomen in the greater number is semi-oval, truncated at the base, and appears at first sight as if attached to the thorax by its entire breadth. The terminal segment is frequently marked by large punctures, and terminates in dentations.

These beautiful creatures deposit their eggs in the nests of the solitary mason-bees, and in those of other Hymenoptera. Their larvæ sustain themselves by devouring the lawful inhabitants.

In some, such as the genus *PARNOPES*, Lat. (Plate CCXXXII. fig. 2), the maxillæ and labrum are very long, and form a kind of false proboscis, bent underneath. The palpi are small and biarticulate. The example figured, *P. carnea*, deposits its eggs in the nest of *Bembex rostrata*. In *CHRYSIS* proper there is no false proboscis. The maxillary palpi are of medium size, or elongated, and composed of five articulations; the labial consist of three. Several analogous genera are recognised by naturalists, such as *HEDYCHRUM*, Lat. (Plate CCXXXII. fig. 3), in which the maxillary palpi are much longer than the labial, the ligula emarginate, and the abdomen rounded and entire at the extremity.⁴

ACULEATA.⁵

This, the second primary section of the hymenopterous order, is distinguished from the preceding by the want of an ovipositor. That organ is represented by a sting composed of three parts, concealed and retractile. It is characteristic of the females, and likewise exists in those individuals (imperfect in a sexual point of view) commonly called neuters, which constitute so important a feature in the social union of the gregarious kinds. It is, however, wanting in several of the ant tribe,—in which case the insect defends itself by ejecting an acid liquid, elaborated and contained in special reservoirs.⁶ Our present Hymenoptera have always simple antennæ, composed of a constant number of articulations, that is, thirteen in the males and twelve in the females. The palpi are usually filiform; those of the maxillæ, which are frequently the longer, have six articulations,—the labial only four. The mandibles of the males are smaller, and generally less toothed, than in the others. All the wings are veined. The abdomen, united to the thorax by a thread or pedicle, is composed of seven segments in the males, and of six in the females.

The larvæ in this family are never furnished with feet. Their food is supplied to them by females or neuters, and varies in its nature according to the different kinds. Latreille divides the section into four families.

FAMILY I.—HETEROGYNA.⁷

The species of this family consist of individuals which differ from each other not only in their sexual characters, but in the presence or absence of the wings, and in other particulars. In all, the antennæ are geniculate, and the ligula small, rounded and hollowed, or spoon-shaped.

Some live in society, and consist of three kinds of individuals, of which two, that is, the males and females, are winged, and the third or neuters are apterous. In the two latter kinds the antennæ gradually increase in thickness, and the length of the first articulation equals at least the third part of their total extent; the second is almost as long as the third, and has the form of a reversed cone. The labrum of the neuters is large and corneous, and falls perpendicularly beneath the mandibles. These Hymenoptera comprise the genus *FORMICA* of Linnæus.

As a separate treatise under the article *ANT*⁸ has been already devoted in this work to the elucidation of the his-

¹ For the other genera, see *Règne Animal*, t. v. pp. 300–2; *Genera Crust. et Insect.* t. iv.; Dalman's *Analecta Entomol.*; and Jurine's *Hyménoptères*.

² The details are given by Degeer in his *Mém. sur les Insectes*, t. ii. p. 334, pl. 28.

³ In as far as we are competent to judge, plants and the mammalia seldom seem to exhibit a metallic surface. But that glowing adornment is frequent among foreign birds, and the subjects of our present treatise.

⁴ See a *Monograph of the Chrysides*, by Pelletier de St Fargeau, in the *Ann. des Sciences Nat.* t. vii. p. 115.

⁵ From *aculeus*, a sting.

⁶ *Journal de Physique*, September 1828.

⁷ From *ετερος*, other or different, and *γυνή*, female.

⁸ See vol. iii. p. 239.

Hymenop-
tera
Aculeata.

tory and habits of these admirable insects, so long noted for their foresight and industry, we shall not occupy our remaining space by repetition, but shall proceed to a brief sketch of the classification of the species, as promised at the conclusion of the article just referred to. Latreille divides the genus *Formica* as follows:—

1st, The genus *FORMICA* properly so called. These want the sting; the antennæ are inserted near the front; the mandibles are triangular, dentated, and incisive; and the pedicle of the abdomen is never composed but of a single squama or knot.

Of the European species we may mention *F. rufa*, Lat., of which the workers measure about four lines in length, and are of a blackish colour, with a great part of the head, the thorax, and the knot, fulvous. The thorax is uneven. The stigmatic eyes are discernible. This species builds in woods, and forms a dome-like or sugar-loaf shaped habitation of considerable size, composed of earth and fragments of wood, &c. Formic acid is obtained chiefly from this insect. The winged individuals make their appearance in spring. (Plate CCXXXII. fig. 4.) *F. sanguinea*, Lat., resembles the preceding in its workers; but the colour is sanguine red, with an ashy-black abdomen. It likewise dwells in woods, and is one of the species named Amazons or *légionnaires* by M. Huber. *F. cunicularia*, Lat., has the head and abdomen of the workers black. Around the mouth, the under parts of the head, the first joint of the antennæ, the thorax, and feet, pale fulvous. The worker of *F. fusca*, Linn., is of an ashy-black, shining, with the base of the antennæ and the feet reddish. The squama or knot is large, almost triangular, and there is an appearance of three stigmatic eyes. Both these species are attacked by the Amazons, carried off, and enslaved.

2d, The genus *POLYERGUS*, Lat. In these the sting is likewise wanting; but the antennæ are inserted near the mouth, and the mandibles are narrow, arcuated, or strongly hooked. In this genus is placed the *F. roussatre* of Lat. so common in France. It is this species which is more particularly named Amazon by M. Huber the younger.

3d, The genus *PONERA*, Lat. In these the workers and the females are armed with a sting. The pedicle of the abdomen is formed of a single scale or knot; the antennæ of the individuals just mentioned are thickened towards the extremity; the mandibles are triangular, and the head is also nearly of that form, without remarkable emargination at its posterior extremity. *F. contracta* of Lat., which occurs near Paris, belongs to this division. The worker seems scarcely provided with eyes, and lives under stones in not very numerous groups. It is very small, black, nearly cylindrical, with the antennæ and feet of a yellowish brown.

4th, The genus *MYRMICA*, Lat. In these there is also a sting; but the pedicle of the abdomen is formed of two knots. The antennæ are exposed, the maxillary palpi are long, with six distinct articulations, and the mandibles are triangular. Such is the *fourmis rouge* of Latreille, of which the worker is reddish, finely chagrined, with the abdomen smooth and shining. There is a spine upon the first knot of the pedicle, and the third segment is brownish. This species occurs in woods, and bites sharply.

5th, The genus *ATTA* of Fabricius, which scarcely differs from *Myrmica*, except by its very short palpi, of which the maxillary are composed of less than six articulations. The head of the workers is usually very large. The species

which serves as the type of the genus in the works of Fabricius, Jurine, and Latreille, is the *fourmis de visite*, or *Atta cephalotes* of systematic writers. It is a foreign insect, and seems to agree with that figured by Madame Merian.¹ This creature burrows in the earth, to the extent, it is said, of six or eight feet. It however leaves its subterranean dwelling for a time once a year, and enters dwelling-houses, where it attacks and destroys every other kind of inconvenient insect. If during these predatory incursions they find an intervening space which they cannot cross, a party volunteer to form a chain of their own bodies linked together, over which, as by a bridge, the main body passes.

6th, The genus *CRYPTOCERUS* of Lat., of which the species are also furnished with a sting, and have the abdomen of the pedicle formed of two knots; but the head, which is large and flat, has a groove on each side for the reception of a part of the antennæ. They are peculiar to South America.²

The other *Heterogyna* live in solitude, and each species is composed of only two kinds of individuals, winged males and apterous females,—the latter always provided with a strong sting. The antennæ are filiform or setaceous, vibratile, with the first and third articulations elongated; the length of the former, however, never equalling that of the third part of the total length of the antennæ. They form the genus *Mutilla* of Linnæus, which has been subdivided into *DORYLUS*, Fab. (Plate CCXXXII. fig. 6), peculiar to Africa and the East Indies; *LABIDUS*, Jurine, proper to South America; and *MUTILLA* properly so called (ibid. fig. 5). Of the latter, *M. Europæa*, Linn., is black, with a red thorax, and three white bands on the abdomen. The female is armed with a powerful sting. The manners of the *Mutillæ* seem little known. We are not ourselves acquainted with the nature of their metamorphosis. They love warm sunny places, and sandy soils. The females being apterous, are always found upon the ground, concealed under stones, or lurking in little holes. The males are seen on flowers, or by the sides of dusty paths, and other places frequented by the females. The genus is extensive, Olivier and Klug having described a great many species.³

FAMILY II.—FOSSORES.⁴

This family comprises such of the stinging Hymenoptera as are winged in both sexes, and of solitary habits. The legs of several are adapted for digging. The ligula is always more or less widened at the extremity, and never filiform or sectaceous. The wings are always extended. The old genus *SPHEX* is the principal representative of this family.

The females of these insects deposit their eggs in little prepared chambers in the earth or in wood, and place alongside of them a supply of insects or their larvæ. They also pierce spiders with their stings, and close them up as provision for their young. The larvæ are without feet, and spin a cocoon before passing into the nymphal state. The perfect insects are in general extremely active, and live among flowers. The maxilla and the labium are elongated, and assume in several the form of a trunk. The numerous minor genera derived in recent times from the genus just named, are distributed by Latreille into seven principal tribes.

¹ *Insectes de Surinam*, ed. of 1726, p. 18, tab. 18.

² Besides the article ANT of this work, see the noted volume by Huber the younger, entitled *Recherches sur les Mœurs des Fourmis indigènes*, and Latreille's *Histoire Naturelle des Fourmis*.

³ In *Encyclop. Méth. and Act. Phys. Med. Acad. César. Leopold*, t. x. pars 2. Latreille has also published a monograph of the French species in the *Actes de la Soc. d'Hist. Nat. de Paris*, and a great number are figured by Coquebert in his *Iconographia Insectorum*.

⁴ From *fossor*, a digger.

Hymenop-
tera
Aculeata.

menop-
tera
culeata.

In the first two the eyes are often emarginate. The body of the males is usually narrow, elongated, and terminated posteriorly, in a great number, by three spinous points or dentations.

TRIBE 1ST, SCOLIETES, Lat.

The first segment of the thorax is sometimes in the form of a bow, and prolonged laterally as far as the wings, sometimes of a transverse square, or resembling a knot or articulation. The legs are short, thick, very spiny or ciliated, with the thighs arched near the knee. The antennæ are sensibly shorter than the head and thorax in the females. The genera are TIPHIA, Fab. (Plate CCXXXII. fig. 7); MYZINE, Lat.; MERIA, Illiger; and SCOLIA, Fab. (ibid. fig. 8).¹

TRIBE 2D, SAPIGYTES.

The first segment of the thorax is formed like that of the preceding group, and the legs are also short, but slender, and neither spiny nor strongly ciliated. The antennæ in both sexes are at least as long as the head and thorax. The body is usually either smooth, or but slightly pubescent. The genera are THYNNUS, Fab.; POLOCHRUM, Spinola; and SAPIGA, Lat.

TRIBE 3D, SPHEGIDES, Lat.

These still resemble the preceding in the extent and form of the first segment of the thorax; but the posterior legs are at least once again as long as the head and thorax. The antennæ are often slender, formed of lengthened articulations, lax, or not compactly set, and curved or arcuated, at least in the males.

Of this tribe a certain number have the first segment of the thorax of a square form, whether transverse or longitudinal, and the abdomen is attached by a very short pedicle. The inner side of the posterior tibiæ is usually furnished with a brush or pellet of hairs. The upper wings have three or two complete or closed cubital cells, and a terminal one which is imperfect. The genera are PEPSIS, Fab. (Plate CCXXXII. fig. 9), of which the species, abundant in South America and the Antilles, are large, with coloured wings; CEROPALES, Lat.; POMPILUS, Fab. (ibid. fig. 10), of which the species feed their young with spiders; PLANICEPS, Lat.; and APORUS, Spinola.

Others of the same tribe have the first segment of the thorax narrowed in front, in the form of a knot or joint; and the first segment of the abdomen, and sometimes even a portion of the second, narrowed into an elongated pedicle. The upper wings always exhibit three complete cubital cells, and the commencement of a fourth. The genera are, AMMOPHILUS, Kirby, of which we may mention, as an example, *Sphex sabulosa*, Linn., the female of which digs holes in the earth by the sides of paths and highways, in which she deposits a caterpillar mortally wounded, and then lays an egg beside it,—the said egg soon producing another larva, which, though much smaller, being in good health, immediately eats the sick one; SPHEX, PRONEUS, CHLORION,² and DOLICHURUS, Lat.; AMPULEX, Jur.; PODIUM and PELOPEUS, Lat.

TRIBE 4TH, BEMBECIDES, Lat.

In these the first segment of the thorax forms only a linear and transverse border, of which the two lateral extremities are distant from the origin of the upper wings.

The legs are always short, or of moderate length. The head, seen from above, appears transverse, and the eyes extend as far as the exterior border. The abdomen forms an elongated semi-cone, rounded on the sides, near the base. The labrum is entirely exposed, or very salient.

Hymenop-
tera
Aculeata.

Of this tribe the species are characteristic of the warmer countries of the earth. Their body is elongated, pointed posteriorly, almost always varied with black and yellow, or reddish, and smooth. The antennæ are approximate at the base, slightly geniculate at the second article, and enlarged towards the extremity. The mandibles are narrow, lengthened, dentated on the inner side, and crossed. The tibiæ and tarsi are provided with little spines or cilia, which are particularly obvious on the anterior tarsi of the females. There are frequently one or two raised teeth beneath the abdomen of the male. The flight of these insects is extremely rapid, and they dart from flower to flower with a sharp and interrupted sound. Several species smell of the odour of roses.

In a certain number we find a false trunk, bent underneath, with the labrum in the form of an elongated triangle.

Of these, some have the palpi very short; the maxillary possessing four, the labial two articulations. Such is *Bembex rostrata*, Fab. (*Apis rostrata*, Linn.), Plate CCXXXII. fig. 11, a large black insect, with transverse bands of citron yellow upon the abdomen. This is a well-known European species. The female digs deep holes in a sandy soil, in which she places the carcasses of other insects, especially Syrphi, and other two-winged flies. Among these she lays her eggs, and then places a plug in the hole. Another hymenopterous insect, however, *Parnopes carnea*, possesses a strong instinctive desire to deposit her eggs in the subterraneous nest of the Bembex. As soon as the latter perceives its natural enemy hovering around its dwelling, it attacks it with the greatest fierceness, and endeavours to thrust its sting through its body,—an attempt, however, which is seldom successful, owing to the hardness of the Parnopes's skin. Others have the maxillary palpi elongated, and with six articulations,—the labial with four. Such is the genus MONEDULA of Lat.

In the remainder of this family there is no false trunk, and the labrum is short and rounded, *e.g.* the genus STIZUS of Jurine.

TRIBE 5TH, LARRATES, Lat.

These in their general aspect resemble the preceding, but their labrum is either entirely or in great part concealed, and there is a deep emargination on the inner side of the mandibles,—a character which distinguishes them both from those which precede and those which follow.

In some the upper wings have three closed cubital cells, of which the second receives the two recurrent nervures. Such are the genera PALARUS, Lat., LYROPS, Illiger, and LARRA, Fab. (Plate CCXXXII. fig. 13). In others the upper wings have only two closed cubital cells, each of which receives a recurrent nervure. Such are DINETUS and MISCOPUS, Jurine.

TRIBE 6TH, NYSSONES, Lat.

In this family the labrum is likewise entirely or in great part concealed. The maxillæ and labium do not form a trunk, and the mandibles have no emargination on the inner side. The head is of ordinary size, and the abdomen is triangular or ovoid-conical, becoming gradually narrower

¹ For the anatomy of the Scoliæ, see Dufour's Observations in the *Journal de Physique* for September 1818.

² For the singular habits of *C. compressum*, common in the Isle of France, where it attacks, slays, and carries off cockroaches to its young, see Sonnerat's *Voyage aux Indes Orientales*; Réaumur's *Mémoires*, t. vi. p. 280; or the *Dict. Class. d'Hist. Nat.* t. iv. p. 42.

Hymenoptera
Aculeata. from the base towards the extremity, and never borne upon a long pedicle. The antennæ are filiform, with the first articulation slightly elongated.

In the genera *ASTATA*, *NYSSON*, *OXYBELUS*,¹ and *NITELLA*, Lat., the eyes are entire; in *PISON* of Spinola they are emarginate.

TRIBE 7TH, CRABRONITES, Lat.

In this, the concluding tribe of Fossores, the head is usually very large, and when viewed from above seems almost square. The antennæ are often enlarged towards the extremity, or club-shaped. The abdomen is either oval or elliptical, and broadest about the middle,—or narrowed at the base into a lengthened pedicle, and as if terminated by a club.

In some the antennæ are inserted beneath the middle of the anterior part of the head, and the chaperon is short and broad. In the genus *TRYPOXYLON*, Lat. the eyes are emarginate. Of these, one of the most remarkable is *T. figulus* (*Sphex figulus* of Linn.), Plate CCXXXII. fig. 13. The female deposits her eggs in holes in old timber, along with a supply of little spiders, which she closes up with moist earth. In the remainder the eyes are entire. In the genus *CRABRO* of Fab. (ibid. fig. 15) many of the males are remarkable for a peculiar dilatation of the anterior tibia, resembling a slender shell, convex without and concave within, and pervaded by a multitude of little holes, or rather of transparent points. They somewhat resemble the well-known expansions on the fore-feet of the male *Dytisci*, and probably serve for the same end.² In the perfect state these insects seem to feed on the nectareous juices of flowers; but the larvæ are extremely greedy of animal food. The female parent forms holes in the earth, in each of which she deposits an egg along with the body of a captured insect. She then, as usual, closes up the orifice, and the entombed prey, whether dead or alive, is soon attacked and eaten by the young larva to which the egg gives birth. Dipterous insects form their most frequent food, although *C. cribrarius* is observed to seize upon the caterpillar of a *Pyralis* which inhabits the oak. Walckenaer observed several species hovering incessantly around the nests of a solitary bee named *Halictus terebrator*, which they seemed much inclined to enter.³ The remaining genera of this division of the Crabronites are *STIGMUS*, Jur.; *PEMPHEDRON*, Lat., of which *P. unicolor* feeds its young on Aphides; *MELLINUS*, Fab. (Plate CCXXXII. fig. 16); and *ALYSON*, Jurine.

In other Crabronites the antennæ are inserted higher up or towards the middle of the face, and are usually enlarged towards the termination, or even club-shaped. In the genus *PSEN* of Lat. the clypeus is almost square, and the abdomen is borne upon an abruptly formed and elongated pedicle, composed of the first segment. The mandibles terminate in two teeth. In *PHILANTHUS* of Fab. the clypeus is trilobed, and the first segment of the body is at most restricted in the manner of a knot. The mandibles terminate in a simple point. The females of this genus dig holes in the sand, in which they bury the carcasses of bees, *Andrenæ*, and even of *Curculionides*, for the nourishment of their young.⁴

FAMILY III.—DIPLOPTERA.⁵

This is the only family of the section in which the upper wings are longitudinally folded.⁶ The antennæ are generally geniculate, and clubbed, or enlarged towards the extremity. The eyes are emarginate. The prothorax is prolonged posteriorly on each side to the origin of the wings, of which the superior have three or two closed cubital cells, the second of which receives the two recurrent nervures. The body is smooth, or nearly so, black, and more or less spotted with yellow or fawn colour. Many of the species dwell in temporary societies, composed of three kinds of individuals, males, females, and workers or neuters. A few females which have withstood the rigour of the winter season commence the building of the nest, and attend to the young first produced, which are usually neuters—and these speedily aid their parent in all matters of household management. The family is composed of two tribes.

TRIBE 1ST, MASARIDES.

In these the antennæ seem at first sight to be composed of only eight articulations; the eighth forming with the ensuing ones an almost solid mass, rounded or obtuse at the end, with the articulations indistinct. The ligula is terminated by two threads capable of being withdrawn within a tube formed by its base. The upper wings have only two complete cubital cells. The middle of the anterior margin of the clypeus is emarginate, and receives the labrum in that emargination. The genera are few in number. In *MASARIS* proper (Plate CCXXXII. fig. 17), the antennæ, a little longer than the head and thorax, have the first article lengthened, and the eighth forming an obconic club, rounded at the extremity. The abdomen is long. In *CELONITES*, Lat. the antennæ are scarcely longer than the head, and their first two articulations are much shorter than the third; the eighth and following form an almost globular body. The abdomen is scarcely longer than the thorax.

TRIBE 2D, VESPIARIÆ.

In these the antennæ always exhibit distinctly thirteen articulations in the male and twelve in the female, and terminate in an elongated mass, pointed, and sometimes hooked (in the males) at the end; they are always geniculate, at least in the females and neuters. The ligula is sometimes divided into four plumose filaments, sometimes into three lobes, having four glandular points at the end, one on each lateral lobe, and the two others on the intermediate one, which is larger, widened, and emarginate or bifid at the extremity. The mandibles are strong and dentated. The clypeus is large. Beneath the labrum there is a little piece in the form of a ligula, analogous to that which Réaumur observed in certain bees (*bourdons*), and which M. Savigny names *epipharynx*. With the exception of a small amount of species, the upper wings have three complete cubital cells. The females and neuters are armed with a very strong and venomous sting. Several

¹ The *Oxybeli* lay their eggs in little nests in sandy soils exposed to the sun. They store up a collection of dead flies for the use of their young.

² See Degeer, *Mémoires*, t. ii. p. 310, pl. 23.

³ We have been under the necessity of doing little more than indicate the names of the generic groups in the family of Fossores. For the details the reader is referred to the corresponding articles in the *Encyclop. Méth.* and the *Diction. Class. d'Hist. Nat.*; to the *Règne Animal*, t. v. pp. 316–32, and more particularly to M. Van der Linden's *Observations sur les Hyménoptères d'Europe de la Famille des Fouisseurs*.

⁴ From *διπλός*, double, and *πτερά*, wings, in reference to the folding of these organs.

⁵ The character however is not universal,—the genus *Ceramius*, Lat. of which Klug has published a monograph, forming an exception.

Hymenoptera
Aculeata. species live in societies composed of three kinds of individuals.

The larvæ of these insects are without feet, and each is enclosed in a cell where it is fed, according to its kind, either on the bodies of insects carried thither by the mother at the period of oviposition, or on the nectar of flowers, the juices of fruits and of animal matter, elaborated in the stomach of the parent, or in that of the workers, and carefully supplied from day to day. This tribe corresponds to the genus *Vespa* of Linn.

The genus *CERAMIUS* of Lat. differs from all the others in having the superior wings stretched or extended, and in the amount of the cubital cells, of which there are only two. The labial palpi are moreover longer than those of the maxillæ. The species occur in South Africa, and the warmer regions of Europe.¹

In all the following genera the superior wings are folded, and present three complete cubital cells.

Sometimes the mandibles are much longer than broad, and approximate anteriorly in the form of a rostrum. The ligula is narrow and elongate. The clypeus is nearly heart-shaped or oval, with the point anterior, and more or less truncate. All the species are solitary, and each is composed of only males and females. The latter provision their young both before their birth and during the continuance of the larva state. Their nests are usually formed of earth, and are either concealed in the holes of walls, beneath the ground, in old wood, or are external, and placed on plants. Each nest contains a supply of caterpillars or other larvæ, which the female piles up in a circular form. She sometimes also stores up spiders, which she has the precaution previously to pierce with her sting.

In the genus *SYNAGRIS*, Lat. the ligula is divided into four long plumose filaments, without glandular points at their extremity. The mandibles of some of the males are very large. The species are few in number, and characteristic of Africa. In *EUMENES*, Lat. the ligula is divided into three portions, glandular at their extremity. The abdomen in some is ovoid or conical, and thicker at the base. Such are *PTEROCHILE* of Klug, remarkable for the great length of the labium and maxillæ, and for their labial palpi beset with long hairs, and composed of only three distinct articulations. In *ODYNERUS*, Lat. those parts of the mouth are much shorter, the labial palpi are nearly smooth, and consist of four perceptible divisions. *Vespa muraria* of Linn. belongs to this genus. It is described by Réaumur.² The female perforates deep holes in sand, or in the plaster of walls, at the orifice of which she forms an outer tube, at first straight, afterwards recurved, and composed of an earthy paste, arranged in thick contorted threads. In the cavity of the interior cell she heaps up from eight to twelve little green larvæ of the same age, disposing them in beds one above another, in a circular form. After depositing her egg, she closes the mouth of the hole, and destroys the outward scaffolding. The abdomen in others has its first segment narrow and elongated in the form of a pear, and the second bell-shaped. Such is the genus *EUMENES* proper, of which *E. coarctata*, Fab. constructs a spherical nest of fine earth on the stems of plants. She fills it with honey, according to Geoffroy, and then deposits an egg.

Sometimes the mandibles, scarcely longer than wide, have a broad oblique truncation at their extremity. The ligula is short, or but slightly elongated. The clypeus is almost square. These insects constitute the genus *VESPA*, or wasps properly so called. They unite in numerous associations, composed of males, females, and neuters. The

last two kinds detach particles of old wood or bark with their mandibles, reduce and moisten them to the consistence of a paste resembling paper or pasteboard in its nature, and construct nests containing horizontal combs suspended from above by one or more pedicles; on the inferior side there is a range of vertical cells in the form of hexagonal and truncated pyramids. These cells serve solely as lodgings for the isolated larvæ and nymphs. The amount of combs forming the same nest varies; and the nest itself is sometimes open or exposed, sometimes surrounded by an envelope, pierced by a common and almost always central opening, which corresponds with a string of holes for the purposes of internal communication, if the edges of the combs adhere to the inner side of the external covering. These singular constructions are sometimes suspended to the branches of plants in the open air, sometimes concealed beneath the earth or in the hollows of old trees. Their form likewise varies according to the species.

The females commence their labours in spring, and in the first place in a state of solitude. In a nest of small dimensions they deposit the eggs of neuters or workers, which, as soon as they are hatched and attain maturity, enlarge the dwelling, and assist in rearing additional members of the body politic. For a considerable time the society consists only of the original founder of the colony, that is, the female parent, and of neuters. Towards the end of summer or beginning of autumn, young males are hatched, along with additional females. But all such larvæ and nymphs as have not completed their final metamorphosis before the month of November are murdered by the neuters, and torn from their cells. These destroyers are themselves ere long destroyed, in common with the males, by the first frosts of winter. The latter sex never work. A few females alone survive the rigours of the winter season, and these again, on the return of spring, become each the founder of a new but equally transitory empire. Of the death and desolation which is so soon to overtake their busy race, the genus *irritabile* is, however, all unconscious during the glad summer days, or those of the fruitful autumn, in which they ply their never-ceasing labours:—

So fails, so languishes, grows dim, and dies,
All that this world is proud of;

and hymenopterous and human kingdoms, alike decay and perish. The polity of wasps, we may observe, is not so exclusively monarchical as that of bees. It partakes rather of the republican order, as many females dwell together in amity during the autumnal season. These *Vespæ* are almost omnivorous. They prey on other insects, on flesh and fruits of every kind, especially when ripe and sweet. They appear to an uninstructed eye as very gluttonous; but their apparent greed becomes more excusable, when we consider that they are catering, not for themselves, but for a numerous and otherwise unprovided offspring. The larvæ, in consequence of the peculiar position of the opening of their cells, lie in a reversed position, with their heads downwards. When about to pass into the nymphal state, they shut up their cells, and fabricate a cocoon.

In several species, that portion of the inner margin of the mandibles which is beyond the angle, and terminates it, is shorter than that which precedes the angle. The central part of the front of the clypeus is pointed. These belong to the genus *POLISTES* of Lat. and Fab. in which we class *P. morio* from Cayenne. Its nest is large, in the form of a truncated cone, pierced inferiorly and at one side. It is composed of very thick pasteboard. Here also are

¹ See Klug's *Entomologische Monographien*, p. 219, et seq.

² *Mémoires*, vi. xxxvi. 1-10.

Hymenoptera Aculeata. placed the *Vespa gallica* of Linn. and the *V. nidulans* of Fab. *P. Lechequana*¹ is a species which we owe to M. Aug. St Hilaire, who brought it from the interior of Brazil. Its combs contain an excellent honey, resembling in consistence that of our own domestic species, but possessing at times the singular quality of rendering those who eat it furious, or void of reason. It has been known from ancient times that common honey is occasionally possessed of very deleterious properties, arising probably from the nature or condition of the flowers from which it is collected. The naturalist just named, and two men by whom he was accompanied, nearly perished in consequence of eating of the Brazilian honey in its poisonous state.

In other wasps the superior portion of the inner margin of the mandibles, or that which succeeds the angle, is as long if not longer than the other portion of that margin. The central part of the front of the elypeus is widely truncated. The abdomen is always ovoid or conical. These constitute the genus *VESPA* properly so called, of Latreille. The French entomologist here places the *V. crabro*, Linn., which we call the *hornet*. (Plate CCXXXII. fig. 18.) It builds its nest in sheltered places, such as barns, old walls, wooden posts, and hollow trees. It is of a roundish shape, composed of coarse materials, and resembles an old leaf in colour. This species devours other insects, and robs bees of their honey. Though a well-known English insect, it has not yet been found in Scotland. The common wasp, *V. vulgaris* (ibid. fig. 19), forms a somewhat similar nest; but it is composed of finer paper, contains a greater number of combs, and is sheltered in a hole in the earth. *V. media*, Lat. is intermediate as to size between the two preceding. It hangs its paper dwelling beneath the branch of a bush or tree. The nest of *V. holsatica*, Fab. is worthy of a brief record. It is almost globular, pierced at the top, and enclosed beneath in a kind of saucer. It is sometimes observed abroad, in barns, or attached to the beams of garrets, and has even been found in hives. It is not unknown in Britain.

FAMILY IV.—ANTHOPHILA,² LAT.

In this, the last family of the stinging Hymenoptera, we find a peculiar power existing in the two posterior legs,—that of collecting the pollen of flowers.³ This character distinguishes our present groups from those of every other family of insects. The first articulation of the tarsi of the hinder legs is very large, compressed, and in the form of a square pallet, or of a reversed triangle. The maxillæ and the labium are usually very long, and constitute a kind of trunk. The ligula is generally shaped like the head of a lance, or resembles a lengthened filament, of which the extremity is silken or hairy. The larvæ are fed exclusively on honey, or the fecundating pollen of flowers. The perfect insects restrict their own diet to the nectareous juices of flowers, and (when Flora's kingdom has fallen before the approach of winter) to the secretion which they form from these, which we call honey. These Hymenoptera, embracing the great genus *APIS* of Linnæus, are divided by Latreille into two sections.

SECTION 1ST, ANDRENETÆ, LAT.

The genera of this section have the intermediate division of the ligula heart-shaped or lance-shaped, shorter

Hymenoptera Aculeata. than the sheath, and bent upwards in some, almost straight in others. They correspond to the *Pro-abeilles* of Réaumur and Degeer, the *Andrenæ* of Fabricius, and the *Melittæ* of Kirby.⁴

The *Andrenetæ* are solitary insects, and consist of only males and females. Their mandibles are simple, or terminated at most by two dentations. The labial palpi resemble the maxillary, and the latter have six articulations. The ligula is divided into three portions, of which the lateral are short, and in the form of auricles. The majority of the females collect the pollen of plants by means of the hairs of their hinder legs, and mixing it with a little honey, they thus form a paste for the nourishment of their young. They form holes in the ground, frequently even in firmly-trodden places by the sides of roads, or in fields, and of considerable depth. In these they place their paste, and depositing an egg along with it, they close up the entrance with earth.

Some have the middle division of the ligula widened at the extremity, almost heart-shaped, and doubled in repose. Such is the genus *HYLÆUS*, Fab. which is now partitioned into two. In the first, or *HYLÆUS* properly so called (Plate CCXXXII. fig. 20), the body is smooth, the second and third joints of the antennæ of almost equal length, and the upper wings present only two complete cubital cells. The species being hairless, do not collect pollen, and seem to deposit their eggs in the nests of other Hymenoptera of this family. In the second genus, *COLLETES*, Lat. the body is hairy, the third article of the antennæ exceeds the second in length, and the upper wings present three complete cubital cells. The females collect their stores from flowers. Such is the *Apis succincta* of Linn.—“l'abeille dont le nid est fait d'espèces de membranes soyeuses,” of Réaumur.⁵ The male is distinguishable by his more lengthened antennæ. The female forms in the earth a cylindrical hole, of which the walls are endued with a gummy liquid, which has been compared to the viscid and shining slime left by slugs on the places over which they have passed. She then forms a number of thimble-shaped cells, apparently composed of the same material, placed end to end, and in a string, and each containing an egg and a suitable portion of paste.

Other *Andrenetæ* are distinguished from the preceding by the form of the ligula, which is lanceolate. In some of these, that part is folded on the superior side of the sheath, as in the genera *ANDRENA* and *DASYPODA* of Lat. (Plate CCXXXII. fig. 21). The females of the latter have the first joint of the tarsi very long, beset with lengthened hairs after the manner of a little feather. The upper wings in both these genera have only two cubital cells. The *Andrena flessæ* of Panzer, common in the environs of Paris, secretes a peculiar kind of honey, black and oily like the grease (cambois) used for carriage-wheels. It has a narcotic odour. In others the ligula is straight, or slightly bent underwards at its extremity. Such are the genera *SPHECODES*, *HALIETUS*, and *NOMIA*, of Latreille.

SECTION 2D, APIARIÆ, LAT.

In this second section of the honey-making Hymenoptera the genera are characterized by the middle division of the ligula being at least as long as the mentum or its tubular sheath, and setiform or filamentary. The maxillæ and labium are greatly elongated, and form a sort of trunk, geniculate and bent beneath while not in action. The

¹ *Ann. des Sciences Nat.* t. iv. p. 339.

² Latreille remarks that the parasitical species are not possessed of this faculty;—but the form of their legs is essentially the same, those parts being merely destitute of the hairs or brushes.

³ *Monographia Apum Angliæ.*

⁴ From *ανθος*, flower, and *φιλος*, lover.

⁵ *Mémoires*, vi. xii.

ymenop- two first articulations of the labial palpi have generally the
tera form of a scaly and compressed seta, which embraces the
culeata. sides of the ligula; the two others are very small, and the
third is usually inserted near the exterior extremity of the
preceding, which terminates in a point.

The Apiariæ are either solitary, or united in society.

A.

In the former, which constitute the first principal division, the species consist of only two kinds of individuals, of the ordinary nature of male and female. Each female provides, by her own unassisted efforts, for the preservation of her posterity. The posterior legs are unprovided with the silky down (*la brosse*) on the inner face of the first articulation of the tarsi; neither do we perceive that particular depression on the outer side of the tibiae, which the French naturalists distinguish as *la corbeille*, or the basket, and which is so useful in the economy of the *workers* in certain other genera. That outer side, as well as the corresponding part of the first articulation of the tarsi, is usually furnished with numerous close-set hairs.

a.

The first subdivision of these solitary Apiariæ consists of species in which the second articulation of the posterior tarsi of the females is inserted in the centre of the extremity of the preceding one; the exterior and terminal angle of the latter does not appear dilated or more advanced than the interior.

*

We shall first signalise a group of genera which have been named *Andrenoides*, no doubt from the resemblance which they bear to the latest of the preceding genera in their labial palpi, composed of slender linear joints, placed end to end, almost entirely similar to those of the maxillary palpi, and which are six in number. The labrum is always short. The females have no brush on the abdomen; but their posterior legs are clothed or garnished with tufts of hair, which serve them to collect the pollen of flowers. Some have the mandibles narrow, contracted towards the extremity, terminated in a point, and, in common with the labrum, smooth. Such are the genera *SYSTROPHA*, Illig. *ROPHITES*, Spinola, and *PANURGUS*, Panzer. Others have the mandibles, in the females, almost spoon-shaped, very obtuse, carinated or grooved, and bidentated at the end. The labrum is very hard, and ciliated above. The antennæ are strongly geniculate and filiform. The upper wings have three complete cubital cells, the first intersected by a little transparent line, the second triangular, the third the largest, and receiving the two recurrent nervures. The genus *XYLOCOPA*, Lat. (Plate CCXXXII. fig. 22), resemble large humble-bees. Their body is usually black, sometimes covered in part with a yellow down, and the wings are frequently adorned by brilliant tints of violet, copper, and green. The males of several species differ greatly from the females. Their eyes are large, and more approximated superiorly. Their anterior legs are dilated and ciliated. The species figured, which is the *Apis violacea*, Linn. is one of the best known in European countries. The female excavates holes in old wood, divided into several cells, in each of which she deposits an egg, and a portion of paste for the sustenance of the future grub. The species are very numerous in foreign countries, and seem to spread over many regions of the globe. Comparatively few occur in Europe.

* *

In other genera the labial palpi appear under the form of scaly setæ; the first two articulations are very large, or much lengthened, compared to the last two, of a scaly consistence, with the margins membranous or transparent. The

maxillary palpi are always very short, and have not unfrequently fewer than six articulations. The labrum in a great number is lengthened, inclined upon the mandibles, sometimes in the form of an elongated square, sometimes of a lengthened triangle.

The group named *Dasygastræ* by Latreille are remarkable, as their name implies, in this, that the abdomen of the female is almost always furnished with numerous short, close-set hairs, which form as it were a silky brush. The labrum is as long or longer than broad, and of a square form. The mandibles of the females are strong, incisive, triangular, and toothed. The paraglossæ are always very short, in the form of scales, pointed at the end. Of all the genera which compose this group, that called *CERATINA* approaches most closely to that of which we last figured an example; and, according to Maximilian Spinola, the habits of the females are identical with those of the *Xylocopæ*.¹ We have several species in Britain. All the remaining *Dasygastræ* have at most only four articulations to the maxillary palpi, and two complete cubital cells. In the six genera next ensuing, the abdomen is obviously furnished beneath with a silky brush. The species belonging to *CHELOSTOMA*, Lat. and *HÉRIADES*, Spin. form their habitations in the hollows of ancient trees. In the genus *MEGACHILE*, Lat. the maxillary palpi are composed of only two articulations, the abdomen is plain above, and susceptible of being raised upwards,—thereby enabling the female to use her sting over her body. This genus contains several singular insects, of which the habits have been well described by Réaumur and other observers.² *M. muraria* is one of the largest of the genus. The female is black, with dark wings tinted with violet; the male is covered with reddish hairs, the terminal segments of the abdomen being black. The former sex constructs her little nest on walls and stones in sunny places. It is made of fine earth worked into a kind of mortar, which drying, becomes very hard and durable. On this account the term *mason-bee* is applied to this insect, and to several other species of analogous habits. The interior of these nests contains about a dozen cells, in each of which the provident parent deposits an egg and a piece of paste. The perfect insect is not produced till the spring of the ensuing year. Another species, *M. sicula*, Lat. is black and hairy, with the front, the upper part of the thorax, and the legs, bright yellow. The female constructs a hard and spherical nest, of rather more than an inch in diameter, which she attaches to the branches of heath and other plants. This insect occurs both in Egypt and the south of Europe, and was lately noticed in Corsica by M. Payraudeau. The habits of other species of the genus *Megachile* are very different from those just noted. They are known by the name of *leaf-eating bees* (Plate CCXXXII. fig. 23), on account of their employing in the construction of their nests perfectly oval or circular pieces of leaves, which they cut out with the most remarkable dexterity. These pieces are conveyed to their straight cylindrical holes, which they previously excavate in the earth, or sometimes in walls, or the decayed trunk of an old tree. They line the bottom of the cavity with these cuttings, and form a thimble-shaped cell (*ibid.* fig. 27), in which they deposit the honeyed provision on which the larva is destined to feed. After laying an egg, they close the cell by means of a flattish or slightly concave lid, also formed of a portion of leaf. These little cells are repeated one over the other till the hole is filled up. To this division of the genus belongs the *M. du rosier* of Lat. (*Apis centuncularis*, Linn.). The genus *LITHURGUS*, Lat. is furnished with four articulations to the maxillary palpi, and the abdomen is depressed above. All the articulations of

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¹ See the article *Ceratine*, in the 2d edition of the *Nouv. Dict. d'Hist. Nat.*

² *Mémoires*, t. iv.

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the labial palpi are placed end to end. The females have a rounded projection in the middle of the head. Such are *Centris cornuta*, Fab. and an unpublished species from the Isle of France, alluded to by Latreille. In the genus *Osmia* of Panzer the maxillary palpi consist of four articulations, or at least of three very distinct ones, and the abdomen is convex above. The habits of the species have been observed by Réaumur, Degeer, Spinola, and other naturalists. Several are *masons*, and have frequently two or three horns on the clypeus, which are probably of use in the construction of their nests. These are concealed in the earth, in chinks of walls, door-posts, and old wood, and sometimes even in the shells of snails (*Heliccs*). One of the most interesting of the genus is the *Osmia papaveris*, which lines its subterranean dwelling with the gorgeous petals of the scarlet poppy. Another, *O. gallarum*, takes possession of a fungous gallnut formed by a kind of *Cynips* which inhabits the oak. The hollow space left by the *Cynips* being too small, the little bee enlarges it considerably, and polishes the interior. The genus is composed of about thirty species, which seem almost peculiar to Europe. A considerable number occur in Britain. The other genera of this group are *Anthidium*, Fab., *Stelis*, Panzer, and *Coelioxys*, Lat.¹ The two last-named genera of *Dasygastræ* resemble the ensuing group in wanting the silky brush, from which it has been presumed that they also coincide with them in being parasitical; but their labrum is parallelogramic, and the mandibles are triangular and dentated. The maxillary palpi are very short and bi-articulate.

* * *

A third group of genera in this subdivision of the (solitary) *Apiariæ* is named *Cuculinæ*. They resemble the preceding in the posterior tarsi, and agree with the concluding genera in the labial palpi being in the form of squamous setæ; they also resemble the genera *Stelis* and *Coelioxys* in the abdomen being destitute of a silky brush. They are parasitical, and their bodies are almost smooth and coloured like those of wasps, sometimes partially clothed or hairy. The labrum assumes the form of a lengthened and truncated triangle, or is short and almost semicircular. The mandibles are narrow, ending in a point, and at most unidentate on the inner side. The paraglossæ are often long, narrow, and setiform. The scutellum in several is emarginate or bidentate; in others it is tubercular. These insects correspond to the *Nomadæ* of Fabricius. Several appear in those countries to which they are indigenous, flitting about in spring partly near the ground, or on walls exposed to sunshine. They are then employed in searching for the nests of other *Apiariæ*, in which they, cuckoo-like, deposit their eggs. It was in reference to this habit that Latreille named them *Cuculinæ*. The genera are *Ammobates*, *Phileremus*, *Epeolus*, Lat., *Nomada*, Fab. (Plate CCXXXII. fig. 24), *Pasites*, Jur., *Melecta*, Lat., *Crocisa*, Jur., *Oxæa*, Klug.² Of these, *Nomada* is the richest in British species. The genus occurs in Asia, Africa, and America, although the majority are characteristic of, if not peculiar to, Europe. The genus *Melecta* is not unknown in Britain.

b.

The concluding subdivision of the solitary bees is characterized by the first article of the posterior tarsi being dilated inferiorly on the outer side, so that the following articulation is inserted nearer to the internal angle of its extre-

mity than to the opposite one. The outer side of that first angle, as well as the corresponding part of the tibia, is furnished with thick and close-set hairs, forming, especially in several exotic species, a sort of brush or tuft,—and thence the name of *Scopulipedes*, bestowed on this division by Latreille. The under part of the abdomen is naked, or at least unprovided with a silken brush. The number of cubital cells is three, with few exceptions, and each of the last two cells receives a recurrent nervure.

Sometimes the maxillary palpi consist of from four to six articulations.

In a certain number the mandibles exhibit only a single tooth on the inner side. These species fly with great rapidity from flower to flower, and with a buzzing sound. They construct their nests either under ground, or in the clefts of old walls. Several prefer ground which has been cut perpendicularly, and exposed to the sun. Those species in which the two lateral portions of the ligula are as long as the labial palpi, and setaceous, and of which the antennæ of the males are lengthened, form the genus *Eucera* properly so called (Plate CCXXXII. fig. 25). The male of a British species (*Apis longicornis*, Linn.) is black, with the labrum and the anterior extremity of the head yellow; its upper portion, thorax, and two first segments of the abdomen, are covered by a reddish down. The female (at one time described by Fabricius as a distinct species, under the name of *Apis tuberculata*) has short antennæ. The maxilla and labium form at their base a slight projection. The abdomen is marked by grey stripes, with a reddish termination. Several other species occur in Britain. Spinola has detached certain species, of which the maxillary palpi have only five distinct articulations, and the superior wings only two cubital cells. These he names *MACROCERA*.³ The *MELIPODES* of Lat. may be defined as American *Eucera*, with but four joints to the maxillary palpi, and three cubital cells to the superior wings. In the other *Apiariæ* of this subdivision, the paraglossæ are much shorter than the ligula, and always exhibit three cubital cells. In *MELITTURGA* and *ANTHOPHORA*, Lat. (of both of which several species are indigenous to Britain), the maxillary palpi have six articulations. In *SAROPODA*, Lat., likewise known among ourselves, the maxillary palpi have only five articulations, and those of the labium are continuous. Lastly, in the genus *ANCYLOSCELIS*, Lat., of which the species are native to Brazil, the maxillary palpi offer only four articulations.

In others the mandibles have several dentations on the inner side, and the maxillary palpi, as in the preceding genus, have four articulations. Such is the American genus *CENTRIS* of Fab.

Sometimes the maxillary palpi consist of only a single very small articulation, which even becomes imperceptible in certain species. The paraglossæ are very short, and the mandibles dentated. Such are the genera *EPICHARIS* and *ACANTHOPUS* of Klug.⁴

B.

Our second principal division of the *Apiariæ* is constituted by many interesting insects, such as the garden and humble bees, so remarkable for their peculiar *regime*, and the gregarious habits of the species, each of which consists of three kinds of individuals—males, females, and neuters, as the workers are often called. The posterior tibia of these last named are furnished on their external face with a smooth depression called the basket, in which they place the pollen

¹ See *Règne Animal*, t. v. p. 350.

² For the characters of the above genera, see *Règne Animal*, t. v. p. 352-3; and Kirby's *Monographia Apum Angliæ*. The haunts and habits of the species are noted under their generic titles in the *Encyclop. Méth.*, and the *Diction. Class. d'Hist. Nat.*

³ The name is objectionable, either on Spinola's part or Meigen's (according to whoever used it last),—as we observe that the German author, in his *Zweiflügeligen Insecten*, applies the same title to a dipterous genus.

⁴ See *Encyclop. Méth.* and other works already named.

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collected from flowers by means of the silky down or brush with which the inner face of the first joint of the posterior tarsi is provided. The maxillary palpi are very small, and consist of a single articulation. The antennæ are geniculate.

Sometimes the posterior tibiæ are terminated by two spines, as in the genus *EUGLOSSA*, Lat. (Plate CCXXXII. fig. 26), which has the labrum square, and the false proboscis, or prolonged parts of the mouth, as long as the body. The labial palpi terminate in a point formed by the two other articulations. The species are peculiar to South America. Latreille supposes that we owe to the one which we have here figured (*E. dentata*), and to that called *E. cordata*, the green honey so much esteemed in the Antilles. We are still ignorant of the habits of these insects. In the genus *BOMBUS* (ibid. fig. 29), the species of which we recognise in this country as *humble-bees*, the labrum is transverse, and the proboscis obviously shorter than the body. The second articulation of the labial palpi terminates in a point, bearing the two others on its outer side. There are few associations of our childhood more deep and lasting than those connected with the pursuit and capture of these beautiful creatures, some of which are remarkable for their size, and the rich contrast which they exhibit of velvet black and crimson, with bars of brilliant yellow. This splendid attire, however, saves them not from being rudely handled; and we remember the day when an artificial *bink*, that is, a little box made of clay, with a piece of glass at one end, and a sprinkling of sugar at the other, contained as many captives in proportion to its size, as the black-hole of Calcutta. But the practice of *blobbing* was one we never patronized, although we know it is pursued in this country, just as it seems to be, judging from the following quotation, by the youth of the *Great Nation*:—" Ils sont bien connus des enfans, qui les privent souvent de la vie pour avoir le miel renfermé dans leur corps, et le sucer.¹ The excitable genius of a great English poet is roused to a wider range of sentiment and association by the sight of one of these industrious beings.

And is she brought within the power
Of vision?—o'er this tempting flower
Hovering until the petals stay
Her flight, and take its voice away!
Observe each wing—a tiny van!—
The structure of her laden thigh,
How fragile!—yet of ancestry
Mysteriously remote and high,
High as the imperial front of man,
The roseate bloom on woman's cheek;
The soaring eagle's curved beak;
The white plumes of the floating swan;
Old as the tiger's paw, the lion's mane
Ere shaken by that mood of stern disdain,
At which the desert trembles.—Humming-Bee!
Thy sting was needless then, perchance unknown;
The seeds of malice were not sown;
All creatures met in peace, from fierceness free,
And no pride blended with their dignity.
—Tears had not broken from their source,
Nor anguish strayed from her Tartarian den;
The golden years maintained a course
Not undiversified, tho' smooth and even;
We were not mocked with glimpse and shadow, then
Bright seraphs mixed familiarly with men,
And earth and stars composed a universal heaven.²

Be this as it may, the species of the genus *Bombus* inhabit subterranean dwellings, assembled together in social groups amounting to from fifty to sixty individuals, or even in certain cases to between two and three hundred. These unions, however, differ from those of the honey or garden-bee in this, that they are dissolved, like those of wasps, on the ap-

proach of winter. They consist of *males*, distinguished by the smallness of their size, their feebler heads, their narrower mandibles, terminated by two dentations, and bearded, as well as by their frequent difference of colour; of *females*, which are larger than the other individuals, and have spoon-shaped mandibles; and of *workers*, of which the mandibles are likewise spoon-shaped, and the size intermediate between the two preceding kinds. Of these workers, Réaumur was the first to distinguish two varieties,—one comparatively large and strong, the other smaller, but more lively and active. This curious fact was afterwards verified by Huber the younger. According to the observations of the Genevese observer, several of the workers born in spring couple during the month of June with males sprung from a common mother, and soon afterwards deposit eggs, from which, however, males alone are produced. These latter couple with the females which are born towards the end of the season, and which continuing through the winter in a pregnant state, become each the founder of a colony in spring. In the mean time, all the others perish, without excepting even the smaller females. The workers, then, though, in common with those of the garden-bee, often called neuters, are in fact females, but of smaller size than the more regular mothers, and with the productive faculty imperfectly developed. No sooner has the genial influence of spring penetrated the mossy cells where these more ponderous matrons have enjoyed their winter sleep, than they rouse themselves from their repose, and wing their dubious flight in search of the first opening crocus, or other garden flower; or, if remote from man, and destined to boom amid wild uplands or other pastoral wastes, the flowering *saughs* (*Salix caprea*), which so often skirt the edges of our mountain streams, and beautify the crystal waters by the reflection of their golden blossoms, afford them a sufficing food. The lover of nature knows how, even among sterile solitudes, a few bright sunny days call into life and beauty many fragrant flowers, not long unvisited by these glad labourers, who ere long settle in some fit abode, and lay the foundations of a future city.

The nests of humble-bees are generally formed beneath the earth, and at a depth of one or two feet. Dry plains, fields, sloping banks, and the sides of hills, are their common localities. These subterranean cavities are of considerable extent, wider than high, and in the form of a dome. The ceiling is constructed of earth and carded moss, carried thither fibre by fibre. The inner walls are plastered over by a coating of coarse wax. Sometimes a simple opening serves as a passage to the foot of the nest; sometimes a tortuous road, of one or two feet in length, leads to the habitation. The bottom of the cavity is lined with a layer of leaves, for the reception of the brood. The female first places in it masses of brown irregular wax, called *pâtée* by Réaumur, and compared to truffles by that naturalist, on account of their shape and colour. Their cavities are destined to contain the eggs and larvæ. The latter live together in society until such time as they are ready to assume the nympha state; they then separate and spin ovoid silken cocoons, vertically fixed against each other. The nymph is always found in a reversed position, or with the head downwards, like those of the females of the honey-bee; and the cocoons are uniformly pierced at their lower end when the perfect insect escapes from its prison. Réaumur asserted that the larvæ fed upon the wax which formed the walls of their habitations; but these, according to M. Huber, merely serve as a protection from cold and moisture; and the actual food consists of an ample provi-

¹ *Règne Animal*, t. v. p. 357.

² Wordsworth's *Vernal Ode*.

Hymenoptera Aculeata. sion of pollen moistened with honey, which the labourers provide for the helpless objects of their instinctive affection. When the supply is exhausted, they pierce the cover of the cells, put in an additional supply, and re-close the protecting habitation. We may truly observe, in relation to these delightful labours, that it is not alone in the "great waters" that man may behold the wonderful works of an omnipotent Creator; for literally the *earth* is "full of his goodness." These affectionate labourers, so pervaded by the instincts of maternity, though themselves for the most part barren, watch like rejoicing mothers over the destiny of the future citizens; and as soon as they perceive that a generous diet has increased their dimensions, they enlarge the size of their habitations. We find moreover in these nests three or four small bodies resembling goblets, composed of brown wax, or of the same consistence as the *pâtée*, always open, and more or less filled with good honey. The exact situation in the hive of these honey jars is by no means constant. It has been said that the workers make use of the empty cocoons for the same purpose; but their doing so is deemed very doubtful by Latreille, in as far as these cocoons are not only formed of a silky substance, but are perforated on the under side.

The larvæ are hatched in about five days after the deposition of the eggs, and accomplish their metamorphoses in the months of May and June. It was formerly supposed that labourers alone were produced at this period; but we have already alluded to the simultaneous production of a certain number of males. The labourers immediately proceed to assist the female founder in her operations; and from this period the number of cells which serve as habitations for the larvæ and nymphs is greatly augmented. They form irregular combs, rising in stages, on the edges of which the *pâtée* of Réaumur is particularly observable. According to Huber, the workers are extremely greedy of the eggs of the female, and sometimes in her absence open the cells in which they are deposited, in order to suck the milky fluid they contain! a most extraordinary fact, as Latreille observes, and one which seems to belie the noted attachment which they entertain for the germs of that race of which they are the natural and appointed guardians. The wax secreted by humble-bees is elaborated by the same peculiar process as that which produces the more beautiful material with which the garden species constructs its honeyed cells. It in fact results from honey, transuded through the intervals of the rings of the abdomen.¹ Several females dwell together in unity, and do not exhibit that instinctive aversion towards each other so remarkable among our domesticated species.

Yet these bees, however humble, have enemies, numerous and of various kinds. Their habitations are uprooted or otherwise attacked by foxes, badgers, weasels, polecats, rats, field-mice, ants, and moths. Certain *Volucellæ* (*Syrphi* of Fab.) deposit their eggs in their nests, the larvæ proceeding from which devour the eggs of the legal occupants. The larvæ of a species of *Conops*, described by MM. Lachat and Audouin, live, like intestinal worms or the grubs of Strepsiptera, within the abdomen of the perfect bee; and after acquiring wings, they make their escape from between the segments.²

The species of the genus *Bombus* are extremely numerous, and seem extended over almost all the regions of the earth. "Scarcely any genus of the insect creation," ob-

serves Mr Kirby, "has so large a range as this of *Bombus*. It is found in the old world and in the new; and from the limits of phænogamous vegetation to the equator; but its metropolis appears to be within the temperate zone."³ We cannot here enter into descriptive details. In Great Britain alone we have above forty different kinds. Of these, the *B. muscorum* (*Apis muscorum*, Linn.), called *Foggie* by the Scottish schoolboy, is recognisable by its reddish colour, uniform in the males, females, and neuters. In *B. lapidarius* the female is black, the abdomen with a red termination; the male (which is the *B. arbustorum* of Fab.) has the front of the head and both ends of the thorax yellow,—the abdomen having likewise a red extremity. This species differs from the others in its habit of forming its nest under stones. Hence its Latin trivial name. The *B. terrestris* is a very common and very beautiful species, widely distributed. It is black, with the posterior extremity of the thorax and the base of the abdomen yellow. The termination of the latter part is white. The *B. arcticus* of Kirby is black, with the base and apex of the thorax, and the anterior half of the abdomen, pale yellow. This insect is the *Apis alpina* of Otho Fabricius;⁴ but not the species so called by Linnæus, which the former author supposed it to be. "The insect before us," says Mr Kirby, "differs so slightly from the description which O. Fabricius has given of that which he mistook for the *Apis alpina* of Linné, that there can be little or no doubt of their identity. He confesses that his specimens (and this bee appears to have abounded in West Greenland, as it was also observed to do in Melville Island, and wherever the expedition landed within the arctic circle) did not in all things agree with the characters assigned to that species. But he states, that as Linné had seen only a single specimen, he did not think himself at liberty to make a new species on account of an insignificant difference. Although, however, Linné had seen this bee only once, it has since been more frequently taken; and having received specimens of it from Sweden, through the kindness of Major Gyllenhal, which agree with the Linnæan description in every point but size (a circumstance easily explained, by supposing the original specimen a queen and those sent to me neuters), I can venture to assert that the two insects are perfectly distinct. *Bombus alpinus* is entirely black, with the upper side of the abdomen, all but the base, covered with orange-coloured or ferruginous hairs. The antennæ also of the female or neuter (an important distinction in a genus the species of which are usually only distinguished by the colour of their hirsuties) are proportionally shorter; and the short hairs that cover the tarsi are black."⁵ The range of the true *B. arcticus* seems limited by the arctic circle, and extends from Greenland only in a westerly direction,—at least the species does not appear to have been observed in Lapland, Iceland,⁶ or other eastern portions of that chilly zone. A European species, named *B. Lapponicus*, is said to be well known in North America, and to extend as far north as Nova Scotia.⁷ Dr Richardson, the intrepid arctic traveller, informed the author of the present treatise, that in the course of the northern land expedition he saw some bees in very high latitudes, resembling our common humble-bee (*B. terrestris*?), but that he did not at the time ascertain the precise species; and the circumstances under which he was then placed unfortunately prevented his preserving specimens of the softer kinds of insects.⁸

¹ *Mémoires du Mus. d'Hist. Nat.* t. viii. p. 147.

² *Journal de Physique*, Mars 1819.

³ *Supplement to the App. to Capt. Parry's First Voyage*, p. 217.

⁴ *Fauna Grœnlandica*, 155.

⁵ For a detailed history of the genus *Bombus*, the reader may consult, in addition to the works already named, "Observations on several species of the genus *Apis*, known by the name of Humble-Bees, and called *Bombinatrices* by Linnæus," by Mr P. Huber, in *Linn. Trans.* vol. vi. p. 214.

⁶ *Supplement to the App. to Capt. Parry's First Voyage*, p. 217.

⁷ Hooker's *Recollections of Iceland*, 1st edit. p. 34.

⁸ *Dict. Class. d'Hist. Nat.* t. ii. p. 451.

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culeata.

The remainder of our social Apiariæ are not characterized, like the preceding, by spines at the extremity of their posterior tibiae. They form two genera.

In the genus *Apis*, Lat., or honey-bees *par excellence*, the workers have the first articulation of the posterior tarsi in the form of a lengthened square, and furnished on its interior face with a silky down, or divided into transverse or striated bands. We here place our invaluable garden species *Apis mellifica*, Linn. (of which we have represented the worker, the female, and the drone, on Plate CCXXXII. figs. 28, 30, and 31), on the wonderful history and attributes of which we could dilate with pleasure to ourselves, if not with satisfaction to our readers, had not the subject been already here treated of at length, and by an abler hand.¹ We shall merely here remark, that all the species of the genus *Apis* properly so called are peculiar to the ancient countries of the world, and that the domestic culture of the honey-bee is of an origin so remote as to be lost in the depth of ages. It served among the Egyptians as the hieroglyphical emblem of royalty, and has been more or less attended to by all civilized nations of whom we have any record; for innumerable in all but the darkest times are the writers who have told—

Of treasure suck'd from buds and bells,
For the pure keeping of those waxen cells,
Where she, a statist prudent to confer
Upon the public weal, a warrior bold,
Radiant all over with unburnished gold,
And armed with living spear for mortal fight,
A cunning forager
That spreads no waste,—a social builder, one
In whom all busy offices unite,
With all fine functions that afford delight,
Safe through the winter storm in quiet dwells!

Our honey-bee (*A. mellifica*), though now well known in America, is in that country not an indigenous, but an imported species. Our land expeditions did not observe its occurrence to the north of Canada. The Americans have now settled the Missouri, as far as the 95th meridian; and it is probable that the New England men, in their journey westward, carried hives along with them. According to Mr Warden, the hive-bee was not found to the westward of the Mississippi prior to the year 1797; but it is now well known, and has been so for a considerable time, as high up the Missouri as the Maka nation,—having proceeded westward six hundred miles in fourteen years.² Such a distance seems great for these tiny creatures to advance by the ordinary process of swarming, even supposing that the flight of the new colonies was invariably in a western direction. It is at the rate of forty-three miles a year; but they have perhaps been smitten by the Yankee passion for settling beyond the clearings.³

Besides the species above named, various other honey-bees are found in different regions of the earth. The *Apis*

unicolor of Lat. occurs in Madagascar and the Isle of France, and yields an esteemed honey of a green colour, like that of the Antilles. The *Apis Indica* of Fab. is found in Bengal and at Pondicherry. The *Apis fasciata* of Lat. is domesticated in Egypt, and is carried at certain seasons, for the sake of a double harvest, from Lower into Upper Egypt, just as we transport our own species, when the “flower-enamelled meads” are on the wane, to the blooming heather of the mountain solitudes. The *Apis Adansonii* is a species found in Senegal; and the *Apis Peronii* is native to the island of Timor, from whence it was first brought by the enterprising navigator whose name it bears. In relation to the European kinds, we have no other British species than the one so frequent in our garden-hives; but the Italians cultivate with success the *Apis Ligustica* of Spinola, which is by some entomologists supposed to occur in the wild state, and unimported, in the Morea and the Mediterranean Archipelago.⁴

The terminal genus of the social bees (and with it we conclude the hymenopterous order) is that called *MELIPONA* by Illiger and Latreille. It is distinguished from the preceding genus by the form of the first articulation of the posterior tarsi, which is narrower at the base, or in the shape of a reversed triangle, and without striæ on the silky brush of its interior face. The upper wings have only two complete cubital cells, while there are three in the genus *Apis*. These Hymenoptera inhabit South America, and build their nests, which resemble bagpipes, on the tops of trees, or in their cavities. Their honey is extremely sweet and agreeable, but very liquid, and apt to corrupt. The Indians form from it a favourite spirituous liquor. These details apply to *M. amalthæa*, of which M. Cordier possesses a specimen enclosed in amber. The species in general have been observed by many travellers, but by few naturalists; and it is therefore not very easy to refer the recorded observations on their history to the proper species. Some nearly allied insects form the genus *TRIGONES* of Lat.⁵

ORDER VI.—LEPIDOPTERA, LINN.⁶

This splendid and much-admired order is characterized by the possession of four membranous and veined wings, covered by close-set scales, which frequently present the most brilliant and richly varied colours. The mouth consists of lengthened filaments or threads, the union of which forms an extensile spiral trunk or tongue, with which the nectareous juices of flowers are absorbed. Two palpi (corresponding to the labial palpi of masticating insects), consisting of three articulations, act as a sheath or guard on either side of the tongue when rolled up. The superior or maxillary palpi are usually very small, inconspicuous, or obsolete. The chrysalis is *obtect*, that is, covered over or

¹ See the article BEE of this work, vol. iv. p. 518. We shall merely observe, in regard to the conversion of the neuter or working bee into a queen-mother, that a great degree of obscurity seems still to pervade the writings of all entomologists, whenever that singular subject is touched upon. Nothing in the history of these creatures has been more clearly demonstrated than the fact of such conversion,—but how a change of food should operate in the course of a few days a determinate change in the organic form and instinctive character of an insect, is as yet a mystery. We are more willing to believe than competent to understand several of M. Huber's facts. It is easy to conceive a greater development of particular organs, the germs of which previously existed,—but the positive alteration in the structure of the feet and maxillæ is not so readily accounted for. We still require some more precise and detailed information regarding this mysterious transmutation than the observations even of the Hubers have furnished. It would tend greatly to elucidate the subject if a series of comparisons could be made at different periods of their development, between the larvæ, nymphs, and perfect insects of the two kinds of queen-bees,—namely, those which were deposited originally in the royal cells (the legitimates), and those whose condition has been altered by the bees themselves in consequence of a failure in the royal line (the citizen-queens). It has not yet been ascertained at what periods or in what manner these singular changes of form take place, further than that the common maggot or bee-worm, on which the change is to be effected, must not exceed the age of three days.

² *Statistical, Political, and Historical Account of the United States of America*, vol. iii. p. 139.

³ *Edinburgh Cabinet Library*, vol. ix. p. 387.

⁴ In addition to the numerous works already cited, see a Monograph of the genus by Latreille, in the *Observations de Zool. et d'Anat. Comp. du Voyage de MM. Humboldt et Bonpland*.

⁵ *Genera Crustac. et Insect.* t. iv. p. 182.

⁶ *GLOSSATA*, Fabricius.

Lepidop-
tera.

Lepidoptera. concealed by a crustaceous envelope, which however exhibits to a certain extent the external traces of the limbs, thorax, and abdomen.

The Lepidoptera are the most beautiful of all insects, and exhibit in their colouring every imaginable hue. It is not the mere brilliancy of the broader masses of colour, or their gorgeous combination, which alone delights our eyes, —but the exquisitely varied markings by which the hand of nature has traced her enigmatical characters on the “sail broad vans” of these fairy and fantastic creatures. What are the forms

Painted on rich men's floors for one feast night,

or the most elaborate Mosaic pavement, when compared with the imbricated surface of a butterfly's wing!¹ It was probably the highly ornamental nature of this order that induced Degeer and Olivier to place it at the head of the class of insects.

The mouth of the Lepidoptera does not differ essentially in its structure from the same organ in the masticating or mandibulated orders.² Savigny and Latreille have shown, in a manner at once precise and philosophical, that it is composed of the same pieces, and that these pieces are peculiarly appropriated to the functions which they are required to perform; thus some parts of little use exist in a merely rudimentary condition, while others of a more indispensable nature have gained an increase of development. The component parts are: a labrum, often nearly invisible, conical, or subulated; two corneous mandibles, very small, rudimentary, hairy, or garnished with small scales, and fixed, or apparently useless; two corneous maxillæ, in the form of tubular threads, generally much extended, and soldered together as far as the origin of the palpi, and forming by the union of their inner edges the trunk or sucker, of which the interior presents three canals; two maxillary palpi, often almost imperceptible, consisting of from one to three articulations, and inserted near the bend of the maxillæ; two labial or inferior palpi of three articulations, closely set with hairs or scales, and rising on each side of the trunk, of which they form a kind of sheath. The labium is composed of a single piece, flat, and triangular.

The antennæ vary in the different groups, but they are always composed of a great number of articulations. In the diurnal tribes they are simple, and generally terminated by a small inflation or knob; in the crepuscular they assume the form of an elongated or fusiform mass; in the nocturnal they are filiform or setaceous, whether pectinated or simple, and often plumose, especially in the males. In many species we find a pair of stigmatic eyes concealed among the scales, and placed between the ordinary eyes or organs of vision. The latter are hemispherical, of considerable size, and composed of innumerable facets. The trunk is either ineffective or altogether wanting in some of the crepuscular and nocturnal tribes. The three segments of which the thorax of many other hexapod insects is visibly composed, seem here united into one,—the anterior being very short and transversal, as in the hymenopterous and dipterous orders. The form of the thorax is extremely uniform, and any apparent variety of aspect is caused chiefly by the extension of its hairy or scaly covering, which sometimes assumes the shape of a crest. The abdomen is composed of from six to seven segments. It is attached to the thorax by a very small portion of its dia-

meter, and never offers either sting or ovipositor, although in a few females (as in *Cossus*) the terminal rings are narrow, and lengthened into the form of a pointed and retractile oviduct. The scales of the wings, on which their gorgeous beauty depends, are implanted by means of a small pedicle. Their figure is variable. They are usually somewhat elongated, rounded at the base from the side of the pedicle, and truncated at the outer extremity, which is generally toothed or serrated. The under wings frequently form on their inner margins a kind of canal for the reception of the abdomen. Among many of the diurnal kinds, the four wings, in a state of repose, are raised perpendicularly, so as to meet above the back; in the two other great sections they are horizontal or inclined; and in these there is often a strong spine or bristle on the anterior margin of the inferior wings, which being received by a buckle-like process of the under surface of the superior pair, maintains them in their position.

The legs of the Lepidoptera are as usual six in number, and the tarsi are composed of five articulations, and are terminated by a pair of hooks. In several diurnal genera the anterior pair are much shorter than the others, are useless as locomotive organs, and are folded on the sides of the chest; their tarsi being large, indistinctly articulated, and destitute of apparent hooks. The existence of the sense of smell in the class of insects is clearly demonstrated by the habits of many species of this order. The males of many nocturnal Lepidoptera discover the females of their own kind at a great distance, even when the latter are carefully and intentionally concealed from sight. The female is generally for the most part perceptibly, and in many instances considerably, larger than the males. They deposit their eggs, by an admirable and wisely granted instinct, not on the plants which they themselves affect during their first buoyant courses, but on such as are best adapted for the future nourishment of their crawling and wingless offspring.

The larvæ of Lepidoptera, usually known under the name of Caterpillars, are composed of twelve annular segments, exclusive of the head. They are furnished with nine stigmatic openings on each side, and the three anterior segments of the body are respectively furnished with a pair of short legs of a scaly consistence, terminated by a hook, and corresponding to the true legs of the perfect insect. There are, besides, from four to ten membranous or false feet upon the other segments. The body of caterpillars is generally elongated, soft, almost cylindrical, and frequently adorned by bright or beautiful colours, besides being variously provided with spines, hairs, or tubercles. Many are however naked, or unprotected by any other than a cutaneous covering. The head is harder than the other parts, and is covered by a corneous or scaly skin. It presents on each side six small shining grains, which are regarded as simple or stigmatic eyes; and two very short conical antennæ are likewise perceptible. The mouth is composed of two strong mandibles, a pair of maxillæ, a labium, and four palpi. The food of caterpillars consisting not of vegetable juices alone, but of the actual substance of the leaves and roots, and even of the well-matured woody fibres of timber trees, the masticating organs are beautifully adapted to their functions. But no sooner is the creeping and voracious larva about to transform itself into the “angelic butterfly,” which floats on gaudy

¹ We find the following memoranda among some notes illustrating the difference between the works of art and nature:

The Sussex pavement.....	} contains {	11	} tessellæ or separate pieces in one inch square.
A modern mosaic picture.....		870	
The wing of a butterfly expanded.....		100,736	
The same in the Aurelia state.....		931,808	

² See Plate CCXX. figs. 5 and 8, with the detailed description given in the note to page 63 of this volume.

pinions from flower to flower, and sustains itself only on the most ethereal of their nectareous juices, than the parts of the mouth undergo a change not less remarkable than that of the general form and aspect, and the long tubular proboscis above described is developed, in subservience to the habits of a new existence. The change, however, is by no means sudden or immediate, but is effected through the transitional state of chrysalis, of which we have already said perhaps more than enough in our attempted exposition of the mysteries of transformation. We cannot, however, here avoid to notice the elaboration of that silky substance which, towards the termination of the caterpillar's career, becomes so singular a feature in its natural economy, and one of such vast importance in the artificial *habits* of the human race. It is formed in two long tortuous interior vessels, which, becoming gradually more slender at their upper extremities, terminate in a small conical spinner at the end of the labium. Had these insignificant secreting organs not existed in the silk-worm, or other allied species, what a difference of character would have been manifested in the lustrous aspect of baronial halls, and even of the courts of kings! It is curious, indeed, to consider how the breeding of a few millions of caterpillars should occasion such a disparity at different times in the circumstances of different tribes of the human race. When the wife and empress of Aurelian was refused a garment of silk, on account of its extreme costliness, the most ordinary classes of the Chinese were clad in that material from top to toe; and although among ourselves week-day and holiday are now alike profaned by uncouth forms, whose vast circumference is clothed "in silk attire," yet our own James the Sixth was forced to borrow a pair of silken hose from the Earl of Mar, that his state and bearing might be more effective in the presence of the ambassador of England,—“for ye would not, sure,” said the royal pedant, “that your king should appear as a scrub before strangers.”¹ King Henry the Eighth was the first of the English sovereigns who wore silk stockings.

Many caterpillars, in walking, fix the anterior feet on the plane of their position, and, bending their body upwards, they advance and fix their anal feet, assuming for a time the form of a loop. They then unfix their anterior hold, and stretching forward their bodies, proceed as it were by spanning the ground. They are hence called surveyors (*arpenteuses*) by the French naturalists. Others, known under the name of *Batons*, fix themselves, in repose, to twigs and branches by their hinder feet, and thus hold themselves out stiff and immovable for many successive hours. It may easily be supposed that this extraordinary attitude must require the exercise of, comparatively speaking, most enormous strength. No vertebrated animal, not in a state of catalepsy, could sustain it even for a few seconds. We find accordingly (through the laborious investigations of a great interpreter of nature, Lyonnnet) that even in the caterpillar of *Cossus ligniperda*, a species which lives in trees, but does not exercise itself in the way alluded to, there are above 4000 muscles. Many move along the ground rapidly by the successive motion of each segment, as if a wave were flowing over or pervading their bodies. The intestines of caterpillars consist of a large canal without inflections, the anterior portion being sometimes slightly separated in the form of a stomach, and the posterior forming a wrinkled cloaca. There are also four very long biliary vessels, usually inserted pretty far back.

The habits of caterpillars are very various in the different kinds. Although a great majority feed on vegetable

substances, many of the smaller kinds are extremely destructive among stuffed birds, and all kinds of woollens. They will even devour leather, lard, wax, wafers, and all fatty matters. Many confine themselves to one particular substance, while others are polyphagous. Some unite in society, and form a silken tent to screen themselves from their natural enemies, and the extremes of heat and cold; others are independent and solitary. As they increase in size they cast their skins, and this process of sloughing generally takes place about four times. A great proportion, before assuming the chrysalis state, spin around them a web or cocoon, more or less compact according to their kind. In some (as in *Bombyx mori*, or the silk-worm) it is of a rich saffron colour, and of exquisite fineness; in others it is of a membranous texture, from being originally more compactly glutinous, instead of consisting of distinct threads. Many mingle with their funeral web or winding-sheet, particles of earth or decayed vegetable substances, which greatly increase the size of their cocoons. The chrysalids of the diurnal Lepidoptera are, however, naked or exposed, and are usually suspended by the posterior extremity, or fastened by a silken cord or girth around the middle of the body. They are also angular in their forms, while those of moths are rounded or cylindrical. In one or two of the crepuscular kinds, or Sphingides, the proboscis projects, and is encircled by a separate envelope, even in the chrysalis state. All the other parts are, however, swathed in a coriaceous covering, although the form of the wings and other members may be traced externally, in slight though distinct relief. The abdominal segments are capable of motion, like the “thaws and sinews” of a warrior in plaited mail. The period of repose varies from a few weeks to one or two years. Such as assume the chrysalis state late in autumn, do not appear in the winged condition till the ensuing spring. Many remain in the egg state all winter; and such diurnal Lepidoptera as have two *flights* in the year are generally produced in the first place in spring from chrysalids which have lain torpid all winter, and become themselves the parents of another flight, which make their appearance at a later period of the same season. Thousands perish before attaining the perfect state, not only as the natural food of most passerine birds, but as the living bed of the Ichneumonides, which deposit their eggs in the fatty substance of the caterpillar, and thus by degrees deprive it of the source of life.

The observance of these and of other singularities, which we cannot here detail, will afford a never-failing source of interest to the student of nature's mysteries, and will assuredly yield an ampler and more enduring recompense than “Pyrrhos' maze or Epicurus' sty.” In spite, however, of all that has been said and written of the wonders of entomology (and the subject, to be understood, must rather be seen than listened to, or even reflected on through the pages of the best instructed author), we fear that many continue to regard it with very inadequate notions. But how may not piety itself revolt at the thought of the most numerous works of an Almighty Creator's hand being regarded as trifling or unworthy of a deep and most reverential consideration. When Solomon, whose earthly glory never equalled the lustre of the “lilies of the field,” desired us to ponder on a meet emblem of diligence and wisdom, it was not from what we consider as the most important parts of the creation that he drew his example:—“Go to the *ant*, thou sluggard; consider *her* ways, and be wise.” So spake, and under a divine impulse, he who is himself emphatically called the “wisest of men.” Yet in many a high-

Lepidoptera.

¹ Edinburgh Cabinet Library, viii. p. 154.

Lepidop-
tera
Diurna.

flown moral and (pseudo) religious declamation, folly and ignorance not seldom combine to illustrate whatever is mean, insignificant, or worthless, by a reference to some unfortunate form of insect life. Even the pious Newton (not Sir Isaac, but the author of *Cardiphonia*, whose name was John) somewhere likens the extremest act of thoughtlessness and folly to a person breaking off from some worldly and important presence to "pursue a butterfly." Did the excellent author forget, or never know, that a butterfly is not only in itself a creature of such exquisite beauty that neither the "sea of light," nor any other of the most famous gems which ever from the brow of an eastern tyrant dazzled the dark eye of a trembling slave, can compare with it in varied and gorgeous lustre;—or did he expunge from his recollection that the same divine hand which formed man after his own likeness, also created every other thing which breathes the breath of life, and that all were declared *good* when seen by that eye, before whose brightness even the angels veil their faces? Compared with the eternal interests of man, we admit that all earthly pursuits, including even the best and purest—those of science—are as dust in the balance; but, bearing in mind our higher destiny, and yet believing that as there are celestial bodies and bodies terrestrial, so we cannot be better occupied than in devoting a convenient season to study (without which we cannot understand) the works of God,—for "the glory of the celestial is one, and the glory of the terrestrial is another," and both, though differing from each other in brightness, co-exist in divinest harmony, simply because

The hand that made them is itself divine.

Therefore, though ourselves among the most loyal of liege subjects, we should not hesitate to pursue a butterfly, if wanting to our collection, "even in the presence of a crowned king." But this, we fear, is a digression.

In lepidopterous insects in the perfect state, we find a first lateral stomach or crop,—a second, inflated or turgid,—a small intestine, tolerably long,—and a cæcum near the cloaca.

The order is naturally divisible into three families, viz. DIURNA, CREPUSCULARIA, and NOCTURNA.

FAMILY I.—DIURNA.

The insects of this family, commonly called Butterflies, are never seen on the wing except during the day, and in a state of repose usually hold their wings erect. Their antennæ are capitated, or terminated by a club or knob, with a few exceptions, such as the splendid genus *Morpho*, in which they are almost filiform, and the Fabrician genus *Urania*, in which they become more slender towards their extremities. The caterpillars have always sixteen feet, and the chrysalids are naked and angular. These are the only lepidopterous insects in which we never find the exterior margin of the inferior wings presenting a rigid seta or bristle, for the retention of the superior pair.

The genus *PAPILIO* of Linnæus, divided into certain sections, contained the whole of that splendid and infinitely-varied tribe which we call Butterflies, of which the species are so numerous and diversified that naturalists soon felt the necessity of multiplying the genera, both because it was right so to do, and for the mere convenience of restricting the amount of species contained in each. In the later editions of the *Systema Naturæ*, Butterflies, or diur-

nal Lepidoptera, were divided into six phalanges. The first, called *Equites* (which now correspond to the true genus *Papilio*, as restricted by Latreille), was divided into *Troes* and *Achivi*, a division since ascertained to be rather unfortunate in some respects, in as far as it occasionally separates the males and females of the same species; the second was named *Heliconii*; the third *Parnassii*; the fourth *Danai*, subdivided into *Candidi* and *Festivi*; the fifth *Nymphales*, also subdivided into *Gemmati* and *Phalerati*; the sixth *Plebei*, again divided into *Rurales* and *Urbicolæ*. Geoffroy (in his *Histoire abrégée des Insectes*) follows the Linnæan system, and improves it chiefly by applying the principles previously established by Réaumur in his *Mémoires*. Degeer and Olivier likewise so far follow Linnæus as to retain the name *Papilio* as a generic term; but, in order to facilitate the labours of the student, they have introduced additional sections and subdivisions. The labours of Scopoli, as we have elsewhere observed,¹ are defective in relation to these insects, in consequence of his generic characters being drawn from the presence or absence of spots on the wings, and other distinctions which are of little or no value, except for the formation of artificial sections, or the discrimination of species. In the earlier works of Fabricius, scarcely any alterations were made in the arrangement of the Linnæan *Papiliones*. But in the *Entomologia Systematica* of that author, and still more in his *Systema Glossata* (left unfinished at the period of his death, a great number of genera were eventually created.² Latreille, in his numerous works, has constituted various generic groups, which appear to have been very generally adopted. Of the chief of these we shall speedily give account. Denis and Schiffermüller (in the *Catalogue des Lépidoptères de Vienne*) had previously benefited this branch of Entomology, by assuming the form and metamorphosis of the caterpillar as principal bases of their divisions; and Ochsenheimer has since successfully applied the same method to all the European species. Our ignorance of the history of the greater proportion of exotic groups has unfortunately retarded the more general application of the principles of an improved system, although Dr Horsfield's admirable *Lepidoptera Javanica* has done much to complete our knowledge of many fine Javanese species. Dumeril and Lamarck have also, each after his own manner, endeavoured to amend the classification of diurnal Lepidoptera; and in regard to pictorial works in this department, Clerk, Cramer, Engrmelle, Hubner, Ernst, Esper, Stoll, Herbst, Jablonsky, Godart, and others, have published collections of coloured figures, some of which stand unrivalled in extent and magnificence by the most costly productions of those who have most successfully endeavoured to illustrate any of the kindred branches of natural science. Even in our own country, where natural history is so sparingly patronised, and so lightly valued, this beautiful branch of zoology has been rather sumptuously exhibited, and the names of Drury, Abbot, Wilkes, Shaw, Donovan, Lewin, Leach, Swainson, Stephens, Curtis, and Horsfield, will readily occur to the grateful recollection of the reader.

Indeed, on account of the exquisite beauty of their forms and colours, Butterflies have, from the earliest periods of natural history, greatly excited the zeal and admiration of collectors. They occur in all quarters of the world,—from the frozen shores of Greenland and Spitzbergen, to high southern latitudes; but the tropical regions of Asia and America are the most productive of large and splendidly-coloured species.

¹ *Illustrations of Zoology*, letter-press preceding plate xxviii.

² Illiger has given an extract from the last-named work, in his *Magazin*; and the English reader will find it exhibited by J. G. Children, Esq. in the *Phil. Mag. and Annals* for February 1830.

Lepidop-
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Diurna.

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Diurna.

Lepidop-
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M. Latreille divides the Linnæan Papiliones into two sections.

SECTION 1st,

Contains all those butterflies which have but a single pair of spurs or spines to their tibiæ, and placed at the posterior extremity of these parts. When in a state of repose they raise their wings perpendicularly, joining them at the tips. Their antennæ are usually clubbed or inflated at the extremity, sometimes almost filiform. In this section are included the genus *Papilio* and the *Hesperia* *uricolæ* of Fabricius. It is itself divisible as follows.

*

Third joint of the inferior palpi sometimes almost wanting, sometimes very distinct, but equally well clothed with scales as that which precedes it. Hooks of the tarsi apparent or projecting.

Some of the genera of this subdivision are hexapod or six-footed, that is, all the feet are formed for walking, and are almost identical in both sexes. Their chrysalids, in addition to the common attachment by the posterior extremity, are fixed by the passing of a silken thread across the body. A few are enclosed in a rude cocoon. The central cell of the lower wing is closed inferiorly.

In *PAPILIO* (proper) of Latreille (Plate CCXXXIII. fig. 2), the inferior palpi are extremely short, scarcely reaching the clypeus with their upper extremity; their third joint is indistinct. The species of this genus are remarkable both for elegance of shape and beauty of colouring. Those spotted with red on the breast form the division of *Equites Troes* of Linn.; those destitute of such marks he styled *Achivi* or Greeks. They abound in the tropical countries of both hemispheres, but are rare in more northern countries. Indeed we are not aware that more than three exist in Europe, viz. *P. Machaon*, *Podalirius*, and *Alexanor*, of which the first is a well-known native of some of the southern counties of England. The caterpillars of this genus are naked, and when alarmed protrude from the superior part of the neck a soft forked horn, that usually diffuses a penetrating and unpleasant odour. The chrysalis is exposed, and is supported by means of a silken band. In the genus *PARNASSIUS* of Lat. (*Doritis*, Fab.), Plate CCXXXIII. fig. 3, the inferior palpi evidently extend above the clypeus, taper to a point, and are distinctly triarticulated. The terminal button of the antennæ is short, almost ovoid and straight. The females are provided with a kind of corneous boat-shaped sack at the posterior extremity of the abdomen. The species of this interesting genus seem peculiar to the alpine or sub-alpine countries of Europe and the north of Asia. Their caterpillars possess a retractile tentaculum, like those of the preceding genus; but they form, prior to their transformation, a cocoon of leaves united by filaments of silk. The species which we have figured in the present work is a noted Swiss insect, *P. Apollo*. It inhabits alpine valleys. It is said, however, to occur on plains near Upsal, and other northern countries. In the genus *THAIS* of Fab. (Plate CCXXXIII. fig. 5), the palpi resemble those of the preceding, but the terminal button of the antennæ is elongated and curved, and there is no corneous pouch at the extremity of the abdomen of the female. The species are characteristic of the south of Europe. A few occur on mountains. In the preceding genera the internal margin of the under wings is concave or folded. In the two following the inferior wings project beneath the abdomen, and form a canal for its reception. The caterpillars, many of which feed on the Cruciferae, have no tentaculum. The species correspond to the *Danaï candidi* of Linn. and in-

clude all our common white Butterflies. In *PIERIS*, Lat. (*Pontia* of Fabricius and of the English entomologists), Plate CCXXXIII. fig. 6, the inferior palpi are almost cylindrical and slightly compressed, with the last articulation at least almost as long as the preceding. The club of the antennæ is ovoid. We have nine or ten British species, including what are usually called cabbage-butterflies, such as *P. brassicae*, *napi*, &c.; also the more richly attired Orange Tip, or Lady of the Woods, *P. cardamines*.¹ Mr Stephens confines the generic title of *Pieris* to the hawthorn butterfly, *P. crataegi*, a species as yet unknown in Scotland. In the genus *COLIAS* of Fab. (Plate CCXXXIII. fig. 4), the club of the antennæ forms an elongated and reversed cone, and the inferior palpi are greatly compressed, with the last joint much shorter than that which precedes it. The indigenous species are in general more warmly coloured than those of the preceding genus.

Other genera of this subdivision (*Tetrapoda*) have the anterior pair of feet much shorter than the others, folded on the breast, and unfit for walking; sometimes in both sexes, sometimes only in the males. The chrysalis is simply attached by its posterior extremity, and hangs with its head downwards. The genus *DANAIS* (*Euplœa*, Fab.), part of the *Danaï festivi* of Linn. (Plate CCXXXIII. fig. 4), are distinguished by their triangular wings, and antennæ terminated by a kind of elongated and curved button. In *IDEA*, Fab. the wings are almost oval and elongated, and the antennæ nearly filiform. In *HELICONIUS*, Lat. (*P. Heliconii*, Linn.) (Plate CCXXXIII. fig. 7), the antennæ are twice the length of the head and thorax, and increase insensibly towards the extremity. In *ACRÆA*, Fab. the antennæ are shorter, and terminate in a more abrupt button. Those in which the inferior palpi are but slightly compressed, distant throughout their length, or at least at their extremity, and terminated abruptly by a slender and acicular joint, and in which the under surface of the wings is frequently ornamented by silvery spots, or by yellow ones upon a fulvous ground, form the genera *CETOSIA* and *ARGYNNIS* (Plate CCXXXIV. fig. 2) of Fabricius and Latreille. The caterpillars (ibid. fig. 3) are beset with spines or tubercles. In the former, of which several species have the wings elevated and elongated, the inferior palpi are distant throughout their entire length, the hooks of the tarsi are simple, and the club of the antennæ oblong. In the latter the club is short and abrupt, the hooks of the tarsi are unidentate, and the inferior palpi are distant only at their extremity. The inferior wings are often rounded. These butterflies are remarkable for the silvery spots upon their under surface. They are called *Fritillaries* by the English collectors. There are four or five indigenous species. The caterpillars have a pair of spines upon the neck, longer than the rest. Such as fall under the genus *Melitea* of Fab. have yellow spots on the under surface, and the general markings above are more disposed in squares, like a chess-board. In *M. Seleni* and *Euphrosyne*, however, the upper surface is very similar to that of the preceding species, and there is an appearance of pearly or silvery lustre on the under surface of the lower wings. Latreille, we think wisely, unites the whole under the genus *ARGYNNIS*.

In the five following genera the inferior palpi are contiguous in their whole length, terminate gradually in a point, and are much compressed. The genus *VANESSA* (Plate CCXXXIII. fig. 9, and CCXXXIV. fig. 1) differs from the others in the antennæ, which are terminated abruptly by a short turbinated or ovoid button. The caterpillars are densely spinous (Plate CCXXXIII. fig. 10). Here is placed the common tortoise-shell (known in Scotland as the

¹ For the indigenous species, see *Naturalist's Magazine*, vol. ii. p. 224.

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Devil's Butterfly), *V. urtica*, and several other British species, such as the Camberwell Beauty, *V. Antiopa*, and the Peacock Eye, *V. Io* (ibid. fig. 9). The Painted Lady, *V. cardui*, remarkable for the vast extent of its geographical distribution, being fully more widely dispersed than any other form of animal life with which we are acquainted, belongs to our present genus. It is, however, placed in the genus *CYNTHIA* by Mr Stephens. In the four following genera the antennæ terminate in an elongated club, or are almost filiform. In *LIBYTHIA* of Fab. the males alone have the anterior pair of feet extremely short, and tippet-like. The inferior palpi project observably in the manner of a beak. The upper wings are very angular. In *BIBLIS*, Fab. the palpi are also longer than the head, but more obtuse, and curved a little at their extremity. The anterior legs are abbreviated in both sexes, and the antennæ terminate in a much smaller club. The nerves of the superior wings seem strongly inflated at their origin. In *NYMPHALIS*, Lat. (Plate CCXXXIV. figs. 5, 7, 9), the legs resemble those of the preceding, but the inferior palpi are shorter. The club of the antennæ is more elongated than in *Vanessa*, from which they are not strongly distinguished. Their caterpillars are, however, different (ibid. fig. 4), being less spiny, and more elongated towards the posterior extremity, which is slightly forked. The species of this genus (of which, as a British example, we may name the Purple Emperor, placed in the genus *APATURA* by Mr Stephens) are frequently ornamented by brilliant and varied colours, and, when in prime condition, are highly prized by collectors. They are distinguished by the strength and thickness of their wings, which enable them to exercise a smooth, powerful, and sustained flight. Their motions are consequently not of that zigzag nature observable in many species, but steady and continuous, like the soaring of a bird of prey. They frequently haunt the summits of forest trees, and other elevated stations, and are therefore difficult to capture. This disadvantage, however, is to a certain extent obviated by the boldness of their disposition; for, when their situation is accessible, they are not deterred by an unsuccessful attack from settling again on the spot where they were first observed. The European species, such as the Purple Emperor above named (*N. Iris*), are taken by means of bag-nets, fixed to poles thirty feet high. They are said to be attracted by the odour of acrid or fermenting substances, and such are sometimes used by entomologists to induce them to descend from their inaccessible positions. The genus is very extensive. M. Godart¹ describes 267 different kinds. *Nymphalis Jasius*, the species which we have selected for illustration on the plate last referred to (figs. 7 and 9), is one of the most beautiful of European insects. We received it from M. Case-Nuove of Lyons. The genus *MORPHO*, Fab. (Plate CCXXXIV. fig. 8), differs from *Nymphalis* in its almost filiform antennæ, which are feebly and insensibly enlarged towards the extremities, but not clubbed. All the species are peculiar to South America, and are well deserving the special attention of those who desire to form a just notion of the splendour and magnificence of many lepidopterous insects. We could describe them with great pleasure did our limits admit of such details. M. Godart has separated, under the name of *PAVONIA* (ibid. fig. 10), certain species, of which the central cell of the lower wings is closed, and the most internal nerve of the upper pair is curved in the form of the letter S, in place of being straight or slightly arched. A species found in the East Indies, of which the lower wings are prolonged into a tail (*P. Phidippus*), forms the type of

the genus *AMATHUSIA* of Fabricius. We have figured the larva and chrysalis on Plate CCXXXV. figs. 1 and 8. All the rest belong to the new world. Those which follow have also the discoidal cell of the lower wings closed posteriorly. Such are *BRASSOLIS*, Fab. (ibid. fig. 3), *EUMENIA*, Godart (do. fig. 5), *EURYBIA*, Illiger (do. fig. 10), and *SATYRUS*, Lat. (do. fig. 6). The caterpillars of the last-named genus are naked, or nearly so, and the posterior extremity of their body is narrowed into a furcated point. The chrysalids are bifid anteriorly, and their back is tuberculated.

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Inferior palpi with three distinct joints, of which the third is almost naked, or much less thickly covered with scales than the preceding ones. The hooks of the tarsi are very small, and scarcely if at all projecting. The discoidal cell of the posterior wings is open posteriorly.

The caterpillars of this subdivision are oval, or resemble *Onisci* in their forms. The chrysalids are short, contracted, smooth, and always fixed, like the genus *PAPILIO* properly so called, by a silken thread across their bodies. These butterflies were classed by Linnæus among his *Plebei*, in the division of *Ruricolæ*, and Fabricius placed them in a corresponding section of his *Hesperia*. They form the genus *ARGUS* of M. Lamarck, and contain, among other species, all our beautiful little *Blues*, which in bright summer days so enliven our grassy downs, and almost all other spots of open sunshine.

Sometimes the antennæ terminate, as usual, in a small and solid button-like inflation. In the genus *ERYCINA*, Lat. (Plate CCXXXV. figs. 2 and 4), the anterior pair of feet are much shorter than the others, at least in the males. They belong to America. In the rest all the legs are alike in both sexes. In *MYRINA* of Fab. (ibid. fig. 11) the inferior palpi are long and projecting. In *POLYOMMATUS* (ibid. fig. 12) the palpi do not extend much beyond the epistoma. These beautiful little insects receive their name from the number of small eye-like spots with which their under surface is ornamented. We have a considerable amount of indigenous species, most of which are blue above, the females of some being brown. In the Scotch Argus (*P. Artaxerxes*), so common near Edinburgh in June and July, at the base of Arthur's Seat, above the line of the Railway, both sexes are blackish-brown above, with a variable white spot on the disk of the upper wings, and some lunated red spots, more or less distinct, on the under. The splendid little butterflies called *Coppers* are placed by our collectors in the genus *LYCÆNA* of Fabricius.

A few Lepidoptera of our present subdivision are remarkable for the peculiar form of their antennæ. Those of one of the sexes of the genus *BARBICORNIS*, Godart, are setaceous and plummy,—those of *ZEPHYRIUS*, Dalman (Plate CCXXXV. fig. 7), are terminated by ten or twelve globular joints, separated like the beads of a rosary.

SECTION 2D.

The second section of diurnal Lepidoptera contains those species of which the posterior tibiæ are furnished with two pair of spines, viz. a pair at their extremity, and another above. The lower wings are usually retained in a horizontal position, even when the insect is at rest, and the extremity of the antennæ very often forms a distinctly hooked point. Their caterpillars, judging from the few with which we are acquainted, bend together the leaves of plants for a protecting covering, and spin within that leafy

¹ *Encyclopédie Méthodique*, art. *Papillon*.

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chamber an extremely thin cocoon of silk, in which they are transformed into chrysalids. The latter are smooth, and without angular elevations. These Lepidoptera form the *Plebei Urbicolæ* of Linnæus, with the addition, by Latreille, of those rare and splendid insects placed by Fabricius in the genus *URANIA*.

The former belong to the genus *HESPERIA* of Fab. (Plate CCXXXV. fig. 13), and are characterized by the distinctly clavate termination of the antennæ, and by the inferior palpi being short, broad, and thickly covered anteriorly with scales. Here are placed *H. alveolus*, *malvæ*, and *tages* (for chrysalis and larva see fig. 15), among the British species. In the genus *URANIA* of Fab. just alluded to (ibid. figs. 9 and 14), the antennæ, at first filiform, become attenuated or setaceous at the extremity, and the inferior palpi are slender and elongated, with the second article greatly compressed, and the last much more attenuated, almost cylindrical, and naked. "The butterflies," says Mr Swainson, "comprising this remarkable genus, are perhaps the most splendid insects in creation. No art can effectually represent the changeable and resplendent green which relieves the velvet black of the wings, and which varies with every change of light. The typical species are found in Tropical America, where they fly with amazing rapidity, and perform, like their prototypes the swallows, annual migrations. When at rest, the anterior wings are flat or horizontal, but only slightly spread."¹ *U. Leilus* is found in Surinam, and is figured in Madame Merian's work on the insects of that country.

U. Rhipheus of Cramer (*Leilus Orientalis*, Swainson) was originally figured from a specimen taken at Chandernagor, in Bengal, and belonged to the rich cabinet of M. Gigot d'Orcy. We perceive, however, the following notice of its locality in a recent work: "Cette espèce, que l'on peut considerer comme le plus beau Lépidoptère connu, habite Madagascar. Elle a été prise une seule fois à Bourbon, où la chenille avoit peut-etre transportée accidentellement."² The synonymy of this exquisite insect has been greatly embroiled on account of Cramer supposing the species represented by his figure, which has six tails, to be identical with Drury's, which has none. Mr Swainson has shown that the latter insect, having clavated instead of filiform antennæ, is not only specifically distinct, but pertains to a different genus. He has named it *Rhipheus dasycephalus*.³ In the *Nouv. Ann.* quoted below, the reader will find an account of the larva of *U. rhipheus*, which, in common with the caterpillars of the other species, has been hitherto unknown to naturalists. Mr Swainson has represented, with his usual elegance and accuracy, almost all the known species of these rare and beautiful insects. That which we have figured in illustration of our present article is a new species (*U. Boisduvalii*), lately published by M. Guérin.⁴

FAMILY II.—CREPUSCULARIA.

The most prominent species of this family are known by the name of Sphinxes or Hawk-moths. They are furnished with a spine or strong bristle on the anterior margin of the inferior wings, which being received by a process of the under surface of the superior pair, maintains them in a horizontal or somewhat inclined position in repose.⁵ The character just mentioned is indeed perceptible also among the nocturnal tribes; but our present family is distinguished by the antennæ, which are prismatic or fusi-

form, usually thickest in the middle. These insects fly with great strength and celerity, owing to the extent and firm consistence of their wings, the powerful muscles by which they are moved, and the bird-like manner in which their taper bodies are poised. From their name, we would naturally infer that they are observed chiefly during the morning and evening twilight; but many species may be seen darting from flower to flower even at mid-day. As their capture is difficult, and their rearing from the caterpillar precarious, they are in general highly prized by collectors. In the larva state they have always sixteen feet. The chrysalis is cylindrical, blunt-headed, with a conical abdomen, and destitute of those points or angular prominences observable in so many of the diurnal Lepidoptera. They are usually enclosed in a cocoon, or concealed either in the earth or under some protecting body. They are supposed to derive the name of *Sphinx* from the peculiar attitude assumed by several of their caterpillars, which in some respects bear a resemblance to the fabled monster of antiquity. A few produce a humming sound. Latreille divides the family into four sections, which, in corresponding order, answer to the genera *Castnia* and *Sphinx* of Fabricius, and to those which he at first named *Sesia* and *Zygæna*.

The first section, named *HESPERI-SPHINGES*, is composed of those species which connect the Hesperides of the preceding family with the Sphinxes properly so called. The antennæ are always simple, thickened towards the middle, or at the extremity, which forms a hook, narrowed to a point, without any tuft of scales, at the end. They are all furnished with a distinct proboscis, and the inferior palpi are composed of three very apparent joints.

In the genus *AGARISTA*, Leach (Plate CCXXXVI. fig. 1), the inferior palpi are elongated, with the second joint strongly compressed, and the last slender and almost naked; the antennæ are simple, gradually thickened towards the middle, and then becoming attenuated, terminate in an elongated hook. In the genus *CORONIS*, Lat. (ibid. fig. 2), the club of the antennæ is more developed. In the genus *CASTNIA* of Fabricius (ibid. fig. 3), all of which are from the new world, the antennæ resemble those of *Agarista*; but the palpi are shorter, broad, and cylindrical.

The second section, named *SPHINGIDES*, have the antennæ always terminated by a little flake of scales; the inferior palpi are broad, or transversely compressed, thickly clothed with scales, and the third article generally indistinct. Most of the caterpillars have a smooth body, elongated, thickest towards the posterior extremity, which is furnished with a horn, the sides obliquely or longitudinally striped. They feed on leaves, and undergo their metamorphoses underground, without spinning a cocoon. Many seem, however, to form a little vaulted chamber, with agglutinated walls, which protects them from the circumjacent earth. Here are arranged many fine insects belonging to the genus *SPHINX* properly so called (Plate CCXXXVI. figs. 5 and 6), of which the antennæ, from about their centre, form a kind of prismatic mass, either simply ciliated, or transversely striated on one side, in the manner of a rasp. The trunk is very distinct. These insects fly with great velocity, sometimes giving utterance to a humming noise, occasioned no doubt by the rapid vibration of their wings. Instead of settling upon flowers like bees and other insects, they are frequently observed merely to hover over or before them, and to extend their long tubular trunks towards the nectaries. This peculiar motion has probably obtained for

¹ *Zoological Illustrations*, second series, fol. 125.

² *Nouvelles Annales du Muséum d'Hist. Nat.* t. ii. p. 261.

³ This character, according to M. Godart, is wanting in some species of the genus *Smicrinthus*.

⁴ *Zoological Illustrations*, second series, plate 131.

⁵ *Iconographie du Règne Animal*, pl. 82 (*Insectes*).

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them the appellation *hawk-moths*. *S. Atropos*, commonly called the death's-head moth, is one of the finest of the European species. When seized it sometimes utters a shrill cry, caused, according to Réaumur, by the friction of the palpi on the trunk,—in the opinion of M. Lorey, by the escape of air from two cavities in the abdomen. It makes its appearance in the perfect state during autumn. The caterpillar, at least in Britain, feeds voraciously on potato-leaves. It is difficult to rear beyond the chrysalis state. We had six specimens alive at one time during the summer of 1826, all of which entombed themselves after a time beneath the earth, but never made their appearance in the perfect state. On being examined after the lapse of ten or twelve months, they were found lying some inches below the surface, in the state of chrysalis, each in an egg-shaped hollow, formed by the caterpillar. They were quite light and stiff, and of course dead and unproductive of the desired *Imago*. The death's-head moth, in common with several others of the genus, is very widely distributed. We have received it from Africa and the East Indies; and M. Boisduval informs us that it is well known in the Isle of France. The natives of the latter country believe that the dust which it casts from its wings in flying through an apartment, is productive of blindness to the visual organs on which it falls. It is difficult to trace the origin of this fable, recorded by St Pierre in his Voyage to the Isle of France. We have many other native species, which we cannot here enumerate.¹ One of the rarest and most beautiful of the European species, *Sphinx Nerii* (genus *Deilephila*, Ochs.), occurs in Madagascar and the Mauritius. It likewise inhabits Asia Minor, Bengal, and the whole of Africa. We received it from the vicinity of Genoa. It has recently been captured in England.

Other genera of the Sphingides have the abdomen terminated by a broad tuft of scales. Such is our humming-bird hawk-moth, *Macroglossa Stellatarum*, Ochs. Some nearly allied species, to which Fabricius latterly applied the generic name of *Sesia* (such as *S. fusiformis*, *Bombylififormis*, &c.), are distinguished by the clear consistence of the greater portion of their wings. In the genus *SMERINTHUS* of Lat. (Plate CCXXXVI. fig. 11), the antennæ are toothed or serrated.

The third section, named *SESIADÆ* by Latreille, contains those species of which the antennæ are always simple, fusiform, and elongated, and frequently terminated, as in the preceding genera, by a little bundle of scales; the inferior palpi are narrow, slender, and distinctly triarticulate, the last tapering to a point. The posterior legs are furnished with very strong spurs. The abdomen is generally terminated by a kind of brush. The caterpillars live by gnawing the interior of the stalks and roots of plants, like those of the nocturnal kinds (such as *Hepialus* and *Cossus*); they are naked, have no posterior horn, and construct, with the debris of the substances on which they are nourished, a cocoon, in which they undergo their final metamorphoses.

In the genus *Sesia* of Latreille (*Ægeria*, Fab. Plate CCXXXVI. figs. 7, 12, and 13), the antennæ terminate in a little tuft of scales. The wings are horizontal, and composed of clearer vitreous portions, interrupted by darker coloured veins. The posterior extremity of the body is brush-like. Several species exhibit to a casual observer rather the appearance of wasps or flies, than of lepidopterous insects. The genus *THYRIS* of Hoffmansegg (ibid. fig. 8) resembles *Sesia*; but the antennæ are more slender, almost setaceous, and without any terminal tuft. The

wings are angular and indented. The abdomen terminates in a point. In *ÆGOCERA* of Lat. (ibid. fig. 9), the antennæ also want the tuft, but they are evidently thickened towards the middle, and fusiform; the second joint of the inferior palpi is furnished with a bundle of hairs, which project in a beak-like fashion. The abdomen likewise terminates in a simple point. The wings are inclined, and entirely covered with scales.

The fourth and final section of our present family is that of the *ZYGÆNIDÆ*. It consists of Lepidoptera in which the antennæ, always terminated by a point destitute of a tuft, are sometimes simple in both sexes, fusiform, or resembling the horn of a ram, sometimes thickened towards the middle, almost setaceous, pectinated in both sexes, or at least in the males; the inferior palpi of medium size, or small, nearly cylindrical, and always formed of three distinct articulations. The wings, when at rest, are inclined; that is, sloped down laterally like the roof of a house, and present vitreous spots in many species. The abdomen is not brush-like at the extremity. The spurs of the posterior legs are usually small. The larvæ of these insects live exposed on various Leguminosæ, and other plants. They are short, inflated about the middle, and attenuated towards either end. Their bodies are smooth, or but slightly haired. In the course of their transformations they spin a pretty solid and coriaceous cocoon, attached to the stalk of a plant. The perfect insect issues from the chrysalis in a few weeks. The flight is somewhat heavy, and both sexes may frequently be taken together, reposing on the plants on which the female lays her eggs.

In the genus *ZYGÆNA* of Lat. (Plate CCXXXVI. figs. 4 and 10), which appears to be as yet unknown in the new world, the antennæ are simple in both sexes, and terminate abruptly in a fusiform mass, or one like a ram's horn. The inferior palpi rise above the clypeus, and are pointed at the end. This genus contains the Burnet moths of the English collectors, of which *L. loti* and *filipendulæ* are well-known examples. The genus *SYNTOMIS* of Illiger differs from *Zygæna* chiefly in the antennæ, which are not so thick, but slender, or insensibly fusiform. The inferior palpi are short and obtuse. In the genus *ATYCHIA* of Hoffm. (ibid. fig. 16), the antennæ are simple in the females, and bipectinated in the males. The inferior palpi are very hairy, and extend obviously beyond the clypeus. The wings are short. The spurs at the extremity of the posterior legs are strong. The genus *PROCRIS* of Lat. (ibid. fig. 17) approaches the preceding so far as respects the antennæ, but the inferior palpi are shorter and less hairy. An ornamental insect, the *Sphinx Statices* of Linn. affords a good example of this genus. It is called the green forester by Harris, and forms with another species the genus *Ino* of Leach and Stephens. Other Lepidoptera of this section have the antennæ in both sexes bipectinated, or furnished with a double row of elongated teeth. Such of them as have a distinct trunk form the genus *GLAUCOPIS* of Fab. (ibid. fig. 18)—those in which that organ is wanting or indistinct compose the genus *AGLAOPÆ* (ibid. fig. 15).

FAMILY III.—NOCTURNA.

The vast assemblage of species of which this great division is composed, are known under the familiar name of Moths, and correspond to the old and undivided genus *Phalæna* of Linnæus. Their wings, with a few exceptions,

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¹ Mr Rennie's *Conspectus of the Butterflies and Moths found in Britain* will prove useful to those who cannot obtain access to the rarer or more costly works from which it is compiled.

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Nocturna. are *bridled*, in repose, by means of a bundle of setæ, or the corneous bristle before mentioned in our generalities of the preceding family. Their position is either horizontal or inclined; sometimes they embrace the sides and upper surface of the abdomen. The antennæ are setaceous, or become gradually narrower towards the extremity. They are frequently feathered or pectinated, especially in the males, and are usually more ample in that sex than in the females. The legs of the larvæ vary from ten to sixteen in number. In certain species both sexes seem to want the tongue; and the females of a few have no wings, or but the merest rudiments of those organs. The chrysalids are always rounded, or without angular points.

These insects, as their family name imports, are seldom seen on the wing till after sunset. They continue their flight, throughout the mild and dewy nights of summer, till the morning twilight. During the brightness of the day season they conceal themselves in tangled vegetation, on the shady side of walls and buildings, on the under side of large leaves, or in the crevices of the gnarled bark of ancient forest-trees, and other sombre places. So astounded indeed are the greater number by the "garish eye of day," that when discovered by the sharp-sighted entomologist, they allow themselves to be taken prisoner without an effort to escape. A few, however, present exceptions to the general rule. Such, for example, are the males of *Bombyx zigzag*, which fly throughout the whole day, and fear not the brightest beams of "glorious Apollo." This same species presents a remarkable confirmation of what we have formerly stated, in the introductory portion of the present article, regarding the sense of smell in insects. The female of the moth just named is extremely sluggish, and seems seldom, if ever, to use her wings. When placed at an open window or elsewhere in an observable position, she will be speedily seen to receive the visits of the males, which fly swiftly towards her from all directions, undoubtedly guided by the sense of smell.

The classification of this family presents great difficulties to the entomologist in the way of a natural division into sections and sub-genera, and to it applies with peculiar force an observation made by Latreille regarding the entire order,—*Lepidopterorum ordo Entomologorum Scopulus*. In fact, the parts of the mouth, from the complex and greatly varied, yet clearly defined structure of which, in the masticating insects, so many excellent and available characters have been deduced, are among the lepidopterous tribes in general restricted in number, simple in form, and very similar in composition. The antennæ, too, especially among the nocturnal tribes, become rather sexual than generic distinctions;—and as the metamorphosis and general habits and history of many of the exotic species, which form the finest features in the richly stored cabinets of Europe, are almost entirely unknown, recourse cannot be had to such excellent and indeed indispensable aids towards a more natural and consistent classification. An accurate, perspicuous, and philosophical arrangement of the Lepidoptera, is therefore still a desideratum in our science.

Latreille, in his latest work (*Règne Animal*, second edition), divides the nocturnal Lepidoptera into *ten* sections. The species of which the wings are entire, or without fissures or digitations, compose the first nine. All those which, under the form of larva, live almost entirely exposed, or in fixed retreats, and of which many have less than sixteen feet, and which in their perfect state are characterized by very small or concealed upper palpi, more or less triangular wings, horizontal or decumbent, and not folding around the body, compose the first eight. The eighth itself is the only one of which the caterpillars have fourteen feet, of which two are anal. If in certain others the same number exists, the anal are wanting.

The first four sections correspond to the divisions *At-* Lepidop-
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tacus and *Bombyx* of the genus *Phalæna* of Linnæus. The trunk is usually rudimentary or very small, and its two filaments are not united. The inferior palpi, with a few exceptions, are small and almost cylindrical. The antennæ, at least in the males, are pectinated or serrated. The wings are horizontal or decumbent, and in several the lower project, in a state of repose, beyond the upper pair. In some, also, the buckle-like process formerly mentioned as fixing the wings together, is here wanting. The thorax is smooth or uniform, as well as the abdomen, and woolly. The latter portion is for the greater part very voluminous in the females. The cocoon of the chrysalis is generally what may be called well *felted*, and of pretty solid consistence. Although the Nocturna of Latreille's fourth section (*Aposura*) bear a close relation to those which precede them, their caterpillars nevertheless offer a character unique and unexampled in the lepidopterous order,—the absence of the anal feet. We shall here give a brief sketch of the general characters of the nocturnal tribes, in accordance with the system of Latreille.

SECTION 1ST, HEPIALITES.

We may here name as types the genera *Hepialus* and *Cossus* of Fabricius. The caterpillars are rarely met with, as they conceal themselves in the interior of the plants on which they feed. The cocoons which they form are composed in great part of particles of those same plants. The edges of the abdominal rings or segments of the chrysalis are toothed or spinous. The antennæ of the perfect insect are always short, and most generally present only one kind of small, short, rounded, and close-set teeth. Those of some others terminate always in a simple thread, but are furnished inferiorly in the males with a double row of barbs. The trunk is always very short, and not very obvious. The wings are decumbent, and generally elongated. The last rings of the abdomen in the female form a kind of oviduct or tail. In the larva state these insects are very destructive to trees, edible plants, and other useful products of the vegetable kingdom.

Sometimes the antennæ, almost conformable in both sexes, have only very short teeth disposed in one or two rows. Such are the three following genera. In *HEPIALUS* of Fab. the antennæ are almost granular, and much shorter than the thorax. The under wings are usually destitute of the curb or spine. The caterpillars dwell in the earth, and gnaw the roots of plants (Plate CCXXXVI. fig. 27). A very abundant species, called the Ghost-moth, *H. humuli*, Fab., is characterized by the upper wings of the males being of a silvery white, without spots,—those of the female reddish yellow, with spots of a deeper hue. The larva is extremely destructive to hops, and also exists in great quantities in districts where that useful plant is unknown. It is often seen hovering over churchyards with a short pendulous motion to and fro, and is also frequently observed in pasture-fields, and plots of grass in garden grounds. In the genus *Cossus* of Fab. (ibid. fig. 14), the antennæ are at least as long as the thorax, and present on their inner side a range of small lamellar teeth, short and rounded at the end. The caterpillars live in the interior of trees, and make use of the saw-dust produced by the action of their mandibles in the formation of their cocoons. The chrysalids advance by a peculiar and instinctive motion to the external apertures of their ligneous dwellings, just at the moment of their final development, when their wings are about to expand. We doubt not that the little spinous projections with which the sides of the abdomen are armed, aid them greatly in that progressive motion. A wriggling movement would naturally produce an advance upwards or forwards,

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but retreat would be impossible. The *Cossus ligniperda* is a noted example of the genus. In the larva state (ibid. fig. 19) it is extremely destructive to elm trees, which it perforates almost to the core, and by degrees produces first an unhealthy condition, rendered visible by a peculiar colour of the leaves, and finally decay and death. In the company of an honoured friend, the Rev. John Fleming of Rairigg, Windermere, we lately witnessed the hewing down of an old elm tree, which had braved the blasts of many stern winters, but had evidently become paralysed in its vital functions by the inroads of some insidious foe. By accident the large scaly head of a caterpillar was one day seen protruding from the rugged bark; and some other circumstances led to the belief that the tree was infested. To ascertain the cause of the disease with certainty, and to stay if possible its progress through the neighbouring groves, the sylvan monarch was consigned to the tender mercies of the woodmen of Bowness; and on being felled and hewn in different parts, we discovered several dozens of very large caterpillars of *Cossus ligniperda*, chiefly in the thickest part of the tree, a few feet above the ground, and several inches within the bark. They gave out, as we extracted them, a very peculiar odour, of an oily nature, and sufficiently repelling, we should suppose, to render it improbable that these larvæ were eaten by the ancients. It is however a well-received opinion, that the *Cossus* described by Pliny, and regarded by the Romans as a most delicious fare, was the caterpillar in question. It is frequently found in the willow as well as in the elm, and may possibly extend its ravages to the oak, the nidus assigned by Pliny to his edible worm. The latter, however, was most likely the larva of *Prionus coriarius*, or some other of the larger long-horned beetles; the more especially as we know from Madame Merian and other writers, that the grub of a congener, *Cerambyx damicornis*, is eaten in Surinam and the West Indies, both by slaves and freemen. The perfect insect of the *Cossus ligniperda* is of an ashy grey, with numerous small black lines on the upper wings. The posterior extremity of the thorax is yellowish, with a black line. We forgot to mention, that the oily odour of the caterpillar is by some considered to proceed from a reservoir of a peculiar fluid which the insect disgorges, for the purpose, it is believed, of softening the timber on which it feeds, and in which, as it increases in size, it perforates its hidden chambers. It is also remarkable as having afforded the subject of an extraordinary anatomical investigation by Lyonnet, detailed in his famous *Traité Anatomique de la Chenille du Saule*. The enthusiasm of a French writer has induced him, while lauding the merits of that signal publication, to allude to its subject-matter under the dignifying appellation of "the immortal worm!" The reader may satisfy his curiosity as to its external aspect, by inspecting the 19th figure of our 236th plate. On the same plate, fig. 14, we have represented the winged state of an American species, *C. Macmurtrei* of Boisduval. The genus *STYGIA* of Draparnaud (ibid. fig. 24), placed by some writers among the *Zygænidæ*, is ranked by Latreille where we now introduce it. The antennæ have a double row throughout their whole length, of small, short, straight teeth, dilated and rounded at the end.¹

Sometimes (and this character distinguishes the following genus from those enumerated in the preceding para-

graph) the antennæ differ greatly in the sexes; those of the males being furnished inferiorly with a double row of barbs, and terminated by a filament; those of the females being entirely simple, but cottony at the base. Such are the species of the genus *ZEUZERA* of Lat. (Plate CCXXXVI. fig. 20), of which *Z. æsculi* is a beautiful indigenous example. Its larva dwells in the interior of the sweet chesnut tree, and in that of pear and apple trees. The body of the perfect insect is of a beautiful white, with blue rings on the abdomen, and numerous little spots of the same colour on the upper wings. It is not a common species.

SECTION 2D, BOMBYCITES.

This section may be distinguished, both from that which precedes and that which follows it, by the following characters: The trunk is always very short, and merely rudimentary; the wings are either extended and horizontal, or decumbent, but the inferior wings extend laterally beyond the upper ones; the antennæ of the males are pectinated.

The caterpillars live exposed, and devour the more tender parts of vegetables. They usually spin a cocoon of pure silk. The chrysalids have no spiny processes or denotations on the edges of the rings of the abdomen.

The species with horizontal and extended wings (the *Phalænæ Attaci* of Linn.) form the genus *SATURNIA* of Schrank (Plate CCXXXVI. fig. 25), with which Latreille combines *AGLIA* (*Bombyx tau*) of Ochsenheimer. It comprehends many magnificent species, such as *S. atlas* of China, called *porte-miroir* by the French, on account of the transparent or vitreous portions of the wings. *S. luna*, of a fine and delicate green colour, is an American species, remarkable for the extended tail-like appendages of the under wings.² The cocoons of two other species of this division, *Bombyx mylitta* of Fab. and *Phalæna cynthia* of Drury, have been employed for their silk from time immemorial in Bengal. The first of these species appears to be identical with the *Ph. paphia* of Dr Roxburgh. It occurs in great abundance in Bengal, and in many parts of the adjoining country, and affords a plentiful supply of a very durable though coarse and dark-coloured silk called *Tusseh*, much used by the Brahmins and other sects of Hindoos. This species cannot be domesticated; but the hill people go into the jungles, and when they perceive the dung of the caterpillars under a tree, they immediately search for them among the branches, and carry off whatever they require. These they distribute on the asseen trees (*Terminalia alata glabrata* of Roxb.), and as long as they continue in the caterpillar state, the Pariahs guard them from birds by day and from bats by night. The natural food of this species is the *Byer* tree of the Hindoos, called *Rhamnus jujuba* by botanists. The Jaroo cocoons are produced from a mere variety, not a distinct species, of this insect. The Arrindy silk-worm, however, belongs to an entirely different species, the *Phalæna cynthia* above named. It appears peculiar to two districts in the interior of Bengal, viz. Rungpore and Dinagepore, where it is reared in a domestic state. The food of this caterpillar consists entirely of the leaves of the common *Ricinus*, or *Palma Christi*, which the natives call arrindy, and hence the name by which the insect is itself distinguished.³ The cocoons are in general about two inches in length and three inches

¹ M. de Villiers has published some new details regarding *S. Australis*, in the *Annales de la Soc. Linn. de Paris*, v. 473. The antennæ in our figure are, we fear, not quite accurately represented, though, from want of a specimen, we cannot correct them. Compare Godart, *Papil. de France*, iii. pl. 22, fig. 29; and Guérin, *Iconog. (Insectes)*, pl. 85, fig. 4.

² This species has been bred at Altona by Mr Zincken von Sommer, from eggs imported from America. We have figured the larva on Plate CCXXXVI. fig. 23.

³ *Edinburgh Cabinet Library*, British India, vol. iii. p. 155.

in circumference, pointed at either end; they are of a white or yellowish colour, and their texture is extremely soft and delicate. The filament indeed is so remarkably fine, that this silk cannot be wound off, but is spun like cotton. The yarn is wove into a kind of coarse white cloth, of a seemingly loose texture; but of such extreme durability that the life of one person is seldom sufficient to wear out a garment of it, so that the same piece frequently descends from parent to child. It must always be washed in cold water.¹

The principal European species of the genus *Saturnia* are known under the names of peacock and emperor moths, &c. such as *S. pavonia major* and *minor*. The former is the largest moth in Europe, and has been known to remain in the chrysalis state for three years.

Other Bombycites have the superior wings decumbent, with the exterior margin of the inferior pair projecting almost horizontally beyond them,—*alæ reversæ*. In the genus *Lasiocampa* (Plate CCXXXVI. fig. 26), the palpi project in the form of a rostrum, and the inferior wings are frequently dentated; some of the species bear a resemblance to little bundles of dried leaves; such are *L. quercifolia* and others. In the genus *Bombyx* properly so called (ibid. fig. 21) the inferior palpi exhibit no remarkable projection. Here is placed the famous *Bombyx mori*, or true silk-worm moth, of a whitish colour, with two or three obscure and transverse streaks, and a lunate spot on the superior wings. The caterpillar feeds on the leaves of the mulberry, and spins an oval cocoon of a close tissue of the finest silk, usually of a yellow colour, but sometimes white. A variety is now preferred abroad, which always yields the latter colour. Although this sumptuous product is now "familiar as household words," its nature and origin were but obscurely, if at all, known in ancient times; and even in the days of Aurelian it was valued at its weight in gold. This was probably owing to the mode in which the material was procured by the merchants of Alexandria, who had no direct intercourse with China, the only country in which the silk-worm was at that time reared. According to Latreille, the city of Turfan, in Little Bucharía, was for a long time the rendezvous of the western caravans, and the chief entrepôt of the Chinese silks. It was the metropolis of the Seres of Upper Asia, or of the Serica of Ptolemy, placed, according to that author, between the Ganges and the Eastern Ocean. Hence the *Serica vestis* of the Romans, and the word *Sericum*, their name for silk. Driven from their country by the Huns, the Seres established themselves in Great Bucharía and in India. It was from one of their colonies, Ser-hend (*Ser-indi*), that certain Greek missionaries, in the reign of Justinian, carried the eggs of the silk-worm to Constantinople. Its cultivation spread, at the period of the first Crusades, from the Morea into Sicily, the kingdom of Naples, and, several centuries afterwards, under the administration of Sully more especially, into France, to which country it is now a source of great wealth. Silks were also anciently obtained by sea or land from the kingdoms of Pegu and Ava, or the Oriental Seres, most frequently mentioned in the writings of the earlier geographers.² Though the manufactures of silk were lauded in terms of the highest admiration both by Greek and Roman writers, they were in frequent use for some centuries before any certain knowledge appears to have been obtained, either of the precise countries from which the material was derived, or of the mode by which it was produced. By some it was supposed to be a fine down adhering to the leaves of trees

or flowers, by others it was regarded as a delicate kind of wool or cotton;³ and even those who had some idea of its insect origin were incorrectly informed of the natural mode of its formation. The court of the Greek emperors, which surpassed even those of the Asiatic sovereigns in splendour and magnificence, became profuse in its display of this costly luxury; but as the Persians, from the advantages which their local situation gave them over the merchants from the Arabian Gulf, were enabled to supplant them in all those marts of India to which silk was brought by sea from the East, and as they had it in their power to cut off the caravans which travelled by land from China through their own northern provinces, Constantinople thus became dependent on a rival power for an article which its sumptuous nobles deemed essential to the enjoyment of refined life. Of course the Persians, with the usual rapacity of monopolists, raised the price to an exorbitant height, and many attempts were made by Justinian to free his subjects from such exaction. An accidental circumstance is said to have accomplished what the wisdom of the great legislator was unable to achieve. Two Persian monks, who had been employed as missionaries in one of the Christian churches established in India, had penetrated into the country of the Seres, that is, to China, where they observed the natural operations of the silk-worm, and acquired a knowledge of the arts of man in working up its produce into so many rich and costly fabrics. The love of lucre, mingled perhaps with a feeling of indignation that so valuable a branch of commerce should be enjoyed by unbelieving nations, induced them to repair to Constantinople, where they explained to the emperor the true origin of silk, and the various modes by which it was prepared and manufactured. Encouraged by the most liberal promises, they undertook to transport a sufficient supply of these extraordinary worms to Constantinople, which they effected by conveying the eggs in the interior of a hollow cane. They were hatched, it is said, by the heat of a dunghill, and the larvæ were fed with the leaves of wild mulberry.⁴ They grew and prospered, worked their webs, underwent their accustomed metamorphosis, and multiplied their kind according to use and wont; and thus, as already intimated, becoming extensively cultivated throughout all the southern countries of our continent, they effected an important change in the commercial relations which had so long existed between Europe and the East.⁵

Another curious species of the genus *Bombyx* is the processionary moth, *B. processionea*, Fab. The caterpillars of this insect live in society on oak trees, where, when young, they spin in common a silken tent, in which they dwell together in unity. They frequently change their domicile until after the third casting of their skins, on which they remain more stationary, forming a new habitation resembling a kind of sack, divided interiorly into several cells. They usually issue forth in the evening, in a very singular order of procession. A single individual takes the lead, and serves as guide, two others follow, forming the second line, then three abreast, next four, and so on for many ensuing columns, each regularly augmented by the addition of a single larva, and all following the course of their first adventurous leader. After a certain time each spins a cocoon alongside that of its neighbour, mingling the hairs of its body with the silken tissue. These hairs, Latreille remarks, are, in common with those of several other kinds, extremely small and fine; and sometimes working their way into the human skin, occasion

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¹ *Account of the Tusseh and Arrindy Silk-Worms of Bengal*, by William Roxburgh, M.D. &c. Linn. Trans. vol. vii. p. 33.

² *Règne Animal*, t. v. p. 402.

³ Robertson's *Historical Disquisition concerning Ancient India*.

⁴ Procopius, *De Bello Gothico*.

⁵ See Gibbon's *Decline and Fall*, &c. Reign of Justinian; also *Edinburgh Cabinet Library*, British India, vol. iii. p. 152-3.

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violent itchings, accompanied by swelling. The inhabitants of Madagascar are known to employ for economical purposes the silk of a caterpillar which likewise dwells in great communities,—a commonwealth of worms. Their nest is sometimes three feet high, and so closely packed with cocoons (500 have been counted in a single mass) that not the smallest hiatus is to be found. The species, however, belongs to the genus *Sericaria* of the ensuing section.

SECTION 3D, PSEUDO-BOMBYCES.

These consist of Lepidoptera in which the inferior wings (in common with those of all the remaining nocturnal tribes) are provided with a curb, which attaches them to the superior when at rest. They are then entirely covered by the latter, and both are decumbent or horizontal, but with the inner edges overlapped (*en recouvrement*, Lat.). The trunk among the concluding members of the section begins to lengthen, and scarcely differs in the final genera from that of other Lepidoptera, except that it is somewhat shorter. The antennæ are entirely pectinated or serrated, at least in the males. The caterpillars live on the exterior parts of vegetation.

Latreille distinguishes first those species in which the trunk is very short, and apparently unadapted to the purposes of suction.

In some, and these are the greater number, the caterpillars live exposed or uncovered, and do not fabricate portable dwellings. Of these, some are elongated, furnished with ordinary feet, well adapted for walking; the rings of the body not soldered above. In the genera *SERICARIA* of Lat. (Plate CCXXXVI. fig. 22), and *NOTODONTA* of Ochs. (Plate CCXXXVII. fig. 1), both sexes have well-developed wings. In the former, which contains the *B. dispar* of Fab. so remarkable for the great size of the female, and the difference of her general aspect when compared with the male, the upper wings exhibit no dentations on their inner border. In the latter, which contains *Ph. zigzag* of Linn. that border is dentated. In the genus *ORGYIA* of Ochs. (ibid. fig. 2), the females are almost apterous (fig. 3), and the caterpillars (fig. 4) are beautifully adorned with aigrettes, or little plumes or tufts of hair. In others of the same tribe the caterpillars creep rather than walk, their feet being extremely short, and even the scaly ones retractile; the body is oval like that of an oniscus, with the skin soldered above from the second ring, so as to form a kind of arch, beneath which the head is withdrawn. These compose the genus *LIMACODES*, Lat. of which the caterpillars seem to represent, in this section of the Nocturna, those of certain diurnal Lepidoptera, such as the genus *Polyommatus*.

Other genera of Pseudo-Bombyces are distinguished from the preceding by the possession of a very distinct trunk, which, when unrolled, extends far beyond the head. The disposition of their colours somewhat resembles that of those diurnal species called chess-boards (*damiers*) by the French. Many of them are extremely rich and beautiful in their adornment. In *CHELONIA* of Godart (*Arctia*, Schr.) Plate CCXXXVII. fig. 5, the wings are decumbent in repose, the antennæ pectinated in the males, the inferior palpi very hairy, and the trunk short. To this genus belongs that common but superb species commonly called the Tiger-moth (*B. carya*, Fab.). It is produced from the blackish-brown creeping caterpillar usually known in Scotland as "the hairy worm." In *CALLIMORPHA*, Lat. (ibid. fig. 6), the wings are also decumbent, but the antennæ are at most only ciliated in the males; the inferior palpi are merely covered by little scales, and the trunk is long. *C. Jacobæa* is an ornamental British species, known

to our older writers under the names of Pink-underwing, and Cinnabar-moth. The upper wings are brown, with a streak and two spots of carmine. The under pair are carmine, with a blackish border. The caterpillar is hairy and black, and feeds on the flowers of the rag-wort. In *LITHOSIA* of Fab. the wings are laid as it were horizontally upon the body.

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SECTION 4TH, APOSURA, Lat.

The insects of this division are characterized by a peculiarity already alluded to,—the want of feet on the anal segment of the body of the larvæ. They derive their name from that circumstance. The posterior extremity of the body terminates in a point, which in several is forked, or even exhibits two articulated appendages, long and flexile, and forming a kind of tail. The perfect insects differ but little from the preceding in regard to their trunk, palpi, and antennæ. Some, such as *DICRANOURA* of Godart (Plate CCXXXVII. fig. 7), have the external aspect of *Sericaria* and *Chelonia*, with the antennæ of the males terminating in a small simple curved thread. The posterior extremity of the larva is forked (ibid. fig. 8). Others, such as *PLATYPTERIX*, Lat. bear a great resemblance to the *Phalænæ* properly so called. Their wings are broad, and the superior angle of the posterior extremity of the anterior pair is somewhat prolonged or falcated. The body is slender. That of the caterpillar terminates in a simple truncated point. In that state they bend over the edges of the leaves of plants, and fix them down by silken cords, so as to form a protecting habitation, which at the same time they partly consume as their natural food. The cocoon of the chrysalis is very bare.

SECTION 5TH, NOCTUÆLITES, Lat.

The species of this extensive section are similar to the preceding insects in the figure and relative proportion of their wings, and their position in repose; but they present the two following distinguishing characters: A horny, spirally rolled, and generally elongated trunk; inferior palpi, terminated abruptly by a very small article, much more slender than that which precedes it,—the latter being broader and compressed. These genera have the body more covered by scales than by a woolly down. Their antennæ are usually simple. The thorax is frequently crested above, and the abdomen assumes the form of an elongated cone. Their flight is rapid, and some of the species make their appearance during the day. The caterpillars have usually sixteen feet. Some have only twelve or fourteen, but the posterior or anal pair are never wanting; and in those which present but twelve the anterior pair of the membranous ones are as long as the next ensuing. The greater proportion spin a cocoon, in which they undergo their metamorphosis. These Lepidoptera correspond to the division named *Noctuæ* of the genus *Phalæna* of Linn.

All the generic groups recently established, and of which the characters are derived rather from the caterpillar than the perfect insect, are referred by Latreille to the two genera which follow. In the genus *EREBUS* of Lat. (Plate CCXXXVII. figs. 10 and 14), the wings are always extended and horizontal, and the terminal joint of the palpi is elongated, elevated, cylindrical, or slightly compressed, and naked. With the exception of a single species, *Ophiura scapulosa* of Ochsenheimer, which occurs in Spain, all these insects are of exotic origin. We have figured a superb example, "the glory of the Noctuidæ," as it is well named by Mr Kirby, on the fourth plate of the first volume of our *Illustrations of Zoology*. It is the *Erebus strix* of Latreille, and is known also under the title of the

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great owl moth of Brazil. It measures nearly a foot in breadth from tip to tip of the extended upper wings. In the genus *Noctua* of Fab. and Lat. (ibid. fig. 9) the terminal joint of the inferior palpi is short, and covered with scales, like that which precedes it.¹ Of those with six feet, which are the greater number, we may mention as a British species *N. sponsa*, Fab. The caterpillar lives upon the oak, is of a greyish colour, and obscurely and irregularly spotted. It is marked with small tubercles, and the eighth ring bears a projection, on which there is a yellow plate. This larva, and some other nearly allied kinds, are called *lichenées* by the French naturalists, on account of their resemblance to, and the difficulty with which they are sometimes distinguished from, various kinds of bark-supported lichens.² The anterior four of the membranous feet are shorter than the others, and they walk like the *surveyors*. Many other well-known species are arranged with that just mentioned. The caterpillars of certain others have only twelve feet, and the perfect insects are frequently ornamented with golden or silvery spots upon the upper wings. Such are two well-known British species, *N. gamma* and *chrysitis*. The former of these receives its name from a character resembling the Greek letter γ inscribed in gold upon its upper wings. "This creature," say Messrs Kirby and Spence, speaking of the larva, "affords a pregnant instance of the power of Providence to let loose an animal to the work of destruction and punishment. Though common with us, it is seldom the cause of more than trivial injury; but in the year 1735 it was so incredibly multiplied in France as to infest the whole country. On the great roads, wherever you cast your eyes, you might see vast numbers traversing them in all directions to pass from field to field; but their ravages were particularly felt in the kitchen gardens, where they devoured every thing, whether pulse or pot-herbs, so that nothing was left besides the stalks and veins of the leaves. The credulous multitude thought they were poisonous, report affirming that in some instances the eating of them had been followed by fatal effects. In consequence of this alarming idea, herbs were banished for several weeks from the soups of Paris. Fortunately these destroyers did not meddle with the corn, or famine would have followed in their train. Réaumur has proved that a single pair of these insects might in one season produce 80,000; so that, were the friendly Ichneumons removed, to which the mercy of Heaven has given it in charge to keep their numbers within

due limits, we should no longer enjoy the comfort of vegetables with our animal food, and probably soon become the prey of scorbutic diseases."³ The caterpillars of some other species have the habit of eating the petals of the flowers of the plants on which they dwell. The antennæ of certain kinds are pectinated, such as *N. graminis*, an insect which has sometimes proved extremely destructive to the meadows in Sweden. We may conclude by observing that caterpillars believed to belong to this genus have been seen to exercise a curious, and, as we would suppose it, an unnatural instinct,—they seize upon other larvæ, even of their own species, transfix them by the middle, and sucking out their interior juices, leave them nothing but their own skins. When we mention that Olivier (in *Encyclopédie Méthodique*) describes 459 species of the Fabrician genus *Noctua*, the reader will readily admit that many of the new generic groups, to which we have been unable to do more than allude, are extremely desirable, were it for nothing else than mere convenience, independent of any higher reasons resulting from the nature of things.

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SECTION 6TH, TORTRICES, Linn.

These are very nearly allied to the Lepidoptera of the two preceding sections. The upper wings, of which the posterior margin is arcuated at the base and then restricted, and their short and broad contour, forming a truncate oval, bestows a peculiar physiognomy upon the species in question. They are named by the French *Phalènes à larges epaules*, *Phalènes chappes*, &c. They are all provided with a distinct trunk, and the inferior palpi are generally very like those of *Noctua*, but somewhat projecting. They are of smallish size, agreeably coloured, with the wings decumbent, but flattish, or almost horizontal, and covering the body,—the inner margins of the upper pair even overlapping each other a little in a state of repose. The caterpillars have sixteen feet, a smooth body, or but slightly haired, and dwell in leaves, which they roll up or convert into tunnels by means of silken cordage. They live upon the parenchyma of their own leafy dwellings, which thus serve them both for food and clothing. Others form their dwellings by uniting several leaves together, while a few are found in different kinds of fruits. Several have the posterior part of their body narrower than the others, and these were named *chenilles en forme des poisson* by Réaumur. Their cocoons are boat-shaped, and

¹ The genus *Noctua* of Fabricius, as observed by Latreille in his note to the *Règne Animal*, t. v. p. 409, is, in Ochseneimer's *Schmetterlinge von Europa*, divided into forty-two genera, from *Acronita* to *Enclidia* inclusive. These are constituted in great part by the conversion into genera of the sections previously indicated in the "Systematic Catalogue of the Lepidoptera of Vienna." Their insertion in this article would however be still more incompatible with our own limits than with those of the *Règne Animal*, from which they are expressly excluded. The *Noctuæ*, according to Latreille, exclusive of *Erebus*, are resolvable into two great parallel series, one of which is related to these latter Lepidoptera, the other to the *Notodontæ*. The first is composed of those of which the caterpillars march after the manner of the surveyors or *Geometræ*. Some have sixteen feet, of which the anterior two or four of the intermediate membranous ones are the shortest; others have only twelve feet, such as *Plusia* and *Chrysoptera*, genera distinguished from the preceding by the size of the inferior palpi, which are recurved upon the head. The second series commences with species of which the palpi are proportionally larger, the antennæ pectinated, and the trunk smaller;—such are *Notodonta palpina* (*Odonoptera palpina*, Lat.) and the genus *Calyptra* of Ochseneimer. Then follow the genera *Xylota* and *Cucullia*, those *Noctuæ* in which the posterior margin of the anterior wings are angular or dentated, those in which the antennæ are pectinated, and those in which they are simple. The latter species are terminated by such as have an even thorax, some of which, belonging to the genus *Erastia*, seem to lead to the *Pyrallites*. All the caterpillars of this second series have sixteen feet, with the intermediate membranous ones of equal size; their mode of progression is rectigrade. The genus *Chrysoptera* (*Plusia concha* of Fischer, in *Entomog. de la Russie*, i. *Lepidop.* iv.), with which Latreille concludes the other series, is related to *Herminia* and *Pyrallis*. Thus both series seem to converge towards the latter section. The *Licheniæ*, or *Catocolæ*, of Ochs., are large species, with almost horizontal wings, which, as well as *Ophiusa*, *Breplos*, &c. appear to approximate naturally to *Erebus*. Latreille is of opinion that if placed in the other series they destroy its harmony.

The *Bombyx cyllopoda* of Dalman (*Analect. Entom.* 102) ought to form a new sub-genus, and of a remarkable nature, in so far as the two posterior legs of the male are shorter than the others, unarmed, and almost useless for the purposes of locomotion. This insect has the antennæ pectinated, a distinct trunk, and the palpi as long again as the head, and ought therefore to be placed near the genus *Calyptra* of Ochs. or *Herminia* of Latreille.

² A beautifully providential change has been rendered natural to some of these species in relation to their food. The larva of *N. alga*, Fab. is always yellow when it feeds on *Lichen juniperinus*, which is itself of that colour; but it becomes grey while pasturing on *Lichen saxatilis*.

³ Réaumur, *Mém.* ii. 327; *Introduc. to Entom.* i. 189.

Lepidoptera Nocturna. are in some kinds formed of pure silk, in others of mixed materials. These insects compose the genus *Pyralis* of Fab. (Plate CCXXXVII. fig. 16). Many of the species are destructive to fruit-trees and vines. *P. pomona* in the caterpillar state lives in the interior of apples, of which it eats the pippins. We may name as a British species *P. prasinaria*, which is the largest known. It measures about two inches in extent. The upper wings are pure green with two oblique streaks in the centre, the thorax is green, the under wings white. This species, with that which we have figured, form the genus *Chloephora* of Stephens.

SECTION 7TH, PHALÆNITES, Lat.

Here are comprised a numerous assemblage of nocturnal Lepidoptera, in which the body is usually slender, with the trunk either apparently wanting, or generally but slightly lengthened, and almost membranous; the inferior palpi are small and nearly cylindrical; the wings ample, extended, and almost horizontal, or flatly decumbent. The antennæ are pectinated in several males. The thorax is always even, or without a crest. The caterpillars have in general only ten legs, though some (*Ph. margaritaria*) have twelve; the anal pair are always present. These insects correspond to the *Geometræ* of Linn., and their peculiar mode of progression, already described in our observations introductory to the lepidopterous order, has obtained for them the name of *surveyors*. Their attitude in repose, also before described, is still more extraordinary.¹ They then resemble little broken twigs of the plant on which they rest; and their colours, and the inequalities of their surface, aid the deception. They thus no doubt frequently escape the observation of their natural foes. Roessel states that his gardener, mistaking one of these ligneous-looking larvæ for a dead twig, the brittleness of which he no doubt expected would admit of his instantly snapping it asunder, started back in the greatest alarm when he found by its consistence and motion that it was a living creature. The chrysalids are almost naked, their cocoons being thin and poorly supplied with silk.

According to Latreille's views, by which we are at present guided, this section, when considered in relation to the perfect insects alone, contains but a single genus, that of *Phalæna* properly so called (Plate CCXXXVII. figs. 13 and 15) of which the characters consequently agree with those just assigned to the section itself. A very different view, however, has been taken by the greater mass of entomologists, foreign and indigenous; and a roll of names of fearful length and deep construction, has been received by many as constituting a proper portion of our scientific nomenclature. Thus Mr Stephens' family *Geometridæ*, corresponding to the *Phalænites* of Latreille, contains above eighty British genera. The number is precisely eighty-three in Mr Rennie's *Conspectus*. Many naturalists believe that no such divisions as genera exist in nature, and consequently that all our generic distinctions are artificial, and constructed merely for convenience, as a helping instrument for ourselves, and an easier mode of mutual communication between ourselves and others. But all naturalists admit that there is a difference in the value of the characters chosen, and that such as are selected as generic should be pervading and influential over a pretty obvious group, not chosen arbitrarily or at hazard from the examination of the limited productions of any one confined insular region, but on mature deliberation, and after a kindly and extended study of the analogous productions of foreign lands. Characters drawn from form and structure are much less liable to accidental variation, and are

likewise of more comprehensive application, than such as are derived from colour;—the former have consequently been used to distinguish the greater groups, including genera,—the latter are chiefly available in the discrimination of species, and their mode, range, and frequency of variation, of themselves afford most interesting subjects of study and reflection, in relation to the varieties of each particular kind. It is doubtful, however, whether the use of the evanescent shades of so superficial a character as colour, is advisable in the distinction of genera. The great test of a good generic character consists in its being in some way connected with or influential over the natural habits of the species which it is assumed to distinguish,—so that it may fairly be presupposed to exist in other species of similar instinctive modes of life. These traits are no doubt difficult to obtain in the insect creation, where the species are so numerous, and the gradations so often insensible from one group to another. But still we know that colour, though occasionally extremely characteristic of natural groups, is a distinction too flighty and fantastical to be generally applied with advantage, otherwise than for artificial combinations. For these and other reasons not necessary to be here adduced, we have hitherto failed to see the propriety of such characters as “first pair of wings somewhat rufous, with darker streaks,” “second pair pale, with a red streak,” “wings banded with green,” “the first pair greenish, spotted with black, the second pair dull,” &c. being adopted as *generic* distinctions,—the more especially as they would prove not very efficient even for the purposes of *specific* discrimination.

There is no doubt, however, that the great extent of the genus in question requires that it should be reduced by subdivision within manageable bounds; and if determinate and distinctive characters of sufficient value can be attached to each, a generic name may as well be used as a sectional mark. Hubner has described and figured above 400 European species, and MM. Lepelletier de Saint Fargeau and Serville have formed numerous divisions among the species described by them in the *Encyclopédie Méthodique*. Modern entomologists have adopted a method of distinguishing by the specific name alone, whether the male of a phalæna has the antennæ pectinated or setaceous. The names of such as exhibit the former structure always end in *aria*, those characterized by the latter in *ata*. A very common species is *Ph. Grossulariata*, white, with some yellow streaks, and spotted with black. The caterpillar is also richly coloured. It feeds on the leaves of the currant and gooseberry. The chrysalis is of a shining black, with yellow rings. It is known in England by the name of Magpie. *Ph. ulmata*, or the clouded Magpie, is a scarcer species. In Scotland at least it is rare. Both these belong to the sub-genus *Abraxas* of Leach. A rather large and elegant species, called the swallow-tailed moth, *Ph. sambucaria*, is of a pale sulphur colour, with two transverse streaks upon the upper, and one upon the under wings. It forms the sub-genus *Ourapteryx* of Leach, and resembles in its form the beautiful *Phalæna machaonaria* of Boisduval, which, with *Ph. guttaria*, *ibid.* we have represented by the figures last referred to. The females of a few present only the rudiments of wings. Such is *Ph. brumata*, which makes its appearance during the winter season, and belongs, for that reason, to the sub-genus *Hibernia* of Latreille.

SECTION 8TH, DELTOIDES, Lat.

This section consists of species very analogous to the true *Phalænæ*, but the caterpillars have fourteen legs, and

¹ See page 239.

live in rolled up leaves. The inferior palpi are elongated and recurved in the perfect insect. The wings form with the body, on the sides of which they spread horizontally, a kind of delta, with a re-entering angle in the middle of the posterior edge, producing a forked aspect. The antennæ are usually pectinated or ciliated. Our present section comprised, in the first edition of the *Règne Animal*, all the *Phal. Pyralides* of Linn. But, as Latreille has more recently observed, a complication of characters resulted from that arrangement, which is obviated by only comprising in this division the genus *HERMINIA* (Plate CCXXXVII. fig. 17), which belonged to *Pyralides* of Linnæus, and is composed of the genus *Hyblæa* of Fab. and several species of his genus *Crambus*. These Lepidoptera are generally of a greyish hue, without much brilliancy of colouring. Several species are remarkable for tufts of hairs upon the upper portion of their legs, the use of which in their natural economy has not yet been ascertained. Indeed we know little of the history of the species, although they sometimes attract our notice by the length of their palpi. They have been named *snouts*, *fan-feet*, &c. by the English collectors.

SECTION 9TH, TINEITES, Lat.

Latreille here comprehends the *Phal. Tineæ* of Linn. and the greater part of the *Phal. Pyralides* of the Swedish naturalist. They consist of the smallest species of the lepidopterous order,—among others, of our common house-moths, so well known for their destructive propensities in the larva state, and the ravages they commit among neglected garments. These larvæ are smooth, have always at least sixteen feet, and live concealed either in fixed or moveable habitations, of their own construction. In some the wings form a kind of elongated triangle, almost flattened, and terminated by a re-entering angle;—such are the *Phalænæ Pyralides* of Linn. They have four distinct and usually exposed palpi. In others the superior wings are long and narrow, sometimes moulded on the body, and forming over it a rounded roof,—sometimes inclined almost perpendicularly, applied close to the sides, and frequently elevated posteriorly after the manner of a cock's tail in miniature. In either case the inferior wings are always broad and plaited. The latter kinds also have not unfrequently four exposed palpi.

All nocturnal Lepidoptera, the caterpillars of which lived in sheaths or cases, received from Réaumur the name of *Teignes proprement dites* or of *Teignes fausses*, according as their habitations were detached and portable by the contained creature, or fixed and immovable.¹ This principle of arrangement, though sufficient for the purposes which the admirable author had in view, is not philosophically founded, and, if strictly applied, would require our including among the Tineites the genus *Pyralis* and others belonging to preceding sections. In the Linnæan system, our present insects composed the seventh division of the great genus *Phalæna*, and were briefly characterized as follows:—Wings almost cylindrically rolled, front projecting. They constitute a generic group in Geoffroy's work.² Following the example of Linnæus, Degeer did not separate these small creatures from the general mass of *Phalænæ*, but satisfied himself by forming them into different sections of his fourth and following family. Indeed his arrangement of the *Phalænæ* is extremely artificial.

The Tineites, although they are the pygmies of the lepi-

dopterous order (what a vast disparity in size between a small clothes-moth and the great owl-moth of Brazil!) are much more richly attired than most of their larger brethren. Indeed, when minutely examined, not many created things will be found more worthy of our admiration; and it is not without reason that Scopoli has observed,—“*Tinearum copia, parvitas, pulchritudo stupenda, ut in his potissimum natura thesauros suos effudisse videtur, tantaque in minimis hisce majestas, ut admirari potius eam liceat, quam aptis verbis indicare.*”³ The wings frequently combine, with extreme beauty of colouring, the most brilliant little stripes and masses of shining silver and burnished gold, which under the microscope exhibit a most radiant richness. This lustrous aspect of many species is however but a poor recompense for the injury which we receive from many more while in the larva state. These clothe themselves at our expense in the warmest woollen garments, which they traverse in all directions, leaving behind a gnawed and worn-out path, so thin and bare as to yield to the slightest pressure. They also destroy furs, hair, feathers, and many other articles of domestic economy, and are the exterminating pests of zoological museums. To them we no doubt owe the destruction of the famous Dodo, once preserved in the Ashmolean Museum of Oxford, and never since seen by human eyes. By means of their maxillæ these little larvæ shear down the surface of various substances, and uniting the particles by means of their glutinous silk, they thus form protecting habitations, which partake of the nature of the woollen or other stuffs on which the foresight of their parents has placed them. When they themselves increase in bulk, so as to find their abodes as inconvenient as a strait waistcoat, they split them down the middle, and interpose a piece, proportioned no doubt to their expected as well as actual increase. They add to the length also by fresh materials to the anterior end. These observations are easily made by removing the young larva in its first restricted case, from a piece of white to a piece of scarlet or other coloured flannel. When about to undergo their transformations they close up the apertures with silk. Another larva of this section (*Teigne des blés*), which Olivier makes an *Alucita* and Latreille an *Æcophora*, is still more destructive on account of its ravages among corn, and its prodigious powers of multiplication. Our grain is also liable to great damage from the larvæ of other Tineæ, such as the *fausse chenille des blés*, described by Réaumur, which, by means of its silken web, connects together several grains in the form of a tunnel, from which it issues forth to feed on the neighbouring heaps. It is a somewhat analogous species which in bee-hives pierces the waxen cells on which it feeds; and by thus causing the honey to flow out, occasions great loss to the apiarian. Our readers must have frequently observed the leaves of many plants and trees pervaded by numerous tortuous windings, of a paler colour than the rest. These are the sub-cutaneous galleries of certain very small larvæ of garden-moths, many of them extremely beautiful, and so minute as to dwell at ease between the upper and under surface of the leaf. Others dwell and feed upon the surface, but screened from immediate observation by a covered way of silk, which they spin along their devious courses. Referring the curious reader to the works of Réaumur, Roesel, and Degeer, for a more ample history of these truly singular and interesting tribes, we shall here briefly notice a few of the principal genera.

In the following groups the four palpi are always dis-

Lepidoptera
Nocturna.

¹ The *Teignes aquatiques* of Réaumur are the larvæ of *Phryganæ*; and those to which he applies the ancient name of *Ligniperdæ* are the larvæ of the genus now called *Psyche*, belonging to the section *Pseudo-Bombycites*.

² *Histoire des Insectes des Environs de Paris*.

³ *Entomologia Carniolica*, p. 243.

Lepidop-
tera
Nocturna.

tinct,¹ exposed, or simply concealed (the upper ones), in part by the scales of the epistoma, and are advanced, of medium size, and analogous to those of the *P. pyralides* of Linn. Their wings are decumbent, generally flattened, or but slightly raised, and form a kind of delta or elongated triangle. In the ensuing genera the trunk is apparent, and serves for the performance of the usual functions. The larvæ live on various plants. In *BOTYS*, Lat. (CCXXXVII. fig. 11), the larvæ roll up leaves, and do not differ externally from the others except in the respiratory organs. In *HYDROCAMPE*, Lat. (ibid. fig. 12), the species are analogous to the preceding, but the caterpillars are aquatic, and are usually furnished with filiform appendages, the interior of which contain tracheæ. They fabricate tunnels or covered ways with the leaves of various aquatic plants. Such are *H. potamogata*, *paludata*, *lemnata*, &c. In the genus *AGLOSSA* of Lat. (ibid. fig. 19) the trunk is wanting, or nearly so. The four palpi are exposed, and the wings form a flattened triangle,—the upper having no emargination at their extremity. *A. pinguinalis*, Réaumur. iii. xx. 5–11, occurs on walls in houses. The caterpillar is smooth or short-haired, of a brownish black, and shining. It feeds on various fatty substances, and also attacks leather,—on which account it is called *fausse-teigne des cuirs* by Réaumur. It is destructive to the binding of books, and is therefore an inconvenient companion in a library. Its case consists of a long tunnel, applied close to the substance on which it lives, and covered by particles of excrementitious matter. According to Linnæus, it occurs, though rarely, in the human stomach, where it occasions effects much more dangerous and alarming than those caused by ordinary intestinal worms. “Un médecin éclairé,” says Latreille, “et dont je ne puis révoquer en doute la véracité, m’a envoyé des chenilles de cette espèce, qu’une jeune famille avait vomies.” Another species, *P. farinalis*, feeds on flour. In the genus *GALLERIA* of Fab. the scales of the clypeus or epistoma form a projection which covers the palpi. The upper wings, proportionally narrower than those of *Aglossa*, and emarginate on the posterior border, are, in common with the inferior, very decumbent, and raised posteriorly like a cock’s tail, as in many species of the ensuing genera. *G. cereana*, Fab. is the species the larva of which is designated *fausse-teigne de la cire* by Réaumur. It is extremely destructive in bee-hives, in which it pierces the honey cells, and constructs as it advances a silken tunnel covered with excrementitious particles composed of the wax which it has devoured. The cocoons of the chrysalids are sometimes found assembled in heaps.

In other groups of Tineites the superior palpi are not always very distinct. The upper wings are long, narrow, sometimes moulded or rolled upon the body, sometimes applied perpendicularly to the sides. In this state the insect has always an elongated and narrow form, approaching that of a little cylinder or cone, when the wings are closed.

In the next-named four genera the inferior palpi, always large, are borne, as it were, in advance, the last joint at most being raised. The palpi are apparent. *CRAMBUS*, Fab. (Plate CCXXXVII. fig. 20), has a distinct trunk. The inferior palpi project straight forwards like a beak. These Lepidoptera occur in dry pastures and on various plants. *ALUCITA*, Lat. (ibid. fig. 22), has also a distinct trunk, but the inferior palpi are raised. The antennæ are simple.

In *EUPLOCAMPUS*, Lat. (ibid. fig. 18), the trunk is short and inconspicuous, and the last article of the inferior palpi is likewise raised, the scales of the preceding one forming a faisceau. The antennæ of the males are furnished with a double row of little barbs. The genus *PHYCIS* of Fab. is closely allied to *Euplocampus*, but the antennæ at most are merely ciliated.

In the following genera the inferior palpi are entirely raised, and even recurved over the head in several. Sometimes the inferior palpi are very apparent, and of medium size. The antennæ and the eyes are distinct. In the two following genera the inferior palpi scarcely surpass the front. In *TINEA* (ibid. fig. 21) the trunk is very short, and formed of little membranous disjointed threads. The head is erected. The species of this genus, which has been greatly restricted since the time of Fabricius, are particularly destructive among our clothes and other household concerns. We shall here notice a few of the principal kinds. *Tinea tapezana*, Fab. and Lat., has the upper wings black on the basal portion, their posterior part being white. This is the species represented by our figure.² Its caterpillar feeds on woollens, on which it forms an arched gallery, lengthening as it advances. *T. sarcitella* is of a silvery-grey colour, with a white spot on each side of the thorax. Though very abundant and extremely destructive in most parts of Europe, its synonymy and consequent history are somewhat confused. The figures given by Réaumur,³ and cited by many authors, appear (at least if we judge from the eleventh) to belong to another genus. The inferior palpi are large, recurved and pointed, a character which rather allies it to the genus *Volucra* of Lat.⁴ and to the *T. vestianella* of Scopoli and Linn. It is even suspected that these two insects are the same. According to the last-named authority, the *T. sarcitella* is of a silvery grey, as above described. In *T. vestianella* the upper part of the head, of the thorax, and even the base of the superior wings, are white. The inferior palpi, recurved in the manner of horns, are of the same colour, ringed with black. The wings lie horizontally on the body, are whitish, and shining, and the upper surface of the superior pair presents some blackish spots of different sizes. The inferior are of a uniform colour, bordered posteriorly, as is also the internal margin of the upper pair, with long fringes. This species is extremely common, and it has been presumed that Linnæus having given an inadequate description from a defective specimen, its identity became difficult to recognise, and that thus Scopoli bestowed a new name, that of *vestianella*, upon an old species.⁵ However this may be, the *T. sarcitella* is extremely pernicious among all woollen substances. It forms and inhabits a silky case, usually spindle-shaped, which it covers with detached hairs or particles of wool. *T. pellionella*, Fab. has the upper wings of a silvery grey, with one or two black points on each. Its caterpillar forms a felted case or tunnel, and lives on furs, which it destroys with ease and satisfaction to itself, by gnawing off the hairs at the base. The wings of *T. granella* are elevated behind, and marbled with grey, brown, and black. Its larva is very injurious to grain. *T. flavifrontella*, Fab. has a *toupee* of a more lively colour than the other parts, approaching to reddish. Its larva forms a silken case, and is extremely hurtful in museums, among birds, insects, &c.

Lepidop-
tera
Nocturna.

¹ The genera *Iponomeuta* (with one or two exceptions), *Ecophora*, and *Adela*, are, according to Latreille, the only Tineites of which the superior or maxillary palpi are not distinctly perceptible; but as they may be concealed by the inferior or labial palpi, it is difficult, in relation to this point, to establish a fixed and rigorous line of demarcation. For this reason the French entomologist has not arranged the Tineites according to the number of the palpi. M. Savigny, in his *Mémoires sur les Animaux sans Vertèbres*, has given figures, in which these parts are represented in their various proportions. (*Règne Animal*, v. p. 417.)

² It is identical with *T. tapetzella* of Linn. and the lamented Mr Haworth.

³ *Mémoires*, iii. vi.

⁴ See *Dict. Classique d'Hist. Nat.* xvi. p. 87.

⁵ *Règne Animal*, t. v. p. 412, note.

epidop-
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Nocturna.

We may conclude by observing, that the most efficient means of preventing or removing moths are care and cleanliness. Let articles of such a nature as may be liable to their injurious inroads be frequently examined, handled, and exposed to light and air. These tiny creatures are lovers of darkness, and of undisturbed repose. The instinct of the mother (and that providential perception is never more unerring than when manifested in relation to the welfare of a future offspring) teaches her to distinguish whatever is neglected or cast aside,—and in like manner she becomes sensible that whatever is used or often handled would form an unsafe nidus for her tender young. In depositing her eggs she therefore selects the one and rejects the other; and hence a careful housewife, who feels a lively interest in her own concerns, and frequently examines and refolds or arranges her household gear, may live for half a century and never see a moth. At the same time, if articles are rolled up in a perfectly close and well-ordered tissue, they are safe from these destructive creatures, which are certainly never *bred* from the things they consume, however old or ill-conditioned. But if a single unsuspected crevice should chance to admit one solitary female moth, “the spinster’s occupation’s gone,” and a colony of worms is suddenly produced from innumerable eggs, which would strike horror into the heart of a Malthusian. Where things must be left unexposed to changes of light and air, and yet cannot be hermetically closed, the use of camphor, spirit of turpentine absorbed upon pieces of sponge or cotton, and other preventives, are tried with more or less success. Exposure to a brisk fire is the most effectual means of expelling the larvæ from stuffed birds, quadrupeds, &c.

In the genus *ILITHYIA*, Lat. (Plate CCXXXVII. fig. 23), the inferior palpi resemble those of the preceding genus, but the trunk is distinct, and of the ordinary size, and the last article of the inferior palpi is obviously shorter than the preceding. In *IPONOMEUTA*, Lat. (ibid. fig. 24), the trunk is also distinct, and of tolerable size, but the terminal article of the inferior palpi is at least as long as the preceding one. These insects, according to Latreille, are related to *Lithosia*. *Y. evonymella* (Tinea of Fab.) has the upper wings of a shining white spotted with black, the inferior pair lead colour. *Y. padella*, Lat. has the upper wings of a greyish-lead colour, and very numerous spotted with black, the under pair lead coloured, with thick fringes. The caterpillars of both these kinds live in large congregations, beneath a dusky web, which they stretch out upon our fruit-trees, of which they devour the leaves. When they have eaten all within their reach at one place, they make a start to another, enclose themselves under a new and more extended canopy, and recommence their ravages, which are found to be extremely injurious to the health of the tree, and its productive powers. The branches seem as if covered with patches of dusty and discoloured crape. In the genus *CECOPHORA*, Lat. the inferior palpi are recurved above the head, in the manner of horns, proceeding to a point, and reaching as far backwards as the back of the thorax.

Lastly, in a few species, such as those of the genus *ADELA*, Lat. (Plate CCXXXVII. fig. 25), the inferior palpi are very small and clothed, the antennæ are almost always extremely long, and the eyes approximate. These

beautiful little creatures occur in woods, and are said to appear with the leafing of the oak. They are frequently brilliantly ornamented with metallic scales. The species which we have figured is *A. Degeerella*, remarkable for its antennæ being many times the length of its body. These delicately articulated organs are whitish, the posterior portion black. The upper wings are of a gilded yellow on a dark ground, forming longitudinal streaks, with a broad transverse golden-yellow band bordered with violet.¹

Lepidop-
tera
Nocturna.

SECTION 10TH, PTEROPHORITES, Lat.

This, our concluding section of the nocturnal Lepidoptera, exhibits many relations to the preceding, in respect to the narrow and elongated form of the body and upper wings; but it differs from it, as well as from all the other sections, in this, that a pair, if not all, of the wings, are as it were split or cloven throughout their whole length, so as to present a branched or digitated appearance, bearded on the edges. The parts look like feathers, so that the wings of these fantastically formed creatures somewhat resemble those of birds. They formed the division of *Phalænæ alucitæ* of Linnæus, and were named *Phalènes-tipules* by Degeer. Geoffroy, Fabricius, and Latreille include them under the genus *PTEROPHORUS*. Their larvæ have sixteen feet, live on leaves and flowers, and construct no cases. The chrysalids of the greater number are naked, coloured, and suspended by a thread. In others they are enclosed in a translucent cocoon. The genus has been lately subdivided. In some the inferior palpi are recurved from their origin, entirely garnished with small scales, and do not exceed the length of the head; these constitute the genus *PTEROPHORUS* properly so called, of Latreille (Plate CCXXXVII. fig. 26). Their chrysalids are exposed, beset with hairs or small tubercles, and are sometimes suspended by a thread, sometimes fixed by means of hooks at the posterior extremity to a little bed of silk, imposed upon a leaf or other vegetable body. *P. pentadactylus*, Fab. is an example of this division. The wings are of an almost snowy whiteness, the upper pair being divided into two, the lower into three parts. In others the inferior palpi are projected, longer than the head, with the second article thickly covered with scales, and the terminal one almost naked, and turned up. The chrysalis is enclosed in a cocoon of silk. To these Latreille has applied the generic name of *ORNEODES* (ibid. fig. 27). The *O. hexadactylus* measures about six lines in length. It is of an ash-coloured grey, with a tinge of brown. The wings, especially the upper ones, are traversed by obscure or blackish bands, with some spots of a paler grey; and each wing is divided to its base into three principal parts, of which the first is subdivided into two radii, and the second into three: the third is simple. The caterpillar of this species has sixteen feet, and lives on the honeysuckle, *Lonicera xylosteum*. The perfect insect is often found on walls and windows, and in the interior of houses. It is widely spread over Europe.

We here take leave of the lepidopterous order, and shall only further remark, that we seek in vain to express by words the splendid colours, the elegant and varied forms, and the exquisite pencilling, by which they are adorned. Even the most richly illumined pages of natural history

¹ In the arrangement of these insects, given by Latreille in the second edition of the *Règne Animal*, and by which we have been guided above, he has apparently, with the view of approximating to the nomenclature of Réaumur, combined the *Pyralides* and *Tineites* in one section. He has however elsewhere indicated the propriety of their being disjoined, and in this event the following genera will compose the *Tineites*: I. Inferior or labial palpi advanced; the terminal articulation at most elevated; superior palpi apparent: Genera *GALLERIA*, *CRAMBUS*, *ALUCITA*, *EUPLOCAMPUS*, and *PHYCIS*. II. Inferior palpi altogether elevated, or even recurved, in several, over the head. A. Inferior palpi of medium size, and very obvious; eyes distant: Genera *TINEA*, *ILITHYIA*, *IPONOMEUTA*, *CECOPHORA*. B. Inferior palpi very small and hairy; eyes approximate: Gen. *ADELA*.

Strepsip-
tera.

convey but a meagre image of their gorgeous attire. That must be sought for—where alone it can be found,—in those far more brilliant and inimitable pages of the *book of nature*, in which the most successful effort of art is transeended by a feeble insect's wing. The imagination of poet and of painter cannot boast,

Amid their gay creation, hues like these.

ORDER VII.—STREPSIPTERA, KIRBY.¹

The singular insects which constitute our present order are parasitical species, which dwell, while in the larva state, between the plates of the abdomen in different kinds of wasps and bees. Their characters were first given by Mr Kirby (*Linn. Trans.* vol. xi. p. 109), who bestowed upon them the name above adopted, and which was subsequently altered, without sufficient reason, by Latreille. The definition given by the former author, in his later work, is as follows: Metamorphosis sub-incomplete? Pseudelytra twisted, attached to the anterior leg. Wings not covered by the elytra, longitudinally folded, forming nearly the quadrant of a circle: neuration simple. Anus styloferous.² On each side of the anterior extremity of the thorax, near the neck and the exterior base of the first pair of legs, are inserted two small crustaceous bodies, like rudimentary elytra, stretching backwards, curved, dilated, and terminating near the origin of the true wings. These are the *pseudelytra* just named, called *prebalanciers* by Latreille. The great French entomologist is of opinion, that, as elytra properly so called always cover the totality of the base of the membranaceous wings, and derive their origin from the second segment of the thorax, the parts in question are not genuine wing-cases, but rather analogous to the tippets (*pterygota*), observable at the base of the upper wings in the lepidopterous order. The actual wings of Strepsiptera are large, membranaceous, divided by longitudinal nervures, proceeding like rays from the shoulder or point of union with the body. They fold lengthways like a fan.³ The mouth is composed of four pieces, of which the shorter two appear to be biarticulate palpi, the others, inserted near their base, have the form of little linear laminæ, pointed, and crossing at the extremity, like the mandibles of various insects, but resembling rather the lancets of the sucker of the dipterous tribes, than true mandibles.⁴ According to Savigny's views, the mouth consists of a labrum, two mandibles, a pair of maxillæ, each bearing a very small uniaarticulate palpus, and a labium without palpi. The head presents two large eyes, hemispherical, granose, and slightly pediculated; two antennæ, approximate at the base, placed upon an elevation in common, almost filiform, short, and composed of three articulations, of which the first two are very short, and the third, greatly elongated, is divided from its origin into two long compressed lanceolate branches, applied against each other. The stemmatic eyes are wanting. The thorax, in its peculiar form and divisions, resembles that of several Cicadariæ, Psyllæ, and Chrysides. The abdomen is nearly cylindric, composed of eight or nine segments, and is terminated by pieces which seem to bear an analogy with those which we find at the posterior extremity of the Hemiptera above named. The six legs are almost membranous, compressed, nearly equal, and terminate in filiform tarsi, composed of four membranous articulations, which appear vesicular at their extremity, and of which the terminal one, somewhat larger than the others, is unfurnished with hooks. The four

anterior legs are approximate, the posterior pair being thrown pretty far back by themselves. The space comprised between the latter pair is ample, and divided into two by a longitudinal groove or furrow. The posterior extremity of the metathorax is prolonged over the abdomen in the manner of a large scutellum, and its sides, which serve as points of insertion to the posterior legs, are much dilated backwards, and form a kind of inflated buckler, which defends the exterior and lateral base of the abdomen.

These singular insects were first observed by Rossi, who concluded, because they were parasitical, that they must belong to the hymenopterous order, to which they certainly bear a greater affinity than to any of the dipterous tribes, among which they were arranged by M. Lamarek. Latreille inclines to consider them as related (although at the same time differing in various ways) to certain hymenopterous species, such as those of the genus *Eulophus*. In the larva state they live between the abdominal plates of hymenopterous insects belonging to the genera *Andrena* and *Polistes*. It has been supposed that the elytra-like portions, already described, serve to disengage the perfect insects with greater facility from the living chambers in which they are incased. They are said to frisk about with a simultaneous motion of these organs and the true wings. Latreille calls them the *Æstri* of insects. We know that a species of *Conops* likewise undergoes its transformations in the interior of a *Bombus*, or wild bee.

This order contains only two genera,—*Xenos* of Rossi, and *Stylops* of Kirby. Their exact nature is still of difficult determination, as will be perceived from the following quotation:—"The true place in nature," says Mr Macleay, "of the singular genera *Xenos* and *Stylops*, is indeed very difficult to determine; and what remarks, therefore, I am now about to offer on them ought to be received by the reader with great caution, as well because it has hitherto been out of my power to become acquainted with them, except through the medium of the works of Kirby, Latreille, Savigny, and Lamarek, as because the total variance in the statements of these authors respecting them demonstrates that their true nature is as yet by no means ascertained.

"Professor Peck and Savigny, however, have both most satisfactorily shown that the *Strepsiptera* are provided with true mandibles and palpigerous maxillæ; and therefore have completely set aside the opinion of MM. Lamarek and Latreille as to their affinity with the *Diptera*. Proceeding, then, on the fact that they belong to the *Mandibulata*, which, by the by, appears at last to be admitted by Latreille, we necessarily make inquiry as to the particular part of this class in which they ought to be placed. Now, the only chasms of importance which we have noticed in the column, are one between the *Trichoptera* of Kirby and the *Tenthredines*, and the other between the *Hymenoptera* and the *Coleoptera*. The deficiency of ocelli, the structure of the whole insect, but particularly that of the wings, prove that the *Strepsiptera* cannot occupy any vacancy near the *Trichoptera*. It therefore only remains for us to place them between the *Hymenoptera* and *Coleoptera*. But this appears to be nearly the situation originally given to the *Strepsiptera* by Mr Kirby; for, in his very remarkable paper on those insects, in the eleventh volume of the *Linnean Transactions*, he says, 'With respect to the place of *Strepsiptera* in the system, it seems to me that this order should follow *Coleoptera*; for its metamorphosis being different from that of *Orthoptera* and *Hemiptera*, and near-

Strepsip-
tera.

¹ RHIPIDPTERA, Lat.

² Hence the name of *Rhipiptera*, bestowed upon them by Latreille, from *ῥίπις*, a fan, and *πτέρω*, wings.

³ *Règne Animal*, v. 425.

⁴ *Introduc. to Entomology*, iv. 370.

er to that of the *Coleoptera*, this seems its most natural station, considered as an elytriphorous order, especially since, if it be inserted between *Orthoptera* and *Hemiptera*, with both of which it has some affinity, it would interrupt the series of semicomplete metamorphosis, by which, besides other characters, these two orders are so closely united? He had previously noticed a circumstance which at once distinguishes them from all *Coleoptera* and *Orthoptera*, and gives them an affinity with the *Hymenoptera*, namely, a narrow collar instead of an ample thoracic shield. And it is worthy of remark that Rossi, in the work which informed naturalists of their existence, placed them among the *Hymenoptera*, induced to this, as Mr Kirby supposes, by the economy of their larvæ. Such, then, is in all probability their true place in nature, though certainly my opinion on the subject, for the reasons already stated, ought to be received, as it is advanced, with great caution. The *Xenos*, beyond a doubt, is, with the *Stylops*, the most puzzling insect to place naturally that we know; it is truly '*animal animum excrucians*;' and no better proof of this can be given than that when Lamarek and Latreille make the *Strepsiptera* a division of *Diptera*, they seem absolutely to have pitched on the most artificial situation for them which they could have chosen. Latreille has remarked that the body of the *Strepsiptera* bears a striking relation to that of some *Homoptera*; and to judge from the descriptions given by Mr Kirby of these insects, their wings are folded like those of *Orthoptera*, while the form of their head resembles that of some *Neuroptera*. To the *Diptera* they have no visible affinity, and scarcely any analogy, except such as we might expect from their proximity to the *Hymenoptera*. How far I am right in adopting Mr Kirby's opinion as to their real affinities, remains yet to be seen; but it is no weak argument in support of its accuracy, that they possess the very precise kind of metamorphosis which insects in the hiatus between the *Coleoptera* and *Hymenoptera* ought to have from analogy.

"The *Strepsiptera* ought probably to be considered as an osculant order; and they undoubtedly form a group which is apparently of much greater importance, and is marked with much stronger characters, than the *Dictyoptera*. These can scarcely be said to afford a type of any very peculiar construction, and may therefore, perhaps, with more propriety, be viewed as an annexed tribe falling into the extensive order of *Orthoptera*."¹

In the genus *STYLOPS*, the last portion of the antennæ is composed of three small articulations. The abdomen is fleshy and retractile. *S. Melittæ*, Kirby, measures about a line and a half in length, and is quite black, with brown legs. The wings are longer than the body. The larva is soft, almost cylindrical, and whitish. Its head is advanced, horny, heart-shaped, a little flattened, of a reddish colour, black posteriorly, and somewhat concave beneath. It lives in the bodies of *Andrenæ*, and when about to be transformed to a chrysalis or pupa (Plate CCXXXI. fig. 29), it fixes itself more outwardly, between the abdominal plates. It occurs in Britain and the continent of Europe. Additional species have been lately discovered by Mr Dale and others, and will be found described in the works of Messrs Curtis and Stephens.

In the genus *XENOS* established by Rossi,² and so excellently illustrated by Mr Kirby,³ the terminal branches of the antennæ are not articulated. The abdomen is corneous with the exception of the termination, which is fleshy and retractile. We are acquainted as yet with the detailed history of only two species. The first is the *Xenos*

vesparum, now called *X. Rossii*, in compliment to its discoverer. It inhabits, and is frequently found in, a European hymenopterous insect or wasp called *Vespa (Polistes) gallica*. The individuals of the latter kind infested by the *Xenos* are readily known by the unnatural swelling of the fourth segment of the abdomen, from which the insect in the perfect state is usually found to emerge. Sometimes one, not seldom two, and occasionally three, are seen to escape from the same wasp. They generally come forth in the winged state in August and September; and if during that period the pupa be extracted with a needle from the abdomen of the wasp, the covering broken open, and the white tunic carefully stripped away, living specimens may be obtained. The mode in which these parasites are originally placed on their living prey is not yet known. It is possible that the egg may be laid in the larva of the wasp before its cell is closed. Rossi at least seems to be of this opinion, although Mr Kirby, reasoning from analogy, thinks it unlikely that it should be deposited on the wasp in its first state, while the larva feeds on it in its last. It has been a subject of wonder to naturalists that these *Vespæ*, after supporting one or more parasites, should survive; yet we know that they are often met with in a most active and vigorous condition, with only the exuviae of the *Xenos* remaining in them. It has been stated as an explanation of this, that the time during which the insect remains in the larva state is very short; and as it does not attack the thorax of the wasp, the muscular energy and general vital powers of the latter thus escape destruction. The other species to which we alluded is the *X. Peckii* (Plate CCXXXI. figs. 30 and 31), so named after an American naturalist, Professor Peck, by whom it was made known to Mr Kirby. This species measures one and a half lines in length. It is of a blackish-brown colour, the legs livid, the tarsi brown. The branches of the antennæ are subdiaphanous, and spotted with white. The larva inhabits a North American wasp called *Polistes fuscata*, of which it so distorts the abdomen that, according to Professor Peck, there is no difficulty in distinguishing the infested individuals even on the wing. "Taking them," he observes, "with the gauze forceps, bringing them into a close room, and permitting them to fly to the windows, I caught them again with a wine glass and a card, fed them with sugar, and thus preserved them till their parasites were disengaged. I had not the pleasure to see them emerge, but found them soon after." "In the feeding state the head of the larva is near the abdomen of the wasp, as I found by dissection. When the feeding state is passed, it is easy to conceive that it turns, and with its flattened head separates the membrane which connects the abdominal seuta, and protrudes itself a little way, accurately closing the aperture, which is but just large enough to admit it. All this time the wasp is active, and associates with its companions. When just protruded, the head of the larva is of a pale-brownish colour; by degrees it assumes a rounder form, and becomes almost black. The chrysalis state ensues; but I suspect that only the part exposed to the air, and that immediately under the pressure of the abdominal rings, becomes hard."⁴

We shall now pass from this limited order to one of much greater extent and more ancient constitution.

ORDER VIII.—DIPTERA.⁵

The numerous order of dipterous or two-winged insects, of which the common house-fly affords a familiar

¹ *Horræ. Ent.* p. 370.

² In his essay *On a new Order of Insects*, *Linn. Trans.* vol. xi. p. 36.

⁵ *ANTIATA*, Fabricius.

³ *Faun. Etrusc. Mant. Append.* p. 114.

⁴ *Linn. Trans.* vol. xi. p. 90.

Strepsiptera.

Diptera. example, is characterized by possessing a pair of veined and membranous wings, with two moveable bodies called balancers (*halteres*) placed a little behind them. The mouth consists of from two to six setaceous pieces of a scaly texture, and its parts are either enclosed in the upper groove of a probosciform sheath, terminated by two lips, or covered by one or two inarticulate laminae, which form the sheath.¹

Dipterous species, like all other hexapod insects, are composed of three principal portions. The head is more or less globular or hemispherical, often concave posteriorly, so as to fit better on the front of the thorax, and is susceptible of turning on itself, as on a pivot, from right to left, and *vice versa*. The greater part of its surface, especially in the males, is generally occupied by the eyes, which are often very beautiful, being composed of a vast number of facettes, lighted up as it were with a metallic splendour. When ocelli or stemmatic eyes exist in this order, they are always three in number, and placed upon the vertex. When the mouth (which is not adapted for chewing or bruising solid substances, but only for extracting and transmitting fluids) consists of six pieces, it then exhibits all the parts analogous to those of masticating insects. Of these parts a single superior portion represents the labrum, and a single inferior portion the ligula properly so called, of the coleopterous and orthopterous orders. The four other parts are disposed in pairs; the upper pair corresponding to the mandibles, the lower to the terminal portion of the maxillæ of the masticating orders. The basal portion of the maxillæ also exists, but it is always very short, and confounded with the fleshy mass, which serves as the base of the trunk, and precedes its first geniculation. Thus in the Muscides, for example, the sucker consists of only two setæ, and is yet accompanied by a pair of palpi, which, according to analogy, can only be those of the maxillæ. Seeing that the piece representing the labrum is inserted, with the other portions of the sucker, near the geniculation of the trunk, and at some distance from the anterior margin of the head,—and that, in other insects, the labrum is always fixed to that margin,—it becomes necessary that a portion of the base of the clypeus, or epistoma as it is now called, should be incorporated with the support of the sucker. We have just stated that the inferior portions of the maxillæ are likewise united with the supporting part, which, when not in action, is withdrawn into the oral cavity. It is not thus with the Lepidoptera and Hemiptera,—the corresponding portion of the maxillæ in these orders being fixed and immoveable, and the labrum always preserving its relative position. In some *Diptera* the sucker is composed of only four pieces, and then the *mandibular* setæ are wanting or imperceptible. Indeed in a great number we perceive only two pieces, and in that case it is the single pieces only (*impaires*), that is, the labrum and ligula, which are cognisable. The reduction in the number of these parts is, according to Latreille, a proof of the inferiority of the dipterous order, when compared with the generality of insects. The sucker in our present order performs the office of a lancet, by piercing the envelope of vegetable fluids, or the vessels which contain the juices of animals. These liquids, by pressure of the parts, are then forced to ascend the internal canal to the pharynx, situate at the inner base of the sucker. The lancets are often grooved or furrowed, by which they become more compactly enclosed, and act in common. The sheath or external part merely serves to maintain the lancet *in situ*, and seems to

represent the lower lip of the triturating orders. It is frequently bent upon itself, at an angle more or less acute, when the insect is using the sucker. This becomes obvious when we examine a gnat or mosquito in the act of pumping our blood. *Diptera*

The antennæ of the *Diptera* are usually inserted on the front, and are approximate at their base. In the family called *Nemocera* by Latreille (*Culex* and *Tipula*, Linn.), these organs resemble those of the nocturnal *Lepidoptera* in form and position, but in his other families they seldom consist of more than two or three articulations, the last of which is fusiform, or shaped like a lenticular or prismatic pallet, provided either with a little styliform appendage, or a thickish hair or seta, itself sometimes simple, sometimes pilose.

The thorax appears as if composed of only a single segment, the first, or prothorax, being very short, or sometimes evanescent, and the metathorax being also very short, and occupying only the posterior extremity, situate beneath the scutellum. The mesothorax, or intermediate portion, thus becomes the principal apparent segment. It bears on each side a pair of stigmata, of which, however, the anterior is frequently alone distinguishable.

The neururation of the veins of the wings is simple. These parts are usually horizontal. Meigen's figures of the wings (of which we have availed ourselves in the plates connected with this article) are extremely exact. He confines himself, however, chiefly to the antennæ in the formation of his generic characters, without having recourse to Jurine's method of employing the neururation of the organs of flight,—a method, indeed, the application of which in the dipterous tribes is attended with greater difficulties than among the hymenopterous order. It has, however, been used in relation to the *Diptera* by Fallen, and other systematic authors.

Above the true wings, and a little behind them, are two small moveable bodies, almost membranous or slightly corneous, usually pale in colour, nearly linear in the greater part of their extent, but with a knob or button-like mass at the extremity, capable of dilatation. These are the balancers or *halteres*, of the nature and supposed uses of which we have already spoken at sufficient length in our general introductory observations.²

Above the balancers we find two membranous or papyraceous pieces, usually white or yellowish, ciliated, united together by one of their sides, and having the form of two valves of a shell applied upon each other. These are the winglets, or *ailerons* of the French writers.³ Their size seems to be in an inverse proportion to the length of the balancers, which to a certain extent they cover and protect. One of them is attached to each of the corresponding wings, and participates in its movements,—but during flight the valves are held in separation, or nearly on the same plane.

The abdomen of dipterous insects is frequently attached to the thorax by a portion only of its transverse diameter. It is composed of from five to nine apparent segments, and in the females usually terminates in a point; in those, however, in which the segments are fewer, the terminal ones form a kind of ovipositor, presenting a succession of small tubes which slip into each other somewhat after the fashion of the different portions of a telescope. It results from this conformation that several of the hinder stigmata are by no means distinctly perceptible.

The legs are usually long and slender, and are terminated by five-articulate tarsi, with two hooks at the extre-

¹ See Plate CCXX. fig. 7, a, b, c, d,—and the detailed description given at page 69, note 4.

² See page 75, note 2.

³ We name them *wing-scales* in the ensuing portion of this treatise, from the German word *schuppschen*, used by Meigen.

iptera. mity, besides, in many instances, two or three small cushion-like expansions, either membranous or vesicular. It is by means of these last-mentioned parts, according to certain authors, that flies are enabled to creep up the smoothest perpendicular surfaces, or to walk on ceilings with their backs downwards.¹

Dr Derham had long ago observed that "diverse flies and other insects, besides their sharp-hook'd nails, have also skinny palms to their feet, to enable them to stick on glass and other smooth bodies, by means of the pressure of the atmosphere."² This opinion, very generally adopted by entomologists, derived additional weight from Sir Everard Home's papers on the subject, illustrated by drawings from the always admirable pen of Mr Bauer.³ The structure of the parts, however, has been variously described by different authors, and by some in such a manner as (supposing their descriptions accurate) to render the organs unfit for the uses supposed, or at least for the particular mode of action assigned by Derham and Home, and coincided in by Messrs Kirby and Spence.⁴ Thus Dr Hooke described the house-fly as having the soles of its feet beset underneath with small bristles or tenters, like the wire teeth of a card for working wool, and which he conceived to give them a strong hold upon any object having irregular or yielding surfaces. In regard to glass, which is neither yielding nor irregular, he imagined that it bore upon it a kind of smoky substance, penetrable by the points of the bristles.⁵ The want of accordance in these accounts lately induced Mr Blackwall to inspect the parts minutely under a good compound microscope, when he immediately became convinced that the function assigned by the writers we have first named was incompatible with the actual organization. "Minute hairs," he observes, "very closely set, and directed downwards, so completely cover the inferior surface of the expanded membranes, improperly denominated suckers, with which the terminal joint of the tarsi of flies is provided, that it cannot be brought into contact with the objects on which those insects move, by any muscular force they are capable of exerting. The production of a vacuum between each membrane and the plane of position is therefore clearly impracticable, unless the numerous hairs on the under side of these organs individually perform the office of suckers; and there does not appear to be any thing in their mechanism which in the slightest degree countenances such a hypothesis."⁶ Mr Blackwall then procured living specimens of the house-fly, *Musca domestica*, and of the large flesh-fly, *Musca vomitoria*, and enclosed them in clear jars and phials of transparent glass, the interior surface of which they traversed in every direction with the greatest facility, even walking upon it with their backs downward, while they remained in full vigour; but when enfeebled either by exposure to cold or by the fatigue of over exertion, the identical individuals ascended the sides of the same jars and phials with difficulty (falling from them frequently), and were altogether incapable of adhering in an inverted position. No sooner, however, were they recruited by repose or an increase of temperature, than they again repeated those extraordinary feats, to which custom makes us callous, with all their original dexterity. He likewise found, that flies which are unable to maintain an inverted position on highly polished bodies, will frequently adhere firmly, with their backs

downward, to glass defective in polish or slightly soiled. This and other facts plainly indicated that flies are not supported on the vertical sides of smooth bodies either by the pressure of the atmosphere or by the aid of a glutinous secretion (as conjectured by some authors), but by means strictly mechanical, as suggested by Dr Hooke. It has been found, in fact, that the house-fly, while it retains its vital powers unimpaired, can not only traverse the upright sides, but even the interior of the dome of an exhausted receiver; and that the cause of its relaxing its hold, and ultimately falling from the station it occupies, is a diminution of muscular force attributable to impeded respiration.⁷

In regard to the anatomical structure of the dipterous order, the following is the substance of the observations on the subject given by M. Marcel de Serres, in his admirable memoir *Sur le Vaisseau dorsal des Insectes*. The dorsal vessel (now regarded as the heart) is itself narrow, and its pulsations frequent. The respiratory system consists of vesicular tracheæ, communicating with each other by tubular tracheæ, and unfurnished with those cartilaginous hoops which we find in the Orthoptera. The nervous system is generally composed of a small cerebriiform ganglion with approximated lobes, from which proceed large optic nerves; two medullary cords of the ordinary kind (already described in our preceding general introduction) form from space to space about nine ganglia, of which three belong to the thorax and six to the abdomen. The intestinal tube presents, 1st, an œsophagus extending to the base of the abdomen; 2d, a rather elongated stomach, somewhat narrow, and furnished at its origin with a considerable number of hepatic vessels; 3d, a cylindrical duodenum, also accompanied by hepatic vessels, but of narrower dimensions; 4th, a short and muscular rectum.

All the Diptera dissected by M. Dufour were provided with salivary glands, a character which that accurate observer regards as being common to all insects furnished with a sucker. The structure, however, of those parts varies according to the genus.⁸ They no doubt serve to increase the fluidity of the nutritive juices absorbed by the sucker. We may add, that both Dufour and Dutrochet have observed that the stomach of many Diptera is accompanied by a kind of paunch, in which a portion of the aliments is deposited.

Many tribes of this extensive order, if not decidedly noxious, at least occasion us great annoyance, not only by sucking our own blood, but by laying their eggs on the bodies of our living domestic animals, and on whatever uncooked fleshy viands they can attain to, especially during sultry weather, when the process of corruption is the most speedy, and the insects themselves are in their prime of strength and vigour. On the other hand, they may be regarded as serviceable, on account of the rapid consumption, by their most gluttonous larvæ, of all animal and several vegetable substances in a state of putridity. Their term of life in the perfect state is but of short duration. A few months or even weeks elapse, and their merry course is run. Such as contrive to fight their way to the conclusion of the ambiguous autumn, perish on the first approach of frost. A few half-benumbed house-flies indeed are generally seen in our apartments till Christmas time; and the delusive gleam of a sunny winter day not

Diptera.

¹ *Phil. Trans.* 1816. An analogous structure, according to Sir Everard Home, enables the walrus to ascend the inclined plane of a slippery iceberg.

² *Physico-Theology*, p. 363, note 6.

³ *Phil. Trans.* for 1816.

⁴ *Introduc. to Ent.* vol. ii. letter xxiii.

⁵ *Recherches Anatomiques sur l'Hippobosque des Chevaux, Annales des Sciences Nat.* vi. 301.

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⁶ *Micrographia*, p. 170.

⁷ *On the Pulvilli of Insects, Linn. Trans.* vol. xvi. part iii. p. 488.

⁸ *Ibid.* p. 490.

Diptera. seldom re-animates their feeble forms so far as to produce a dubious buzz about our windows; but such as show themselves in open places are speedily snapped up by red-breasts and other feathered epicures, greedy of insect food at that unaccustomed season; and it is probable that few survive till spring. As their eggs, however, are generally deposited in a putrescent nidus, adapted to the propensities of the incipient young; and as that nidus is not of a nature to remain for a length of time unconsumed, it may be fairly inferred that our summer swarms are produced originally from a few individuals, which in some snug corner have survived the most inclement season of the year, and are not the result (as happens in the case of many lepidopterous kinds) of eggs which have been laid during the preceding autumn. It is possible that such as assume the pupa state towards the close of summer under ground, may rest secure in that condition, till called into their winged existence by the returning warmth of the enlivening spring.

All these insects undergo a complete metamorphosis, and are remarkable in this, that the larvæ do not change their skins except at the period of their passing into the nympha state. Some form a kind of cocoon; but others remain uncovered, and can scarcely be even said to change their skin, which seems to harden over them, so as to form an egg-like case for the enclosed pupa. Dipterous larvæ are apodal or without feet, although some which belong to the family Nemocera of Lat. are provided with appendages which serve the same purpose. The head is sometimes projected and constant in its form, sometimes variable in figure, capable of being withdrawn into the body, and undistinguishable from the other segments except by its anterior position, and the existence of the parts of the mouth. This soft and changeable form of the head is, we conceive, peculiar to the larvæ of the present order. It is generally furnished with one or two retractile hooks, and some nipple-like projections. The principal orifices of respiration are almost always placed at the posterior extremity; and in many species there is also a pair of stigmatic openings on the segment next the head. Such as dwell in water, or inhabit corrupt and fluid matters, have their bodies terminated posteriorly by a tail-like prolongation, susceptible of being lengthened or withdrawn according to circumstances, and ending in a radiated expansion, which communicates with internal tracheæ. There are few pieces of natural mechanism so ingenious and admirable as the respiratory systems of the rat-tailed worm, and of the larvæ of gnats and other aquatic Diptera.

We have already alluded to the peculiar transformation of these insects. The skin of the larva seems to harden over and enclose the nymph. The body of the contained insect first detaches itself to a certain extent from the outer skin, leaving on its inner surface the exuviae of its external organs. In its early state it presents only a soft or gelatinous mass, without distinct characters; but after a time the parts of the perfect insect begin to be developed, and it finally escapes from its prison by butting with its head against the upper part of the case, which ere long opens as it were upon a hinge, like the lid of a cylindrical snuff-box.

The general characteristics of this order are obvious to the eye of an ordinary observer, and are designated in the works even of the most ancient naturalists. Yet Fabricius, by placing with the Diptera certain Arachnides,

and the parasitical species of the genus *Pediculus*, falsified the essential nature of the order. It cannot be denied, however, that here, as in all other great natural groups, there are anomalous or aberrant genera, which depart in a great measure from the ordinary conditions of their kind. Thus, among the pupiparous tribes, the wings, the balancers, and the usual sheath of the sucker, show a tendency to disappear in many species; and in *Nycteribia* and *Melophagus* the organs of flight are entirely wanting.¹

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DIVISION I.—PROBOSCIDEÆ.

The apex of the proboscis with a fleshy labium, and the haustellum covered by a horny labrum; before these are placed two jointed palpi.

A. The antennæ consisting of many joints.

FAMILY I.—TIPULARIÆ.

Antennæ extended forwards, consisting of six or more distinct joints. Palpi standing out, jointed. Halteres naked. Abdomen with seven or eight segments.

a. Culiciformes.

Eyes lunate: ocelli wanting: antennæ of the males plumose, of the females pubescent: mouth not elongate: palpi five-jointed: thorax without a cross suture: abdomen consisting of eight segments.

*

Proboscis extending forwards, longer than the antennæ; palpi straight; wings with the nervures and margin covered with scales.

GENUS *CULEX*, Linn. Antennæ porrect, or extending forwards, filiform, fourteen-jointed; plumose in the male, pilose in the female; palpi porrect, five-jointed, longer than the proboscis in the male, very short in the female; proboscis porrect, the length of the thorax: wings scaly, incumbent. Meig. Zw. pl. i. fig. 1-10.

The species of this and of some nearly allied genera are extremely troublesome towards evening, especially in the neighbourhood of moist or marshy places. They are greedy of blood, and under the well-known names of Gnats, Mosquitoes, &c. they persecute man and beast, not only sucking our "life-stream," but instilling a poison which, though feeble from its minute quantity, yet often produces pain and inflammation. Although abundant in Italy and all the warmer countries of the earth, they are nowhere more troublesome than amid the barren wastes of Lapland. They feed also on vegetable juices. The female deposits her eggs in the water to the amount of several hundreds, and the larvæ are consequently very frequent in all stagnant pools in spring and summer, where they may be seen when undisturbed, suspended from the surface, with their heads downwards. At this time they breathe by the caudal extremity; but in the nympha state, during which they are still aquatic, the respiratory organs are placed upon the thorax. On assuming the perfect state, the light exuviae of the nymph serve as a support, by means of which the imago sustains itself for a time on the surface of the waters. The whole of these transformations are passed through in the course of three or four weeks. It is said that the females alone annoy us as blood-suckers. Their

¹ The principal works on this order are, Fallen's *Diptera Suecica*, 4to, 1814-17; Meigen's *Systematische beschreibung der bekannten Europäischen Zweiflügeligen Insecten*, 8vo, 1818-1830 (by this work we are guided in the ensuing portion of our article); Wiedeman's *Diptera Exotica*, 8vo, 1821; and Macquart's *Insectes Diptères du Nord de la France*, 8vo, 1826-9, published in the *Mém. de la Soc. Royale*, &c. de Lille.

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shrill nocturnal pipe, the prelude to a closer contact, is particularly distressing in many continental countries, especially to an inexperienced traveller, unprovided with a *cousinière* or mosquito curtain. The Laplanders defend themselves by means of smoke and grease.

C. pipiens. Palpi and antennæ dark brown: thorax rufous, nearly rust colour, with two brown longitudinal lines: abdomen ringed with whitish grey and dark brown: halteres whitish: wings unspotted: legs pale brownish, the base of the thighs yellowish; the apex of the tibiæ with a small spot of changeable white. Length three lines. Fab. Linn. Réaumur. Wood's *Illus. of Linn. Genera of Insects*, pl. xcvi. Common in almost all countries.

GENUS ANOPHELES, Meigen. Antennæ porrect, filiform, fourteen-jointed; plumose in the male, pilose in the female: palpi porrect, five-jointed, the length of the proboscis: proboscis porrect, the length of the thorax: wings scaly, incumbent. Meig. *Zw.* i. 10, pl. i. f. 11-17; Curtis, *Brit. Ent.* v. pl. ccx.

A. bifurcatus. Plume of the antennæ brownish grey in the males: the two terminal joints of the palpi forming a flat club; circle round the eyes white: thorax ash grey, with a dark-brown line on the sides, and three others down the middle: abdomen grey, ringed with brown: legs brown, the thighs yellowish: halteres dirty white; wings unspotted. The colour of the female is yellowish brown. Three and a half lines. Curtis, *l. c.* *Culex bifurcatus*, Linn. According to Linnæus, the larva, like those of the preceding genus, reside in the water, and the perfect insect does not bite. Only one other species is described by Meigen, which is distinguished by having five dusky spots on each wing. Two others are described in the third volume of the *Zoological Journal*.

GENUS ÆDES, Hoffm. Antennæ porrect, filiform, fourteen-jointed; plumose in the male, pilose in the female: proboscis porrect, as long as the thorax: palpi very short: wings scaly, incumbent. Meig. *Zw.* i. 13.

Æ. cinereus. Greyish brown: thorax reddish, pubescent: wings unspotted: thighs rather paler than the other parts of the leg: palpi very short, in other respects not differing much from *Culex*. Two to two and a half lines. Apparently a rare and imperfectly known insect.

* *

Proboscis shorter than the antennæ; palpi incurved.

GENUS CORETHRA, Meig. Named from the Greek word *κόρηθρον*, a brush, with reference to the appearance of the antennæ. Antennæ porrect, filiform, fourteen-jointed; verticillately plumose in the male, pilose in the female: palpi standing out, incurved, four-jointed, the first joint shortest: wings incumbent, the nervures villose, and the hinder margin ciliated with scales. Meig. *Zw.* i. 14, pl. i. f. 18-23.

C. pallida. Whitish: plume of the antennæ brown; eyes black: thorax with three pale-brown abbreviated lines: thighs and tibiæ white, spotted with black; the joints of the tarsi somewhat brownish: wings hyaline, with an obsolete brownish shade over the middle. Male two and a half, female two lines. Meig. *Zw.* vol. i. pl. i. fig. 23, female. Found on the continent of Europe. *C. plumicornis* and *culiciformis* inhabit Britain, and have been described, with their usual felicity, by Réaumur and Degeer. Their larvæ differ from those of *Culex* in their usually horizontal posture. That of *C. plumicornis* is remarkable for its translucent texture, which renders it almost invisible. It was hence called *Tipula cristallina* by Degeer.

GENUS CHIRONOMUS, Meig. (Plate CCXXXVIII. fig. 1). Antennæ porrect, filiform, in the male plumose, thirteen-jointed; the terminal joint very long (ibid. fig. 1, a); in the female six-jointed, pilose; palpi standing out, incurv-

ed, four-jointed; wings lanceolate, deflexed. Meig. *Zw.* i. 18, pl. ii. f. 1-7.

C. elegans. Head light yellow; plume of the male antennæ brown; female antennæ pale yellow, the terminal joint brown; thorax hood-shaped in front, elongate, sulphur-yellow, with fulvous vittæ, and having three black spots on each side in the form of a triangle, towards the base of the wings; abdomen sulphur-yellow; legs fulvous, thick, with black joints and a ring of the same colour in the centre of the middle and hinder tibiæ; anterior tarsi not clongate; wings white, with three black points not far from the hinder margin, one towards the middle, and two others near each other, towards the apex. Three to three and a half lines. Meig. *Zw.* vol. i. pl. ii. f. 7, female. This rare species, represented by the figures last referred to, has been taken lately at Raehills in Dumfriesshire. We believe it to have been previously unknown in Britain. The genus is very extensive, comprehending little short of a hundred species, the greater portion of which inhabit Britain. The little pink-coloured tortuous worm, frequent in water-barrels, is the larva of *Chironomus plumosus*.

GENUS TANYPUS, Meig.; named from *ταῦνον*, to stretch out, and *πῶς*, the foot. Antennæ porrect, filiform, fourteen-jointed; in the male plumose, with the twelve lowest joints globose, the thirteenth very long, the terminal short and acute; in the female pilose, all the joints globose, the terminal thickest; palpi standing out, incurved, four-jointed, the basal joint shortest; ocelli wanting; wings lanceolate, deflexed, pilose. Meig. *Zw.* i. 55, pl. ii. f. 8-12.

T. varius. Male. Antennæ and palpi brown; head and thorax grey, the lines on the latter dark brown, with a grey play of colour in the middle; abdomen yellowish, banded with brown, and having a blackish line on the back; legs brownish yellow, the knee and apex of the tibiæ brown; halteres white; wings with an oblique grey cloud before the apex, having two dark-brown spots in it near the anterior border, and three smaller dark spots at the hinder margin; there is a grey spot at the apex of the wing, and near the middle a rather broad band, in the anterior part of which are placed three blackish spots, two behind each other, and the third, which is smaller, beneath, forming a triangle. The female is of a yellower hue than the male, and the marks on the back, as well as the bands on the abdomen, are paler; the wings are marked in a similar manner. Male three to three and a half, female two to two and a half lines. Meig. *Zw.* i. pl. ii. fig. 12, male. Frequents banks and hedges, but is not common. It occurs near London, and in some other parts of England.

The *Tipula maculata*, of which the history is given by Degeer, belongs to this genus. Twelve species are described by Benoit Frederick Fries, in his *Monograph of the Swedish Tanypids*. His work is enriched by some new historical details. Above twenty species occur in Britain.

GENUS CERATOPOGON, Meig. The generic name is derived from *κεράς*, a horn, and *πῶς*, a beard. Antennæ porrect, filiform, thirteen-jointed, the eight lowest joints globose (bearded externally in the male), the following cylindrical, elongate; palpi porrect, incurved, four-jointed, the joints unequal; ocelli wanting; wings parallel, incumbent. Meig. *Zw.* i. 68, pl. ii. f. 13-18.

The larvæ of these insects differ from those of most of their congeners in not being aquatic. They inhabit vegetable galls. The species are numerous, and of small dimensions. Meigen describes forty-five different kinds, of which about one half have been detected in Britain.

C. bipunctatus. Black; the antennæ, including the brush of the males, dark brown; thorax clothed with fine yellow pubescence; halteres white; wings thickly covered

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with grey pubescence, and having a whitish spot in the middle of the anterior margin; legs pitch-brown; tibiæ with long hairs externally; pubescence of the tarsi white. One line. *Tipula bipunctata*, Linn.; *Forcipomyia pictipennis*, Megerle; *Labidomyia bipunctata*, Stephens. Inhabits England and various parts of the continent.

GENUS MACROPEZA, Meig. So named from *μακρος*, long, and *πεζα*, the foot, the hinder legs being remarkable for their length. Antennæ porrect, filiform, fourteen-jointed; the joints cylindric, the five last longest: wings lanceolate, elongate; hinder legs very long. Meig. *Zw. i.* 87, pl. iii. f. 1, 2.

M. albitarsis. Head black, with a broad forehead without ocelli; thorax cinereous, with three narrow black lines, the central one widest; sides of the thorax and shoulders black; scutellum cinereous; abdomen black; halteres white; wings hyaline, with pale-brown nervures; legs black, the tarsi whitish; the hinder legs uncommonly long, particularly the tarsi, which are as long as the thighs and tibiæ united. Length one and a third. Length of the wing two and two thirds, of the hinder legs four lines. Pl. iii. f. 1, female. The female only of this singular insect appears to be known: it has not occurred in Britain.

b. Gallicolæ.

Eyes lunate: antennæ with hairs disposed in whirled; palpi incurved; wings pubescent, obtuse, with two or three longitudinal nervures; tibiæ without spurs at the end.

GENUS LASIOPTERA, Meig. The name is from *λασιος*, hirsute, and *πτερά*, wings. Antennæ porrect, filiform, consisting of many joints, which are globose and hairy; ocelli wanting: wings incumbent, villose, with two nervures. Meig. *Zw. i.* 88, pl. iii. f. 3-5.

L. picta. Female. Antennæ black, shorter than the thorax, cylindrical, twenty-four jointed; the joints nearly globose and pubescent: thorax black; abdomen black, margined with white, and having two triangular white spots on each segment: thighs yellow; tibiæ and tarsal joints white, with the apex black: halteres white: wings ash-grey, having a narrow black edge anteriorly, in which there is a white spot. One line. Meig. *Zw. i.* pl. iii. fig. 3, female. *Diomyza Juniperi*, Megerle.

Occurs on the continent of Europe, but is rare.

GENUS CECIDOMYIA, Latreille. Antennæ projecting, moniliform, many jointed, the joints remote from each other: ocelli wanting; first joint of the tarsi very short: wings incumbent, villose, with three nervures. Meig. *Zw. i.* 93, pl. iii. fig. 8-12.

C. palustris. Thorax pale, with three broad black vittæ: abdomen flesh-red; the halteres white. *Tipula palustris*, Fab. Linn. Not unfrequent in Britain and elsewhere. We have nearly thirty indigenous species, among which *C. tritici*, commonly called the *wheat-fly*, is an object of great interest to the agriculturist.¹

GENUS CAMPYLOMYZA, Wied. Antennæ projecting, cylindrical, fourteen-jointed, the two radical joints thickened: ocelli three: wings pilose, with three nervures. Meig. *Zw. i.* pl. iii. fig. 6-7.

C. bicolor. Female. Antennæ dark brown: head and thorax black, somewhat shining: abdomen dark brown, with pale incisures: halteres white: legs testaceous: wings hyaline. Half a line in length.

Found in April and May in hedges, not common.

c. Noctuæformes.

Eyes lunate: ocelli wanting: antennæ moniliform, with a seta at the base: wings broad, villose, with numerous

longitudinal nervures, but without cross nerves: tibiæ without spurs.

GENUS PSYCHODA, Lat. (Plate CCXXXVIII. figs. 2 and 2 a). Antennæ projecting, moniliform, pilose, many jointed, the two radical joints thick, the remainder globose, and remote from each other: palpi standing out, four jointed, the joints equal: ocelli wanting: wings broad, lanceolate, villose, without transverse nerves. Meig. *Zw. i.* pl. iii. fig. 13-18.

P. palustris. Head, thorax, and abdomen covered with white wool-like hairs: wings black at the apex, the centre with a dark-brown band, which forms an acute angle in the middle, the base shaded with brown; fringe dark brown, white at the apex of the wing: halteres dark brown: legs white; apex of the tibiæ and the two last tarsal joints black. Two lines. Meig. *Zw. i.* pl. iii. fig. 18. Found in Britain occasionally, along with above a dozen other species. We know little of the habits or metamorphoses of these insects. They occur in moist and impure, as well as in marshy places.

d. Rostratæ.

Eyes somewhat rounded, separated on the forehead; ocelli wanting: head elongated into a rostrum anteriorly: palpi incurved: thorax with an arched suture across the middle: abdomen eight-ringed: tibiæ more or less spurred.

GENUS ERIOPTERA, Meig. From *εριος*, wool, and *πτερά*, wings. Antennæ projecting, setiform, sixteen-jointed, the first joint cylindrical, second cup-shaped, the following ovate: ocelli wanting: palpi standing out, incurved, cylindrical, four-jointed, the joints equal: intermediate legs shorter than the others: wings incumbent, parallel, the nervures villose.

E. maculata. Dirty yellow, as well as the antennæ and legs: thighs brown at the apex, and having a brown ring in the middle: palpi brown; the abdomen with a brown line along the back: wings with pale nerves and ferruginous ocellated spots, which are partly single and partly form a macular band. Two and a half lines. Inhabits Britain and the continent of Europe. We have about thirty ascertained indigenous species.²

GENUS LIMNOBIA, Meig. From *λιμνη*, a marsh, and *βίωω*, I live. Antennæ projecting, setiform, the joints from fifteen to seventeen, the radical joint cylindrical, second cup-shaped, the remainder oblong or globose: palpi standing out, incurved, cylindrical, four-jointed, the joints equal: ocelli wanting: wings generally incumbent and parallel, the nervures naked. Meig. *Zw. i.* pl. iv. v. vi.

L. rivosæ. Antennæ as long as the head, setiform, reddish brown; palpi of a similar colour: head grey; the forehead with a small protuberance behind the antennæ: thorax light grey, with reddish-brown vittæ; scutellum yellowish; metathorax bright grey: abdomen light grey inclining to red, with a reddish-brown line on the back, which is waved on the sides, and has a grey play of colour in the middle: legs rather thick, testaceous, the thighs darker: halteres yellow: wings clear hyaline, having a testaceous streak along the anterior margin; not far from the base another streak leaves the marginal one and runs along the third longitudinal nerve, and from this a third runs along the cross nerves, forming an obtuse angle; the anterior streak has a semicircular projection near the middle, and just behind the base there is a transparent marginal streak with a black spot. From twelve to thirteen lines. *Tipula rivosæ*, Linn.; *Tipula triangularis*, Degeer; *Pedicia rivosæ*, Lat.

Rare on the continent. In Scotland we lately observ-

¹ See Linn. *Trans.* iv. 230, and v. 106.

² The genus is named *Eriopteryx* by Mr Stephens—a commendable change, in as much as it avoids a termination characteristic of the ordinal rather than the generic groups of Entomology.

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ed it in considerable numbers in several of the northern counties, frequenting marshy glades by the sides of rivers. It likewise occurs in the vicinity of Edinburgh. The genus *Limnobia* is rather extensive, containing upwards of sixty European species, the greater proportion of which are indigenous to Britain. Degeer has published some curious details regarding the manners and metamorphoses of *L. replicata*.¹

GENUS RHIPIDIA, Meig. Antennæ projecting, fourteen-jointed, the radical joint cylindrical, second and third cup-shaped, the following globose, remote, pectinated on two sides in the male: palpi standing out, incurved, cylindrical, four-jointed, the joints nearly equal: ocelli wanting: wings incumbent, parallel. Meig. *Zw. i. pl. v. fig. 9-11*.

R. maculata. Forehead light grey; palpi and antennæ brown, the latter twice the length of the head: thorax bright grey, with a brown vitta, which has an indistinct brown line close to it on each side behind: abdomen dark brown: halteres pale yellow: legs long, thin, brownish yellow; the apex of the thighs, the tibiæ, and the tarsi, brown: wings hyaline, the surface sprinkled with pale brown spots, some of which at the anterior border are larger and darker, and the cross nerve is margined with brown. Three lines. Meig. *Zw. i. pl. v. fig. 11, male*. Inhabits England, Germany, &c.

GENUS CTENOPHORA, Meig. Antennæ projecting, thirteen-jointed, the radical joint cylindrical, second globose, third oblong, the following pectinated in the male, in the female simple, globose or ovate: palpi standing out, incurved, cylindrical, four-jointed, the terminal joint elongate: ocelli wanting: wings spreading, shining.

C. bimaculata. Head black: palpi rufous beneath, brown above: antennæ dark brown, the joints globular in the female: thorax and abdomen black; the latter in the female marbled on the sides and belly with rufous, which sometimes runs into orange-yellow, spots; the abdomen of both sexes has a greyish transverse spot at the base: halteres and legs rufous; the apex of the thighs, the tibiæ, and the tarsi dark brown: wings hyaline, the anterior margin yellow, having a dark-brown band, extending half way across, and the apex of the same colour. Male six, female from seven to eight lines. *Tipula bimaculata*, Linn. Found in Britain, with six other species belonging to the same genus.

GENUS TIPULA, Linn. (Plate CCXXXVIII. figs. 3 and 3 a.) Antennæ projecting, thirteen-jointed, the radical joint cylindrical, second cup-shaped, the following cylindrical and pilose: palpi standing out, incurved, cylindrical, four-jointed,² the terminal joint elongate: ocelli wanting: wings lanceolate, spreading.

T. oleracea. Palpi and antennæ dark brown, the two lowest joints of the latter yellowish grey; forehead bright grey, with a reddish-brown line; the snout yellowish brown: thorax bright grey, having a testaceous dorsal line bounded with dusky; metathorax whitish grey: abdomen testaceous, with a dusky line on the back, which is scarcely perceptible; thighs and tibiæ testaceous, the apex and the tarsi dark brown: halteres brown: wings pale brown, the anterior margin bordered with testaceous, but not to the apex; behind this border there is a whitish streak. Eleven lines. Linn. Fab. Degeer, Lat. This species is common in meadows. It is known in England by the title of *Harry Long-legs*, and is called *Jenny Nettles* in Scotland. The genus *Tipula*, considered in relation to Europe, contains forty-four species, several of which are large

and conspicuous insects, and many of them are very plentiful. *T. crocata*, of a deep velvet black with yellow bands, is a very ornamental species. We have taken it near Edinburgh.

GENUS NEPHROTOMA, Meig. Antennæ projecting, in the male nineteen-jointed, with the first and third joints cylindrical, second cup-shaped, the following excised; in the female fifteen-jointed, the first and third joints cylindrical, second cup-shaped, the following somewhat cylindrical, thickened at the base: palpi standing out, incurved, four jointed, the terminal joints elongate: ocelli wanting: wings lanceolate, spreading. Meig. *i. pl. v. f. 19-22*.

N. dorsalis. Antennæ with the first and second joints ferruginous, the rest black: ground-colour reddish yellow; the forehead with a black vitta: thorax with three shining black lines; the sides of the breast unspotted: scutellum with a black spot; metathorax marked with a black line, and the hinder margin of the same colour: abdomen with a black dorsal line, and a longitudinal line of the same colour on the sides and belly: thighs and tibiæ ferruginous, the apex brown: tarsi dark brown: halteres yellow: wings nearly hyaline, slightly clouded with brownish yellow, the stigma dark brown: the apex of the wing is likewise brownish. Male five and a half, female seven lines. Found in hedges during summer, but is not common. It has occurred in the vicinity of London.

GENUS PTYCHOPTERA, Meig. Antennæ projecting, sixteen-jointed, the radical joint short and cylindrical, second cup-shaped, third long and cylindrical, the following oblong: palpi standing out, incurved, elongate, four-jointed, the first joint shortest, second and third long, and of equal length, the fourth very long, setaceous: ocelli wanting: wings spreading, plicate at the hinder margin.

P. contaminata. The prevailing colour is shining black: palpi ferruginous: antennæ dark brown: the sides of the breast silky grey: scutellum testaceous: abdomen of the male with two ferruginous bands, that of the female with two ferruginous spots on both sides: legs rufous: the apex of the thighs, the tibiæ, and the tarsi, dark brown: halteres rufous, the knob brownish at the tip: wings nearly hyaline; near the middle of the anterior border is a dark-brown abbreviated band; between this and the apex there is a brown marginal spot, and two or three others at the anterior margin. Male three and a half, female five lines. *Tipula contaminata*, Linn. Fab. Lat. Not rare during summer in Britain and other parts of Europe.

GENUS NEMATOCERA, Meig. Antennæ projecting, filiform, six-jointed, the radical joints cylindric, second cup-shaped, the following cylindrical, equal: ocelli wanting: palpi standing out, incurved, four-jointed, the joints equal.

N. bicolor. Head ash-grey; forehead wide, brighter at the eyes: thorax bright grey, with three dark lines on the back, that next the side short: abdomen flat, dark brown: legs of the same colour, the base of the thighs, and likewise the halteres, yellow: wings rather dull, without a stigma. Five lines. Meig. *Zw. i. pl. vi. fig. 1*.

Seemingly rare: we are unacquainted with its native country. The specimens from which Meigen took his description were preserved in the collection of M. Baumbauer.

GENUS ANISOMERA, Hoff. Antennæ projecting, setaceous, six-jointed, the radical joint cylindrical, second cup-shaped, third very long: ocelli wanting.

A. obscura. Antennæ brown: the prevailing colour of the body brownish grey; thorax with three wide dark

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¹ *Memoires*, t. vi. plate 20.

² Latreille says, "de cinq articles,"—but he counts the radical tubercle, which does not seem to have been regarded in Meigen's enumeration.

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lines: along the abdomen of the males, which is nearly hoary, runs a narrow vitta, and on the under side of the first segment there is a broad yellow spot, and a smaller one on the second; wings brownish yellow, especially at the cross nerves; legs yellowish brown; the apex of the thighs dark; the anterior thighs thicker and shorter than the others. Four lines. Meig. *Zw. i. pl. vii. fig. 5, male*. Found in Germany, Portugal, and England. In the latter country another species has occurred, which has been named *A. lucidipennis*.

GENUS TRICHOCERA, Meig.; from *τριχ*, hair, and *κερας*, a horn. Antennæ projecting, setiform, the two lower joints thickened, the remainder oblong and pubescent; palpi standing out, incurved, cylindrical, five-jointed, the joints nearly equal: wings incumbent.

T. hiemalis. Palpi, antennæ, and legs, dark brown: head grey: thorax greyish, with four distinct brown vittæ, the hinder part unspotted: abdomen wholly dark brown passing into grey; the caudal process in the female shining black: halteres pale yellow, with a brown knob: wings pale grey or somewhat brownish, unspotted. Two and a half lines. *Limonia hiemalis*, Lat. Abundant in October and November, and usually found throughout the winter. Another British species, *T. regelationis*, is also often seen on walls and houses, even during that inclement season.

e. Fungicolæ.

Eyes round or oblong, separated on the forehead: ocelli unequal, sometimes wanting. Palpi incurved, four-jointed: thorax without a cross suture: abdomen seven-ringed: coxæ long: tibiæ spurred.

*

Antennæ setiform, with indistinct joints, the two lower ones thickened.

GENUS DIXA, Meig. Antennæ projecting, setiform, the two lowest joints thickened, the rest pubescent: palpi standing out, incurved, cylindrical, four-jointed, the first joint very short: ocelli wanting: wings incumbent, parallel.

D. aprilina. Palpi and antennæ dark brown: head brownish yellow, with a large blackish heart-shaped spot on the forehead: thorax light yellow, passing into brown, and marked with three dark lines: abdomen dark brown: halteres yellowish, with a brown knob: legs brownish yellow; apex of the thighs, of the tibiæ, and the tarsi, dark brown: wings hyaline, somewhat whitish, with brown nerves. Two lines. Meig. *Zw. i. pl. vii. fig. 12, male*. Found on the continent and in Britain. Meigen describes four species, two of which occur in this country, which also produces a third, named *D. variegata* by Mr Stephens.

GENUS BOLITOPHILA, Hoff. Antennæ long, setiform, projecting forwards, the two radical joints thick: ocelli three, placed on the forehead in a transverse line: wings incumbent, parallel, obtuse.

B. fusca. Head yellowish, with dark-brown antennæ: thorax yellowish, with three brownish lines on the back: abdomen, halteres, and legs, dark brown; basal half of the thighs yellow, which gradually passes into brown: wings somewhat greyish, with a brown spot at the stigma. Two to two and a half lines. English examples of this species are preserved in the British Museum. According to Mr Curtis, two other kinds inhabit Britain, viz. *B. maculipennis* and *B. cinerea*; the former of these does not appear to be known to continental naturalists. M. Guérin has published a complete and detailed history of a species of this genus, of which the larva lives in mushrooms.¹

GENUS MACROCERA, Meig.; named from *μακρος*, large,

and *κερας*, a horn—the antennæ being of unusual length. Antennæ projecting, setiform, long, the two radical joints thick: ocelli three, placed on the forehead in the form of a triangle: wings obtuse, incumbent, parallel.

M. lutea. Of a uniform ochre-yellow: antennæ above twice the length of the body, brown, yellow at the base: abdomen inclining to brown behind: legs yellow, with brown tarsi. Three lines. This species occurs in the south of England, and eight others are recorded as indigenous to Britain.

**

Antennæ compressed, sixteen-jointed.

GENUS SYNAPHIA, Meig. Antennæ projecting, cylindrical, sixteen-jointed? the two lowest joints distinct: eyes rounded: ocelli three, unequal, placed in a line on the forehead: tibiæ unarmed on the sides.

S. fasciata. Head and antennæ black: palpi ferruginous: thorax pubescent, shining black; scutellum of a similar colour, small: first four joints of the abdomen shining red, with a black band across their hinder margin, the remainder black: thighs and tibiæ ferruginous, tarsi brown: wings hyaline, the central longitudinal nerve forming an oblong cell behind the cross nerve. One and a half line. Inhabits Germany, but is rare.

GENUS MYCETOBIA, Meig. Antennæ projecting, cylindrical, sixteen-jointed, the two radical joints distinct: eyes kidney-shaped: ocelli three, unequal, approximating, placed on the forehead in the form of a triangle: tibiæ unarmed on the sides.

M. pullipes. Black: palpi yellow: antennæ brown, nearly cylindrical, and about the length of the thorax; the latter somewhat pubescent: abdomen rather depressed: halteres and legs bright yellow, the tarsi passing into brown at the apex: wings large, rounded at the apex: and having brownish-black nervures. One and a half line. Occurs in the vicinity of London, and in some other parts of Britain.

GENUS PLATYURA, Meig. Name derived from *πλατυς*, broad, and *ουρα*, the tail. Antennæ projecting, compressed, sixteen-jointed, the two radical joints distinct: eyes rounded: ocelli three, approximating, unequal, placed on the forehead in the form of a triangle: tibiæ unarmed on the sides: abdomen depressed behind.

P. semirufa. Head, antennæ, and thorax black; the latter with a narrow arched line of white anteriorly: abdomen yellowish red, passing into brown, the two first segments black: halteres and legs rufous, the tarsi brown: wings nearly hyaline, without spots or bands. Three lines. Found near London, Edinburgh, and in the border counties of Scotland. Thirteen other species are natives of Britain.

GENUS GNORISTE, Hoff. Antennæ projecting, cylindrical, sixteen-jointed, the two radical joints thick and short: proboscis elongate, bearing the palpi at the apex: ocelli three, unequal, placed on the forehead in the form of a triangle: tibiæ spurred at the apex, the sides spinose.

G. apicalis. Head black; antennæ dark brown: proboscis twice the length of the head; the palpi, which are inserted near the apex, small and ferruginous: thorax black, impressed with two deep longitudinal lines, which become obsolete behind the middle: abdomen dark brown, pubescent: halteres yellow: coxæ elongate, the anterior pair ferruginous, the others black: thighs and tibiæ yellow, the tarsi dark brown: wings somewhat clouded, the apex brown. Five lines. Has been found in Prussia, but is rare.

GENUS SCIOPHILA, Hoff. Antennæ projecting, some-

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¹ *Annales des Sciences Nat. t. x.*

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what compressed, sixteen-jointed, the two radical joints distinct: ocelli three, unequal, approximating, placed on the forehead in the form of a triangle: tibiæ with spurs at the apex, and spines on the sides: wings with the intermediate cell small and nearly quadrate.

S. fimbriata. Ferruginous; antennæ brown, yellow at the base; anterior part of the head yellow, the forehead brown: thighs ferruginous, tibiæ and tarsi brown: abdomen pubescent, the segments margined behind with black, the hinder extremity likewise black: wings unspotted, hyaline. One two-thirds. This insect, and seven other species of the genus, occur in Britain.

GENUS LEIA, Meig.; named from λείος, *smooth*. Antennæ projecting, compressed, sixteen-jointed, the two radical joints distinct: eyes oblong: ocelli three, unequal: tibiæ with spurs at the apex, the hinder ones spinous on the sides.

L. flavicornis. Ochraceous, as well as the antennæ: ocelli remote: thorax and abdomen somewhat shining: tarsi brown: wings slightly yellowish, with a narrow, somewhat arched, cross band of brown before the apex, slightly increasing in width at the anterior border; and towards the hinder margin of the wing there is a small pale-brown spot placed at the hindermost longitudinal nerve. Two lines. Meig. *Zw. i. pl. ix. fig. 11, female*. Inhabits Britain, with four others of the ten described by Meigen as occurring in Europe.

GENUS MYCETOPHILA, Meig. Antennæ projecting, compressed, sixteen-jointed, the two radical joints distinct: eyes oblong: ocelli indistinct: tibiæ with spurs at the apex, the hinder ones with spines on the sides.

M. lineola. Hypostoma¹ and palpi yellow; antennæ greyish brown, the two radical joints yellow: thorax ochraceous above, with three brown lines, the sides of the breast with a mixture of grey: abdomen brown, with yellow incisures: halteres yellow: legs pale yellow, the tarsi brown; hinder thighs black at the apex: wings yellowish, somewhat dusky along the anterior border, and marked with a dark-brown spot near the middle. Two lines. Meig. *Zw. i. pl. ix. fig. 15*. This species occurs in Roxburghshire, near London, and on the continent of Europe. The genus contains thirty species; of these upwards of twenty are included in the entomological catalogues of Britain. The larvæ of several species are found in great numbers in fungi, on the substance of which they feed. The *M. fusca* of Lat. and Meigen seems indeed to have been described by Degeer under the name of *Tipula fungorum*.²

GENUS CORDYLA, Meig. Antennæ projecting, twelve-jointed, the two radical joints distinct: eyes rounded: ocelli wanting: tibiæ with spurs at the apex, but unarmed on the sides.

C. crassicornis. Head blackish; antennæ twice the length of the head, compressed when seen from the side, the colour dark brown: thorax grey, the back darker in the middle: abdomen dark brown: halteres and legs bright yellow, the hinder thighs brown at the apex; tarsi brown: wings grey. One and a half. Meig. *Zw. i. pl. x. fig. 1*. Inhabits Austria, England, &c.

f. Lugubri.

Eyes nearly meeting above, and deeply margined: ocelli unequal: antennæ cylindrical: palpi three-jointed: thorax without cross suture: abdomen seven-ringed.

GENUS SCIARA, Meig. Antennæ porrect, cylindric, pubescent, sixteen-jointed; the two basal joints thickest:

eyes deeply emarginate: ocelli unequal: palpi exserted, incurved, three-jointed: wings incumbent, parallel.

S. Thomæ. Black; abdomen with a longitudinal line of saffron yellow on each side, consisting of spots in the male, and narrower than in the female; the last has the incisures also yellow: wings smoke coloured, iridescent: halteres and legs piceous: thighs of the fore legs rufescent in both sexes. Four lines. *Tipula Thomæ*, Linn.; *Molobrus Thomæ*, Lat. Occurs at times in tolerable plenty in woods in the south of Scotland, and in many parts of England, generally frequenting umbelliferous plants, in the months of June, July, and August.

g. Latipennes.

Eyes of the male meeting above, those of the female separated and kidney-shaped; ocelli wanting: antennæ cylindrical: palpi four-jointed: proboscis porrect, perpendicular: abdomen eight-ringed: wings very broad.

GENUS SIMULIA, Meig. Antennæ porrect, cylindric, eleven-jointed, the two basal joints distinct: palpi exserted, incurved, cylindric, four-jointed, the basal joint shortest: ocelli wanting: wings broad, incumbent, parallel.

S. reptans. Female. Palpi and antennæ brown; hypostoma white; forehead blackish blue; thorax brown, with a bluish play of colour, the anterior part cinereous, with a brown line in the middle, which has a cross streak of brown close to it on each side; the hinder part with an ash-grey play of colour: abdomen dark brown, with pale-yellow hairs at the base, the hinder segment shining bluish grey: thighs brown: tibiæ white, brown at the apex: anterior tarsi deep black, the medial and posterior tarsi brown: halteres pale yellow. One line. *Culex reptans*, Linn.; *Simulium reptans*, Lat. Of pretty frequent occurrence in Britain, and other countries. We have above a dozen indigenous species. These insects bite sharply, and attack various animals.

h. Muscæformes.

Eyes of the male meeting above, in the female separate and round: ocelli three, of equal size: antennæ cylindrical: thorax without a cross suture in the middle.

GENUS SCATOPSE, Geoff. Antennæ projecting, cylindrical, perfoliate, eleven-jointed: eyes kidney-shaped: ocelli three: palpi concealed: legs unarmed.

S. notata. Shining black, smooth. The thorax has a white spot on the sides anteriorly: and there is another, crescent-shaped, before the base of the wing, and a similar crescent-shaped spot is placed on the sides at the base of the abdomen: halteres black. One and a third line. *Tipula notata*, Linn.; *Tip. latrinarum*, Degeer, vi. 160, pl. xxviii. p. 1-4; *Tipula albipennis*, Fab. Found in England, Scotland, Germany, &c.

The palpi in the preceding genus, as far as perceptible, seem to consist of only a single articulation—a character in which they differ from their congeners. The larvæ are apodal, and live in impure substances. The nymphs are naked and motionless. The perfect insects occur on the trunks of trees, on moist walls, and on flowers, especially those of the *Synanthereæ*, of which they suck the nectaries. The species are few in number, and of small size.

GENUS PENTHETRIA, Meig. Antennæ projecting, cylindrical, perfoliate, eleven-jointed: eyes oval: ocelli three: palpi standing out, incurved, four jointed: legs unarmed.

P. holosericea. Entirely velvet-black, with brown eyes and wings: forehead of the males very narrow, that of

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¹ This term is used by Meigen to designate the region of the head lying between the antennæ, the eyes, and the mouth. The same part is named *clypeus* by Fallen.

² *Mémoires*, t. vi. pl. 22. fig. 1-13.

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Probosci-
deæ.

the female wide; head in both sexes as wide as the thorax: wings of the male much smaller than those of the female: legs pubescent, without spines, much longer in the male than in the female. Male two and a half, female three and a half lines. Lat. *Gen. Crust.* iv. 267; Meig. *Zw.* i. pl. x. fig. 17, 18. Found in Germany, &c.

GENUS DILOPIUS, Meig.; from *δις*, two, and *λοπος*, a comb. Antennæ projecting, cylindrical, perfoliate, eleven-jointed: palpi standing out, incurved, five-jointed, the third joint dilated at the apex: anterior tibiæ radiated at the apex.

D. vulgaris. Shining black: wings of the males hyaline, with blackish marginal nerves; those of the female brown, with the apex hyaline, the nerves with a pale margin, and the stigma blackish. Two and a half lines. Meig. *Zw.* i. pl. xi. fig. 1, male. *Tipula febrilis*, Linn. Fab. Lat. Common during spring and summer.

GENUS BIBIO, Geoff. Antennæ projecting, cylindrical, perfoliate, nine-jointed; palpi incurved, cylindrical, five-jointed, first joint very short: ocelli three: anterior tibiæ mucronate at the apex. Meig. i. 309, pl. xi. f. 9-15; Curtis, *B. E.* pl. cxxxviii.

B. Pomonæ. Shining black, with pubescence of the same colour: thighs rufous: wings hyaline, the anterior margin fuscous, marginal nervures and stigma dark brown. Male six, female seven lines. *Tipula Pomonæ*, Fab. Don. ix. 27, pl. ccc.

B. Marci. Very like the last, but entirely black; wings of the males hyaline, of the females brown; both have the anterior margin dark brown, with black-brown nervures, and a stigma of the same colour. Five to six lines. ♀ *Tipula Marci*, Linn.; *Hirtea Marci*, Fab.; ♂ *Tip. brevicornis*, Linn. These two species, which are the largest of the genus, occur not unfrequently in Britain: in the south of Scotland the former is common, and we have often seen large flocks of the latter near Edinburgh.

In this genus the sexes differ considerably, which has not seldom led to the males and females being described as distinct species.¹ The larvæ are frequently found in the dung of cattle. They are apodal, but otherwise bear a resemblance to small caterpillars, being furnished with a few hairs directed backwards. They are also believed to change their skins before assuming the nymphal state. The perfect insects appear in spring; and, according to the continental naturalists, at two different periods, corresponding to the feasts of St Mark and St John,—a circumstance which has obtained for them the names of *Mouches de St Marc* and *Mouches de St Jean*. Their flight is heavy, and they are sometimes seen in great quantities on fruit trees, to which, however, notwithstanding a vulgar prejudice to the contrary, they are in no way injurious. Meigen describes sixteen European species, and Mr Stephens enumerates fourteen as occurring in Britain. Their manners are curiously detailed by Réaumur.

GENUS ASPISTES, Hoff. Antennæ projecting, eight-jointed, the terminal joint thickened, ovate: ocelli three: anterior tibiæ terminating in a spine.

A. berolinensis. Antennæ black, somewhat longer than the thorax, the two lowest joints thickened at the apex, the following short, the terminal one broader, ovate, and excavated in the middle: thorax pitch-black, with an oval spot on the back anteriorly: abdomen pitch-black, pubescent, the hinder extremity brownish red: thighs nearly black; tibiæ and tarsi reddish yellow: wings hyaline, the marginal nervures dark brown, the others pale

brown: halteres black. One line. Inhabits Germany, Prussia, &c. One or two other species are said to occur in Britain.

GENUS RHYPHUS, Lat. Antennæ projecting, subulate, sixteen-jointed, the two radical joints distinct: palpi exerted, incurved, four-jointed, the joints unequal, the second clavate: ocelli three, equal: legs unequal: wings parallel, incumbent.

R. fuscatus. Antennæ and palpi dark brown; head and thorax cinereous, the latter with three black lines, the central one longest: scutellum grey: abdomen of the males dark brown, with pale incisures, that of the female brownish yellow: halteres whitish: wings somewhat clouded, and having brown nervures, the stigma and a marginal spot fuscous. Male four, female three lines. Meig. *Zw.* i. pl. xi. fig. 18. ♀ Found in Britain, and is common in many parts of Europe.

B. Antennæ consisting of few joints.

FAMILY II.—XYLOPHAGI.

Antennæ projecting, approximating at the base, three-jointed, the third joint eight-ringed: proboscis retracted: ocelli three: abdomen composed of eight segments: halteres uncovered: wings parallel, incumbent; onychii three.

GENUS BERIS, Lat. (Plate CCXXXVIII. figs. 4 and 4 a.) Antennæ with the two radical joints short, third elongate, conical, eight-ringed: scutellum with many rays on the margin. Meig. Curtis. *Brit. Ent.* vii. pl. cccxxxvii.

B. vallata. Antennæ dark brown; head and thorax shining black: abdomen reddish yellow, that of the male having two black spots at the base; legs rufous, the hinder half of the tibiæ and the tarsi brown: wings of the female scarcely inclining to brownish, the base and anterior margin yellowish, the stigma dark brown. Two and a half lines. *Stratiomys clavipes*, Fab.; *Beris nigratarsis*, Lat. This species is found pretty frequently throughout the greater part of Britain. We have observed it near Edinburgh, and in Roxburghshire; and it occurs in Essex, Kent and other parts of the south of England. We have ascertained the existence of *B. femoralis*, *B. clavipes*, (Linn.), and *B. chalybeata*, in the south of Scotland; and seven others inhabit the more southern portion of the island.

GENUS XYLOPHAGUS, Meig. Antennæ with the second joint cup-shaped, the third elongate, eight-ringed; proboscis retracted: scutellum unarmed.

X. ater. Shining black: first joint of the palpi yellow, second black: thorax of the males entirely shining black, that of the female with three grey vittæ, the lateral ones somewhat abbreviated: anterior legs bright yellow, with the apex of the tarsi brown; hinder legs bright yellow, the apex of the thighs, of the tibiæ and tarsi, brown; halteres yellow. Male five, female six lines. Meig. *Zw.* ii. pl. xii. fig. 14. Lat.; *Empis subulata*, Panz. Apparently the only species of the genus found in Britain.

GENUS CENOMYIA, Meig. Antennæ with the radical joint elongate, cylindrical, second cup-shaped, third conical, eight-ringed: scutellum bidentate.

C. ferruginea. Rust brown: thorax with two lines of changeable white, which disappear behind the middle: abdomen dark rust brown anteriorly, paler behind; the second segment with a rather large white spot on each side

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¹ For example, *Tipula Hortulana* of Linn. is the female of *B. Marci* described above.

² *Memoires*, t. v. p. 55, et pl. vii.

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deæ. behind, the two following with a similar spot, but united by a narrow white line; belly rust yellow, the hinder margins, with the exception of the first, whitish; legs ferruginous: halteres bright yellow: wings brownish yellow, with ferruginous nerves. Six to seven lines. *Tabanus bidentatus*, Fab. Gmel. Lat.; *Sicus ferrugineus*, Fallen. Not unfrequent in Germany and other continental countries in the months of June and July. It has not hitherto been observed in Britain.

FAMILY III.—TABANIDÆ.

Antennæ projecting, approximating at the base, three-jointed; third joint from four to eight-ringed, or six-jointed: proboscis and palpi standing out: abdomen consisting of seven segments: halteres half covered: wings divaricating: onychii three.

a. Antennæ three-jointed.

GENUS PANGONIA, Fab. Antennæ with the basal joint cylindric, second cup-shaped, third elongate, subulate, eight-ringed: ocelli three: proboscis elongate, exserted: wings spreading.

P. ferruginea. Antennæ black, the second joint and base of the third yellow; proboscis black, the length of the thorax; the latter thickly covered with brownish-yellow pubescence: abdomen with similar pubescence, and marked with black spots on the back, the segments margined behind with whitish: belly rust-brown: wing-scales, halteres, and legs bright brown; thighs black: wings brownish. Eight lines. Lat. Gen. Crust. iv. 282. Inhabits Portugal. The genus contains six European species, none of which appear to occur in Britain.

GENUS SILVIUS, Meig. Antennæ with the radical joint cylindrical, second cup-shaped, third subulate, five-ringed: ocelli three: palpi standing out, two-jointed, pilose, the second joint cylindrical in the male, conical in the female.

S. Vituli. Antennæ ochre-yellow, the apex black; hypostoma bright yellow; forehead of a similar colour, with a shining black callosity anteriorly in the female; palpi yellow, the apex black in the male: thorax yellow with a brown play of colour, pubescent: abdomen pubescent, yellow: wing-scales and halteres yellow, the knob of the latter whitish: wings with microscopic hairs, somewhat greyish, with the anterior margin yellow; legs yellow, with brown tarsi. Five to six lines. *Tabanus Vituli*, Fab.; *Tabanus Italicus*, Fab. This insect occurs on the continent, but we have no knowledge of its precise localities.

GENUS TABANUS, Linn. (Plate CCXXXVIII. figs. 5 and 5 a). Antennæ with the basal joint cylindric, second cup-shaped, third compressed, the lowest ring very large and crescent-shaped at the base: ocelli wanting: palpi exserted, capitate in the male, subulate in the female: wings spreading.

T. bovinus. Antennæ black, reddish brown at the base: hypostoma, palpi, and forehead bright greyish yellow; the latter in the female with a black line, which terminates beneath in a shining black roundish callosity; eyes green during life: thorax dark brown, with yellowish hair, sometimes inclining to slate-colour, and having dark lines on the back: abdomen dark brown, with a rather wide reddish-yellow cross band on the hinder edge of the segments, and a row of bright yellow triangular spots down the middle: belly yellowish grey, darker behind the incisures, with rather large nearly triangular spots of black, and near these an oblique black line: thighs and tarsi dark brown; tibiæ bright yellow, the apex brownish: wing-scales and halteres brown, the apex of the latter pale; wings brownish, the anterior margin inclining to yellow.

One inch. Linn.; Degeer, vi. 88. i. pl. xii. fig. 6-14. Common on the continent. It is not quite so plentiful in Britain, especially in Scotland, where we have seen it only on a few occasions in the northern and middle counties. We have taken it by the banks of Loch Katrine, and in Sutherland. Eighteen kinds of Tabani inhabit Britain, and upwards of twice that number are known as European. Besides *T. bovinus*, we are not acquainted with any other Scotch species except *T. tropicus* and *T. autumnalis*.

Latreille, Lepelletier and Serville, Meigen, Wiedemann, Macquart, and the late Palisot de Beauvis, have cleared away many of the difficulties which encumbered the systematic study of this and the allied genera; but their natural history, properly so called, has scarcely received any accession since the days of Degeer. It is to that great observer that we owe our knowledge of the manners and metamorphoses of the species above described, the only one in fact of which we have any detailed account. *T. maroccanus* is extremely troublesome to camels in the north of Africa. M. Defontaines has frequently observed their bodies entirely covered by these insects. The species occurs also in Portugal.

GENUS CHRYSOPS, Meig. (Plate CCXXXVIII. figs. 6 and 6 a). Named from χρυσος, gold, and ὄψ, the eye, which is usually very brilliant during life. Antennæ cylindrical, three-jointed, two basal joints equal, third longer, five-ringed: palpi exserted, two-jointed, pilose, the second joint conic: ocelli three: wings spreading.

C. cæcutiens. Male. Black; the eyes with two dark purple bands; the uppermost interrupted; hypostoma yellow, with large dark spots which nearly conceal the ground colour: forehead black: thorax with reddish pubescence on the sides and beneath: abdomen black, with a rufous spot on each side of the second segment; under side black brown, the two basal segments yellow, having a brown line in the middle: antennæ, palpi, legs, and halteres black: wings almost entirely brown; in the middle there is a small light-coloured spot; at the hinder margin, before the apex, a nearly uncoloured triangle, and not far from the base a pale mark.

The thorax of the female is lined with cinereous; the first segment of the abdomen has two yellow spots, the second is yellow, with two dark lines in the centre, enclosing a triangular mark of yellow behind: wings whitish; the base, anterior margin, a broad band rather behind the middle, and an apical spot, brown. Four lines. *Tabanus cæcutiens*, Linn.

Frequent in most countries of Europe. In Scotland it is rather scarce, but has been taken occasionally in Dumfriesshire, Roxburghshire, and elsewhere.

GENUS HÆMATOPOTA, Meig.; named from αἷμα, blood, and ποτῆς, drinker. Antennæ three-jointed, the second joint cup-shaped, third subulate, four-ringed: palpi exserted, two-jointed, second joint conic: ocelli wanting: wings parallel, deflexed. Meig. ii. 76. pl. xiv. f. 8-16.

H. pluvialis. Eyes greenish, with waved purple-brown bands: palpi and hypostoma light grey; antennæ scarcely longer than the head; first joint thick, oblong, shining-black, pubescent; thorax blackish, with whitish lines, the two next the middle having a white spot in the centre; sides of the breast light grey, somewhat pubescent: scutellum blackish, sometimes cinereous over the middle: abdomen blackish brown, with whitish incisures and a cinereous line down the back; on the third and following segments on each side of this line there is a round cinereous spot; in the males the three first segments are somewhat testaceous on the sides: belly brownish grey: thighs cinereous: anterior tibiæ yellow at the base, the apex, together with the tarsi, black brown; posterior tibiæ yellow, with three brown rings, one in the middle and another at

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each end; the tarsi black brown, with the first joint yellowish: halteres yellowish, having a brown spot on the knob: wings brownish-cinereous, with numerous waved lines of white, and a dark-brown marginal streak. Four to four and a half lines. Meig. ii. 78, pl. xiv. f. 16. *Tabanus pluvialis*, Linn. Very plentiful throughout Britain. This insect is known in Scotland by the name of *Cleg*, and is very troublesome during the heat of summer both to man and beast, particularly horses.

b. Antennæ six-jointed.

GENUS HEXATOMA, Meig.; named from ἕξ, *six*, and τόμος, *section*, in allusion to the number of joints in the antennæ. Antennæ six-jointed; the first and third joints elongate: palpi exserted, two-jointed; second joint capitate (in the male) or conical (in the female): ocelli wanting: wings parallel, deflexed. Meig. ii. 83, pl. xiv. f. 17-24. *Heptatoma*, Lat. *Gen. Crust.* iv. 284.

H. bimaculata. Hypostoma of the males shining-black, with yellowish hair; that of the female light grey above and yellow beneath; thorax blackish, with rufous pubescence: abdomen of the males black, the pubescence of the two basal segments brownish yellow; on the belly these segments are bluish white at the sides and blackish in the middle; the following black, with three pair of bluish-white transverse streaks: abdomen of the female black, the base with brownish-yellow pubescence, and the second segment with bluish-white lateral spots: feet black brown: wings vitreous. Six lines. *Tabanus pellucens*, Fab. A rare species, which has not yet been detected in Britain.

FAMILY IV.—LEPTIDES.

Antennæ porrect, approximating at the base, three-jointed; third joint without rings: proboscis and palpi exserted: ocelli three: abdomen consisting of seven segments: halteres uncovered: onychii three.

GENUS LEPTIS, Fab. Antennæ with the first joint cylindrical, second cup-shaped, third conic with an apical seta: palpi pilose, the second joint elongate: ocelli three, vertical: wings spreading.

L. aurata. Male. Hypostoma blackish grey; antennæ dark brown; thorax and abdomen thickly covered with shining golden hairs: halteres, thighs, and tarsi dark brown; tibiæ testaceous: wings pale brown, with the stigma reddish brown.

Female. Hypostoma and forehead dark grey, the latter broad: thorax and abdomen thickly clothed with light-yellow hairs; sides of the breast black; wings nearly hyaline, scarcely tinged with brown, the stigma reddish brown: halteres and legs as in the male. Three to four lines. *Rhagio atratus*, Fab. Lat.; *Rh. tomentosus*, Fab. In marshy meadows in May, common. This genus, as constituted by Meigen, contains twenty-two species; but more recent writers have separated it into two genera, corresponding to his sectional divisions. Nearly all of these inhabit Britain, and some are very abundant, particularly *L. scolopacea* and *L. tringaria*.

GENUS ATHERIX, Meig. (Plate CCXXXVIII. figs. 7 and 7 a.) Antennæ with the terminal joint ovate, having a naked dorsal seta at the base: palpi standing out, pilose, incurved: ocelli three, vertical: wings spreading.

A. Ibis. Hypostoma and forehead bright yellow; the latter in the female yellowish with a brown vitta; thorax pubescent, yellowish brown, with broad lines of dark brown along the back; scutellum brown: abdomen of the males conical; the first segment dark brown, the following fer-

ruginous with the hinder margin bright yellow, and marked with three black spots, one on the back and another on each side; on the last segments these spots run together; belly yellow: abdomen of the females ash-grey, the segments with a black band anteriorly, the hinder margin white; belly ash-grey: legs ferruginous, the tarsi brown at the apex: halteres yellow, the knob brown: wings hyaline, with irregular cross bands of reddish brown, which are paler in the female. Male four, female five lines. Curtis, *Brit. Ent.* i. 26; *Rhagio Ibis*, Fab.; ♀ *Atherix maculatus*, Lat.; *Anthrax Titanus*, Fab. Mr Curtis states that there are at present but two species of this genus recorded as natives of Britain, although twelve are enumerated as European. The species described appears to be everywhere rare. The male and female were placed by Fabricius in different genera.

GENUS CLINOCERA, Meig. Antennæ remote, the lower joints spherical, the third conical with an incurved terminal seta: ocelli three, placed on the forehead: wings incumbent, parallel.

C. nigra. Head black; body dull black; thorax with three darker lines; legs long, slender, and black: halteres black, uncovered: wings hyaline. Two lines. Found in Germany and elsewhere.

FAMILY V.—XYLOTOMÆ.

Antennæ projecting, approximating at the base, three-jointed, the third joint without rings: proboscis concealed: ocelli three: abdomen seven-ringed, conical: halteres uncovered: wings spreading: onychii two.

GENUS THEREVA, Lat. Antennæ with the radical joint cylindrical, second cup-shaped, third conical: proboscis retracted: ocelli three: wings spreading.

T. fulva. Ferruginous, with pubescence of a similar colour, intermixed with black hairs on the thorax; two first joints of the antennæ ferruginous, the third dark brown: on the forehead of the females is the usual shining black spot, and the hinder extremity of the abdomen is likewise black: thighs and tarsi brown; tibiæ ferruginous: halteres yellow: wings nearly hyaline, the anterior border yellowish. Four to five lines. This insect is of not unfrequent occurrence in the south of Scotland, where *T. anilis* and *T. plebeia* are likewise found. The former is distinguished by its reddish thorax, and abdomen of a silvery-white or grey colour. It is generally seen sitting upon sand, but flies off suddenly if an attempt is made to seize it. Meigen mentions twenty species. Britain produces about one half of that number.

FAMILY VI.—MYDASII.

Antennæ projecting, five-jointed, the joints without rings, the terminal one club-shaped.

GENUS MYDAS, Lat. (Plate CCXXXVIII. figs. 8 a and 8 b.) Antennæ with the two lowest joints small, the following cylindrical, the terminal one clavate. Proboscis exserted.

M. lusitanicus. Entirely black, except the hinder edge of the abdominal segments, which are yellowish white: beard and mystax¹ white: the sides of the thorax and two first segments of the abdomen are beset with long white hairs, and the back of the abdomen and legs with short white pubescence: wings yellowish. Eight lines. Inhabits Germany, Portugal, &c. Another species, named

Diptera
Proboscideæ.

¹ This term is applied to a semicircle of bristles or hairs placed over the mouth.

Diptera
Proboscideæ.

M. filatus, is found in America. It is figured by Drury.¹ Brazil produces one above two inches long.

Diptera
Proboscideæ.

FAMILY VII.—BOMBYLIARII.

Antennæ projecting, three-jointed; third joint without rings: hypostoma beardless: forehead flat: (proboscis retracted or somewhat projecting) ocelli three: abdomen consisting of seven rings, cylindric or elliptical: wings spreading: halteres uncovered.

GENUS HIRMONEURA, Wied. Antennæ remote, the joints sub-globose, equal, the third with a terminal style: ocelli three, the anterior one remote: proboscis retracted and concealed.

H. obscura. Hypostoma ochre yellow; forehead cinereous with blackish hairs: thorax black, with yellowish hairs on the sides, those on the breast more inclining to grey: abdomen with the lateral edges yellow, the upper side with yellowish grey pubescence, the apex of the segments slate grey; belly yellowish, and covered with pubescence similar to that on the breast: wings brownish grey, especially at the anterior margin: halteres dark brown: legs ochre yellow, the tibiæ and tarsi a little darker: extremity of the abdomen with two short truncated styles. Seven and a half lines. Found in Dalmatia.

GENUS FALLENIA, Meig. Antennæ remote, the joints sub-globose, the last with an elongate terminal style: proboscis the length of the body, and bent beneath the breast.

F. caucasica. Head and thorax covered with whitish hair; eyes of a metallic hue: abdomen nearly orbicular, with blackish pubescence; the first segment wide, with grey pubescence, the following fringed with whitish grey upon the hinder edge; the anus ferruginous: wings yellowish: legs brownish grey, with rather indistinct grey hairs. Five to five and a half lines. *Volucella caucasica*, Wied. *Zool. Mag.* i. 2, 7. Found in Russia and elsewhere, but appears to be scarce. There is only one other species, *F. fasciata*, Fab. a native of Italy.

GENUS STYGIA, Meig.² Antennæ approximating, the first joint dilated at the apex, and obliquely truncate, second cup-shaped, third conical: head sub-globose; eyes kidney-shaped: proboscis retracted.

S. Belzebub. Male. Hypostoma and forehead black, the last having a tendency to pass into grey over the antennæ: thorax wholly shining black, with pubescence of the same colour: abdomen shining black, the hinder margin of the segments (with the exception of the first) narrowly edged with yellow; the pubescence on the sides of the first segment whitish, and on the following black: belly entirely black: wing-scales black, fringed with white hair: stalk of the halteres brown, the knob pale yellow: legs black. Five to six lines. *Anthrax Belzebub*, Fab. This fly is found in France, Italy, Hungary, England, and in most other parts of Europe.

GENUS ANTHRAX, Scop. (Plate CCXXXVIII. figs. 9 and 9 a.) Antennæ distant, the first joint cylindrical, second cup-shaped, third sub-globose, with an elongate or conical style; eyes kidney-shaped: proboscis retracted or very slightly produced.

A. flava. Hypostoma with bright yellow pubescence; forehead black, with short rufous hairs, which are mingled with black ones: antennæ black: thorax and abdomen

covered throughout with long reddish shining hairs, the anus having pale yellow hairs, and three black tufts: stalk of the halteres brown, the knob yellow: wings hyaline, with a yellowish-brown streak along the anterior edge, and the base with a pectinated mark of black: wing-scales brownish yellow: legs black; thighs and tibiæ sprinkled with yellow. Seven lines. *Anthrax hottentotta*, Fab.; *Musca hottentotta*, Don. xiv. 69, pl. cccxciv. Inhabits England, France, and Holland, occurring not unfrequently. This genus, as constituted by Meigen, contains about sixty species, a small proportion of which has yet been detected in Britain. We know little of their history or transformations.

GENUS MULIO, Lat. Antennæ distant, the first joint short and cylindrical, second cup-shaped, third conical, acute; eyes elliptical: proboscis standing out, horizontal.

M. infuscatus. Hypostoma with ash-grey hairs; the forehead with dark-brown hairs; proboscis as long as the head: thorax dark brown, ash-grey on the sides: abdomen flat and arched, with ferruginous hairs, the incisures beset with numerous black bristles; halteres brown, the knob almost entirely white; wings light brown, the apex hyaline: legs yellow and glistening; the tarsi brown. Three and a half lines. Found in Provence by M. Baumhauer.

GENUS BOMBYLIUS, Linn. (Plate CCXXXVIII. figs. 10 and 10 a.) Antennæ approximating, the first joint cylindrical, second cup-shaped, third elongate and compressed; proboscis standing out, longer than the head: body woolly.

B. minor. Beard whitish; mystax reddish: the sides covered with black hairs: forehead of the females with reddish hair: antennæ and proboscis black: ground colour of the body deep black, the whole surface covered with rufous hairs: halteres dark brown; wings somewhat greyish, the base and anterior margin more or less rufescent. Four lines; the proboscis from two and a half to three lines. Fab. Linn. Found in several parts of England: we have often observed it in considerable abundance on the sides of Arthur's Seat, and in the fields to the south of Duddingston. About six other species occur in Britain; and although the appearance of these is very familiar, naturalists in truth know little or nothing of their transformations. Latreille supposes that their larvæ are parasitical. Nearly fifty European species are described by systematic authors.

GENUS PHTHIRIA, Lat. Antennæ approximating, the two lower joints short and equal, the third elongate, spindle-shaped, compressed: proboscis standing out, horizontal, elongate: palpi clavate.

P. minuta. Male. Hypostoma and forehead black, and covered with black hairs: body wholly deep black, with soft and rather long black hairs: wings smoke-brown, the stigma brown: halteres and legs black.

Female. Hypostoma white; the forehead blackish, the margin of the eyes white: body black, with traces of white hairs; scutellum yellow, having a dark-brown streak along the sides: under side of the breast whitish; halteres brown above, white beneath: wings brown, but considerably paler than those of the male: legs black. One and a half line. Lat.; *Volucella minuta*, Fab. Occurs, along with five other species, on the continent of Europe.

GENUS GERON, Hoff. Antennæ approximating, the first joint elongate, cylindrical, second cup-shaped, third

¹ Illustrations, vol. i. tab. 44, fig. 1.

² The name of this genus is defective, in as far as it has been already applied to a lepidopterous genus. Meigen has since altered it to *Lomatia*, which is scarcely more fortunate, as it also has been previously applied by Mr Brown to a genus in botany of the family of Proteaceæ. Latreille has altered the original designation to *Stygides*.

Diptera
Proboscideæ.

cylindric-subulate: proboscis standing out, horizontal, elongate.

G. gibbosus. Hypostoma and forehead white; antennæ black; thorax whitish grey, with two wide lines of brownish black down the back: scutellum and abdomen black: halteres white; wings hyaline, inclining to pale yellow at the anterior border: legs dark grey. Two and a half lines. Has been found in Bucharía by M. Baumhauer in the month of July.

GENUS USIA, Lat. Antennæ approximating, the first joint sub-cylindrical, very short; second cup-shaped; third spindle-shaped, elongate, obtuse: proboscis standing out, elongate, horizontal, acute.

U. ænea. Dark brassy: forehead white anteriorly, greyish behind, with a shining black vitta; hinder part of the head cinereous, and marked with a shining black streak in the centre: wing-scales and halteres white: abdomen finely pubescent, wide, flat, and arched; the belly whitish yellow, marked with black cross bands which are abbreviated at the sides: wings hyaline, with a yellow base and a large black spot near the middle of the anterior margin: legs black, with a metallic lustre. Two and a half to three lines. Lat. *Gen. Crust.* iv. 315. Found near Bourdeaux and elsewhere.

GENUS PLOAS, Fab. Antennæ approximating, the first joint very thick and conical, second cup-shaped, third spindle-shaped, and furnished with a jointed style at the apex; proboscis standing out, horizontal, the length of the head.

P. grisea. Colour varying from black to slate-grey: thorax marked with four grey lines, the two in the middle united anteriorly: halteres white: abdomen griseous: wings brownish at the base and anterior margin. Three and a half lines. *Bombylius griseus*, Fab. Inhabits Germany, Spain, &c.

GENUS CYLLENIA, Lat. Antennæ approximating, the first joint cylindrical, second very short, cup-shaped, third conical with a simple style at its apex: eyes oval: proboscis somewhat standing out, horizontal.

C. maculata. Antennæ with the radical joint brownish grey, second white, the third black: forehead black, the margin of the eyes white: thorax black, with yellowish-grey pubescence, mixed with long black hairs: abdomen with the first segment brown, the following pale yellow anteriorly, brown behind, with reddish-yellow hair and long black ones intermixed; on each segment are two longitudinal lines of black, diverging behind, and a black spot: halteres pale yellow above, brown beneath: legs black, covered with matted hair of a ferruginous colour: wings pale brown at the anterior edge, and sprinkled over the surface with dark-brown spots. In the male the hinder thighs are much thicker than in the female. Three to four lines. Lat. *Gen. Crust.* iv. 312. The species described is the only one belonging to the genus. It appears to be more frequent in France than in any other European country.

GENUS TOXOPHORA, Meig. Antennæ longer than the head, approximating, the two lower joints cylindrical, the third conical; proboscis standing out, arched, one half longer than the head; the palpi slender, cylindrical, bent and acute.

T. maculata. Hypostoma white, the hinder part of the head of a similar colour; thorax black, covered with a sulphur-coloured down on the sides and back: abdomen clothed in a similar manner, and having two rows of naked black spots down the back: legs black, with white down, the tibiæ somewhat bristly: halteres white, uncovered:

wings hyaline, the anterior margin and the base yellowish. Four lines. This rare fly has been found in the south of France and in Russia. It appears to have been formerly described by Villers under the title of *Asilus fasciculatus*.¹ It was brought from Syria by Labillardière, and is justly admired as a beautiful and interesting species.

The genus is widely distributed, and probably requires subdivision. We have received species from Brazil; Meigen Le Conte has taken it in the United States; Wiedemann describes a species from Java; and *Bombylius cupreus* of Fab. which is now regarded as a *Toxophora*, is native to Cayenne.

FAMILY VIII.—ASILICI.

Antennæ projecting, approximating at the base, turned upwards, three-jointed; the third joint without rings: hypostoma with a mystax: forehead depressed: proboscis projecting horizontally, short: abdomen consisting of seven segments: halteres uncovered: wings parallel, incumbent.

a. Tarsi with two onychii.

GENUS DIOCTRIA, Meig. Antennæ inserted into a frontal tubercle; first joint cylindric, second shorter, somewhat cup-shaped; third elongate, compressed, the apex with a blunt two-jointed style: proboscis exerted, short, nearly horizontal: hinder legs straight, ciliated beneath: wings incumbent.

D. rufipes. Shining black: hypostoma bright brass-yellow, shining: on the thorax are two changeable white lines, which, however, are scarcely observable in the males; the sides of the thorax with silvery streaks: halteres yellow: legs rufous, the hinder pair dark brown: wings hyaline. Six to seven lines. *Asilus rufipes*, Degeer. Not a rare insect throughout England: in Scotland it is far from scarce, and *D. lateralis* frequently occurs in company with it. Meigen describes twenty-eight species, eleven of which have been detected in Britain.

GENUS DASYPOGON, Meig. (Plate CCXXXVIII. figs. 11 and 11 a). Named from *δαρύς*, hairy, and *πογων*, a beard. Antennæ with the two lower joints sub-cylindric, equal, third elongate, compressed, somewhat spindle-shaped, the apex with a short two-jointed style: proboscis horizontal, the length of the head: tibiæ straight.

D. ruficornis. Thickly pubescent: antennæ ferruginous, black at the base; mystax ferruginous, the forehead dark brown: thorax shining brownish black, with yellowish-grey spots, and having white hairs anteriorly: scutellum black: abdomen deep black, shining, the hinder half of the second segment and the whole of the third and fourth dull ferruginous, the fifth in the female with a ferruginous margin behind: belly shining black; legs very hairy, dark brown, the tarsi reddish brown: halteres brown, with a yellow knob. Seven to eight lines. *Asilus ruficornis*, Fab.; Meig. *Zw.* ii. pl. xx. fig. 11. This insect occurs in France. The genus contains forty-four European species, only two of which, viz. *D. punctatus* and *D. brevis* (Curtis, *B. E.* fol. 153), have been noticed in Britain.

GENUS LAPHRIA, Fab. Antennæ with the radical joint cylindric, second cup-shaped, third clavate, obtuse: proboscis standing out, horizontal: tibiæ arched.

L. gibbosa. Beard pale-yellow, with a brownish play of colour: thorax black, with reddish-brown hairs: three first segments of the abdomen shining black, the three following clothed with whitish-yellow down; the seventh black, retracted: belly and legs black, the latter with brown pubescence: nervures of the wings margined with

Diptera
Proboscideæ.

¹ *Entom. Lin.* iii. pl. 10, fig. 31.

Diptera
Probosci-
deæ. yellowish brown: halteres black. Ten lines. *Laphria gibbosa*, Fab.; *Asilus gibbosus*, Fab. Found in various parts of Europe. *L. nigra* (Curtis, *B. E.* fol. 97) is the only species of the genus, which contains thirty-two different kinds, satisfactorily ascertained to inhabit Britain. It has been found in Darent Wood, Kent, in the vicinity of London, and at Coombe Wood.

GENUS *ASILUS*, Linn. Antennæ with the basal joint cylindric, second cup-shaped, third subulate, compressed, having a setiform apical style: proboscis exserted, horizontal: tibiæ straight, spinulose.

A. crabroniformis. Head yellow: two basal joints of the antennæ rufous, third brown: thorax rufous, with two brown dorsal lines, which are usually obsolete, behind: scutellum brown: three basal segments of the abdomen deep black, the second incisure with a white spot on each side; the remaining segments rufous, with a fine glistening lustre; that of the female bent downwards and terminating in a black style: legs rufous, with brownish thighs: halteres brownish yellow: wings pale yellow, the hinder margin spotted with fuscous. One inch nearly: the male rather less. Meig. ii. 309; Linn. *Fauna Suec.* 1908. Occurs throughout Europe, and in some countries of Asia. The genus is extensive (containing nearly sixty European species), and a considerable number inhabit Britain,—some of them being rather common. *A. opacus* abounds in several parts of Scotland. All the species are carnivorous, and prey upon other Diptera. They even attack hymenopterous insects. Their flight is rapid, and frequently attended by a buzzing sound. They occur in woods and various other places, chiefly in autumn, or the end of summer. Their structure and metamorphoses have been illustrated by Frisch,¹ Degeer,² and Marcel de Serres.³ The larvæ live under ground.

b. Tarsi without onychii.

GENUS *LEPTOGASTER*, Meig. Antennæ with the two lowest joints short, cylindrical, equal; third conical, with the apex pilose: proboscis horizontal, short.

L. Pallasii. Naked: thorax slate-grey, black when seen in certain directions; sides of the breast whitish: first segment of the abdomen very small; the last nearly club-shaped, all of them margined with light grey: legs pale yellow, with a ring on the thighs, the apex of the tibiæ and the tarsi brown: hinder legs much longer than the anterior ones, club-shaped, with a ring near the apex: halteres pale: wings with the lower half brown, the remainder hyaline. Four and a half lines. Found in the south of Russia. It is rare.

FAMILY IX.—HYBOTINÆ.

Antennæ projecting, approximating at the base, three-jointed: the first two joints united so as to form one, the third without rings: hypostoma beardless, flat: forehead flat: proboscis projecting horizontally, short: thorax much arched: abdomen slender, consisting of seven rings: halteres uncovered: wings parallel, incumbent.

GENUS *HYBOS*, Fab. Antennæ with the two lowest joints united, cylindrical; the third conical, with a pubescent seta at the apex: hinder thighs thickened.

H. funebris. Black, with a whitish hypostoma, and pale yellow halteres: thorax with a white play of colour behind: wings with a dark-brown stigma. Two lines. *Asilus culiciformis*, Fab. Common everywhere in hedges and among grass. Four other species in addition to the above are indigenous to Britain.

Diptera
Probosci-
deæ. GENUS *OCYDROMIA*, Hoff. (Plate CCXXXVIII. figs. 12 and 12 a.) Antennæ with two lowest joints united, cylindrical; third lenticular, bearing a seta at the apex: proboscis sub-exserted, horizontal: all the legs simple.

O. flavipes. Antennæ dark brown; palpi yellow: thorax and abdomen entirely black: halteres yellow: legs yellow, all the tarsi brown; the hinder coxæ, the apex of the hinder thighs, and the tibiæ, are likewise brown: wings somewhat brownish. Three lines. Found in England and on the continent.

GENUS *OEDALEA*. Antennæ with the first joint cylindrical, short; second cup-shaped, third elongate, conic, compressed; proboscis short and horizontal: hinder thighs thickened and spinose beneath.

O. minuta. Body black, finely pubescent, shining: halteres brown: legs pale reddish yellow; in the anterior pair the tibiæ and tarsi are brown, and in the hinder pair the tarsi only are of that colour: wings brownish, with a long brown stigma. One and a half line. *Empis minuta*, Fallen. Found in Britain, France, &c.

FAMILY X.—EMPIDINÆ.

Antennæ porrect, approximating at the base, three-jointed, the third joint without rings, and having a style or a seta at the apex: hypostoma beardless: ocelli three: proboscis exserted, very perpendicular, with incurved palpi: abdomen consisting of seven segments: wings parallel, incumbent: onychii two. Meig. iii. 1.

GENUS *HILARA*, Meig. (Plate CCXXXVIII. figs. 13 and 13 a.) Antennæ with the basal joint cylindric; second cup-shaped, third subulate, compressed, the apex with a two-jointed style: proboscis thick, shorter than the head: wings incumbent, parallel, with an oblique transverse nervure at the apex. Meig. *Zw.* iii. pl. xxii. f. 1–5.

H. cilipes. Dusky black, antennæ reddish brown: wings fuscous; halteres whitish; the anterior metatarsus of the male dilated in an elliptical form, and fringed on the external margin with long hairs. Two lines. Meig. *Zw.* iii. 3, pl. xxii. fig. 3; Curtis, *B. E.* 130. Found near London. Upwards of twenty species belong to the genus, and nearly all of them inhabit Britain.

GENUS *BRACHYSTOMA*, Meig. Antennæ with the first joint cylindric, second cup-shaped, third conic, with a very long terminal seta: proboscis the length of the head: wings incumbent, parallel.

B. vesiculosa. Hypostoma greyish white; forehead narrow, black: antennæ as long as the head, black; the two first joints of equal length, the third with a long apical seta bent downwards: proboscis perpendicular, nearly as long as the head: thorax shining black, cinereous on the sides: scutellum very small: abdomen cylindrical, black; the seventh segment very much inflated, pellucid, waxen yellow: halteres white: wings hyaline, with a scarcely perceptible pale marginal streak: coxæ cinereous, short; thighs ferruginous; tibiæ at the base, and the tarsi, brown. Two and a half lines. *Baccha vesiculosa*, Fab. Inhabits Britain and the continent of Europe.

GENUS *GLOMA*, Meig. Antennæ with the first joint cylindric, very slender, second cup-shaped; third globose, with an apical seta: proboscis the length of the head, thick.

G. fuscipennis. Antennæ black; thorax of the same colour, pubescent: abdomen pubescent, black brown, with yellowish incisures: halteres brown: wings brown, with a dark marginal streak; legs pubescent, brown; all the thighs

¹ In his work on the *Insects of Germany*.

² *Mémoires*, t. vi.

³ *Annales du Mus. d'Hist. Nat.* t. iv. p. 361.

Diptera
Probosci-
deæ.

and the hinder tibiæ with a groove on both sides; the hinder legs as long as the anterior ones. Two lines. Meig. *Zw.* iii. pl. xxii. fig. 11. Inhabits England, but is very scarce.

GENUS EMPIS, Linn. Antennæ with the basal joint cylindric, second cup-shaped, third conic, compressed, the apex with a two-jointed style: proboscis perpendicular or bent inwards, longer than the head, slender: wings with a transverse nervure at the apex, incumbent, parallel. Meig. *Zw.* iii. 15, pl. xxii. fig. 13-20; Curtis, *B. E.* pl. xviii.

E. tessellata. Palpi, antennæ, and proboscis black, the latter as long as the head and thorax: hypostoma and forehead cinereous; thorax of the same colour, bristly, with three dorsal lines black, the central one narrowest: abdomen hairy, cinereous, with a line down the back, and the hinder margin of the segments blackish; when seen in another direction both colours change, the black becoming grey and the grey black: halteres yellowish: wings brown, ferruginous at the base: legs black, the tibiæ testaceous, shining. Five to six lines. Meig. *Fab. E. livida*, *Fab.* var. Common on flowers, during summer, in England and Scotland, and most parts of Europe: it has been likewise taken by Pallas in Tauria. Twenty-eight species of Empis occur in Britain, and nearly double that number are known to entomologists. Their early states have not been well determined. In the perfect state they prey upon other flies.

GENUS RHAMPHOMYIA, Hoff. Antennæ with the radical joint cylindric, second cup-shaped, third conic, compressed, the apex with a two-jointed style: proboscis perpendicular or bent inwards, slender: wings incumbent, parallel, the transverse nervure at the apex wanting. Meig. *Zw.* iii. 42.

R. longipes. Deep shining black, as well as the legs: proboscis twice the length of the head, slender: halteres dark brown: wings hyaline, with a scarcely perceptible stigma: in the males the hinder legs are stout, elongate, and pubescent; the hinder tibiæ somewhat clavate, and the first joint of the tarsi distinctly thickened: in the female the anterior legs are simple. Found in summer, but is rare.

FAMILY XI.—TACHYDROMIÆ.

Antennæ porrect, approximating at the base, two-jointed, with an apical seta: ocelli three: proboscis short, perpendicular: palpi incumbent on the proboscis: abdomen consisting of seven segments: onychii two.

GENUS HEMERODROMIA, Hoff. (Plate CCXXXVIII. figs. 14 and 14 a.) Antennæ with the first joint cylindric, second ovate, the apex supporting a seta: proboscis short and perpendicular, with incumbent palpi, which are subulate or cylindric: anterior coxæ elongate: wings incumbent, parallel. Meig. *Zw.* iii. 61, pl. xxiii. fig. 5-15.

H. monostigma. Yellowish white: forehead cinereous: on the thorax are two cinereous vittæ, which anteriorly are drawn into two black lines: along the back of the abdomen runs a black line, which is notched or sinuated on both sides: the fifth joint of the tarsi is black; wings hyaline, with a marginal spot of black. Two lines. Meig. *Zw.* iii. pl. xxiii. fig. 6. Found in the south of England and elsewhere.

GENUS TACHYDROMIA, Meig. *Sicus*, Lat. Antennæ with the first joint cylindric, second ovate or oblong, with a terminal seta: the anterior or intermediate thighs thickened: wings incumbent. Meig. *Zw.* iii. pl. xxiii. fig. 16-24.

T. fuscata. Palpi yellow, proboscis black; hypostoma white; forehead cinereous; antennæ black, with the basal

joint yellow: thorax cinereous: abdomen shining black, with a broad cinereous ring, interrupted in the middle, at the base of each segment: halteres bright yellow: legs rufous, the tarsi black at the apex: wings yellowish. Two lines. Meig. *Zw.* iii. pl. xxiii. fig. 22. Has been taken by Dr Leach in England, where thirty-three other species occur. Few of these have been ascertained to inhabit Scotland. *T. minuta*, however, has lately been found near Edinburgh. There are about sixty species in Europe.

GENUS DRAPETIS, Meig. Antennæ with the first joint cylindric, second lenticular, with a seta at the apex: proboscis scarcely exerted, very short, perpendicular, covered by the palpi: wings incumbent, parallel. Meig. *Zw.* iii. pl. xxiii. fig. 25-28.

D. exilis. Head black, nearly round; antennæ black: thorax shining black, without a transverse suture above: abdomen of the males entirely shining black, rather long, nearly cylindric; that of the female more oval, pointed, reddish yellow above, with a black transverse band at the hinder margin of the segments, entirely ferruginous yellow beneath: thighs somewhat thickened, black; tibiæ brown, unarmed; tarsi yellow: halteres black: wings hyaline. Male half a line, female three fourths of a line. Said to be common in hedges during the months of August and September, in various parts of the continent.

FAMILY XII.—INFLATÆ.

Antennæ very minute, two-jointed: head almost entirely occupied by the eyes: ocelli three: abdomen very thick, consisting of five segments: onychii three.

GENUS CYRTUS, Meig. *Acrocera*, *Fab.* Antennæ nearly vertical, the first joint cylindric, second ovate with a terminal seta: proboscis exerted, horizontal, longer than the head. Meig. *Zw.* iii. pl. xxiv. fig. 1-6.

C. gibbus. Proboscis and palpi yellow: thorax nearly globose, arched, pubescent, yellow, with a black dorsal line anteriorly, which is widened in the middle into a large spot: scutellum semicircular, black, with a triangular spot of yellow at the hinder margin: abdomen very thick, inflated, globular, flat beneath, of a yellow colour, with four black cross bands produced in the middle into a point: wing-scales large and cinereous; the halteres small, and yellow: wings lanceolate, hyaline, yellowish at the anterior margin: legs ferruginous. Four to five lines. A rare insect, found occasionally in the south of Europe and in the north of Africa. The species in general frequent flowers.

GENUS ACROCERA, Meig. Antennæ vertical, the second joint spindle-shaped, with a terminal seta: proboscis concealed. Meig. *Zw.* iii. pl. xxiv. fig. 7-10.

A. sanguinea. Thorax black, naked, with a white spot on the shoulder, and a whitish line before the wing-scales: abdomen blood-red, with four dorsal spots, the three anterior ones triangular: legs black: wing-scale blackish brown: wings brownish, the marginal nervures dark. Three and a half lines. Meig. *Zw.* iii. pl. xxiv. fig. 10. The species are few in number, and frequent moist places. The one just described is found on the continent. Two others, *A. globulus* and *A. albipes*, inhabit England.

GENUS HENOPS, Illig. (Plate CCXXXVIII. figs. 15 and 15 a.) Antennæ porrect, inserted into the upper margin of the mouth, the basal joint patelliform, second ovate, with a terminal style thickened at the apex: proboscis concealed.

H. marginatus. Thorax black, with fine grey pubescence: abdomen black brown or pitch colour, the hinder margin of the segments white: legs entirely rufous: wing-scales and wings hyaline, the last with yellowish-brown

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marginal nervures: belly white, with dark-brown bands. Two to three lines. Meig. *Zw.* iii.; Curtis, *Brit. Ent.* pl. cx. This species has been frequently taken in the New Forest.

FAMILY XIII.—STRATIOMYDÆ.

Antennæ porrect, approaching at the base, three-jointed; third joint ringed: proboscis along with the head projecting: ocelli three: abdomen with five segments: onychii three.

GENUS PACHYGASTER, Meig.; named from *παχυς*, *thick*, and *γαστήρ*, *the belly*. Antennæ with the third joint globose, four-ringed, and having a terminal seta: scutellum unarmed. Meig. *Zw.* iii. pl. xxiv. fig. 16–23.

P. ater. Antennæ of the males brownish, of the females rufous: forehead of the males triangular, small, shining white, with a longitudinal furrow; the crown with three ocelli: thorax rather elongate, black; scutellum unarmed: abdomen wider than the thorax, arched above, flat beneath, black, naked: legs pale yellow with black thighs: halteres with a yellowish stalk and a black-brown knob: wings lanceolate, microscopically pubescent, when in a state of repose lying parallel with the body; the basal half brown, the rest hyaline. Two lines. *Vappo ater*, Lat. Leach. Not a scarce insect on the continent, and in this country it has been found in Darent, Birch, and Coombe Woods, besides various other places. The larva is elongated, of a reddish grey, marked with three obscure longitudinal bands.¹ Another British species is represented in Curtis' *Brit. Ent.* fol. 42, and named after Dr Leach, by whom it was discovered in Devonshire. The most obvious mark of distinction is derived from the appearance of the wings, which are uniformly hyaline in *P. Leachii*, while the lower half is brown in *P. ater*.

GENUS SARGUS, Fab. (Plate CCXXXVIII. figs. 16 and 16 a.) Antennæ with the first joint sub-cylindric, second cup-shaped, third lenticular, three-ringed, having an apical seta: scutellum without spines. Meig. iii. 104; Lat. *Gen. Crust.* iv. 278.

S. Réaumurii. Male. Head black; forehead with two white spots over the antennæ, the latter black brown; eyes green, without purple bands: thorax shining brassy green above, with a longitudinal line of white on each side: abdomen bright copper colour, with yellowish white pubescence: halteres and feet rufescent, the tarsi brown at the apex: wings reddish brown, the stigma somewhat obscure. Six lines. Meig. iii. 109; Réaumur, *Ins.* iv. 22, pl. 5–8.

The female is considerably less than the male, and is strikingly distinguished by having the abdomen of a bright steel blue, with the two basal segments red, having a narrow steel-blue line on the back. This sex is figured by Mr Curtis, *B. E.* pl. cccv. This beautiful species has been taken occasionally in England, and has been observed oftener than once near Edinburgh. On one occasion Mr Duncan found both sexes abundant in an open wood on the banks of the Teviot. All the species hitherto described occur in Britain, excepting two. Several, particularly *S. infuscatus*, *S. politus* (*Musca polita*, Linn.), and *S. formosus*, are common throughout the south of Scotland, the two former frequenting woods and gardens, the latter marshy meadows. *S. flavipes* (Meig. pl. xxvi. f. 14), which appears to be one of the rarer species, has been captured among the Pentland Hills.

The insects of this genus delight in warm and sunny weather. During cloudy days they may be found upon

the leaves of various plants, dull, inactive, or in a state of stupor. One of the larvæ has been described by Réaumur. Its form was oblong-oval, narrowed to a point in front; the head scaly, furnished with a couple of hooks; the body thinly beset with hairs. It was found in cowdung. It became a chrysalis without changing its skin, and the perfect insect made its exit by knocking off the anterior lid of its hardened envelope. Macquart divides the genus into two sections.

GENUS NEMOTELUS, Fab. Antennæ inserted into the apex of a conical hypostoma, the lower joints equal, third elongate, spindle-shaped, four-ringed, the apex with a two-jointed style: scutellum without spines. Meig. *Zw.* iii. pl. xxv. f. 16–20.

N. uliginosus. Male. Forehead black, with a whitish spot over the antennæ: thorax shining black, with fine cinereous pubescence, and a white vitta extending from the shoulder to the base of the wing: scutellum black: abdomen white, black at the base, and having a spot of the same colour before the apex: legs white; thighs black, with a white apex; hinder tibiæ black, white at the base and apex: halteres white: wings hyaline, the marginal nervures yellowish.

Female. Shining black: head with short whitish silken hair, and an interrupted cross band of the same colour over the antennæ: thorax with short whitish silky pubescence, the shoulders and a line on each side running to the base of the wings, white: abdomen surrounded with yellowish white, and marked with three rows of triangular spots, the side rows united to the yellowish margin: in other respects like the male. Three lines. Meig. *Zw.* iii. 114, pl. xxv. fig. 19, *female*. *Musca uliginosa*, Linn.; Don. xv. 31, pl. 519.

Found in meadows and marshy places, in Britain and on the continent of Europe.

GENUS CLITELLARIA, Meig. Antennæ with the two lowest joints nearly equal, the third conic, five-ringed, with a two-jointed terminal style. Meig. *Zw.* iii. pl. xxv. f. 21–25.

C. Ephippium. Hypostoma and forehead black, the latter in the female with two whitish pubescent spots: antennæ black brown: thorax covered with a silky pile of a fiery red colour, the sides and breast black; before the base of the wing there is a black pubescent spine: scutellum black, with two pubescent spines rising from the hinder edge: abdomen black: halteres yellow: wings smoke colour, deepening at the anterior edge: legs black, the hinder tibiæ somewhat crooked. Five lines. Meig. *Zw.* iii. pl. xxv. f. 25. Inhabits Germany, France, Switzerland, and England.

GENUS OXYCERA, Meig. Antennæ with the two lowest joints equal; third spindle-shaped, four-ringed, with a two-jointed terminal style: scutellum armed with two spines.

O. pulchella. Male. Hypostoma black, with whitish-grey pubescence: eyes with a purple fascia: forehead with two silver-white pubescent spots: antennæ black: thorax black: from the shoulder extends a yellow vitta to the base of the wings, where it turns downwards somewhat pointedly; behind the base of the wing towards the scutellum there is a yellow triangle: scutellum and spines yellow, the latter with a blackish apex: abdomen black, each side of the third and fourth segment with a long spot of a fine yellow colour directed forwards, and a triangular one on the terminal segment: belly black, the second, third, and fourth segments yellowish in the middle: legs yellow: thighs black in the middle: the anterior

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¹ Macquart, *Dipt. du Nord de la France*, p. 112.

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tarsi with the four last, and the others with the three last joints, blackish brown: halteres yellow: wings hyaline, the nervures brown.

Female. Hypostoma and forehead yellow, with a black vitta in the middle; crown black; hinder margin of the eyes yellow: on the first segment of the abdomen, beneath the scutellum, is a yellow spot: in other respects the same as the male. Three lines. Meig. *Zw.* pl. xxv. f. 29; *Musca hypoleon*, Don. v. 6, pl. cxlvi. f. 3. Found in summer on hedges and bushes near lakes and marshes.

GENUS STRATIOMYS, Geoff. Antennæ with the second joint cup-shaped, third elongate, somewhat spindle-shaped, five-ringed: scutellum armed with two spines.

S. Potamida. Thorax fuscous; scutellum with a black band at the base, the spines entirely yellow: abdomen black, the second segment with a yellow triangular spot on both sides, and on the hinder margin of the third segment there is a narrow band of yellow, which is broad and interrupted in the males, but entire in the females; the following segments have a narrow band in both sexes, and the anal one is marked with a yellow triangle: the belly is dirty yellow marked with four bands of black, the first one interrupted. From six to seven lines. *Musca Chamaeleon*, Harr. *Ex.* 44, pl. xi. fig. 1. Of occasional occurrence in Britain, and on the continent of Europe. *S. Chamaeleon* is more frequently met with in this country, particularly in the more northern parts.

The manners of these insects have been studied by Geoffroy and Réaumur. The larvæ have a long flattened body, covered by a coriaceous or rather solid skin, divided into segments, of which the last three, more slender and elongated than the others, form a tail terminated by a radiated expansion of barbed or plumy hairs. The head is scaly, small, oblong, and provided with a great many appendages and hooks, with which they agitate the water in which they dwell. They respire by an opening in the caudal segment, while suspended from the surface. Their skin becomes the cocoon of the nymph. The latter scarcely change their form, but they assume a rigid consistence, and become incapable of motion. They float upon the water, and their tails frequently form a right angle with the body. The perfect insect issues from a cleft which opens in the second ring. The species are few in number. About half a dozen are found in Britain.

FAMILY XIV.—SYRPHICI.

Antennæ three-jointed; third joint compressed, not ringed, with an apical style, or a dorsal seta at the base: ocelli three: proboscis concealed: abdomen with five segments: onychii two.

a. Antennæ with a terminal style.

GENUS CALLICERA, Meig. Antennæ inserted on a common tubercle, the first joint cylindrical, second of equal length, compressed and dilated at the apex, the third terminating in an acuminate style: abdomen conical: wings incumbent, parallel.

C. ænea. Hypostoma yellow and pubescent, having a black line down the middle: thorax pubescent, of a yellow colour, blackish on the back, and marked with three obscure lines: scutellum blackish, the pubescence yellowish white: abdomen shining brassy green, with yellow pubescence, of a conical form in the male, more rounded in the female, and in the former marked with a black nearly triangular spot at the base: legs yellow, the thighs almost entirely black. Males five and a half, females nearly seven lines. *Bibio ænea*, Fab.; *Musca ænea*, Gmelin.

This insect has occurred at Berlin and in the south of France.

GENUS CERIA, Fab. Antennæ seated on a common footstalk; the basal joint cylindrical, second and third equal, clavate, compressed, and furnished with an apical style: abdomen cylindrical: wings divaricating?

C. conopsoides. Shining black and pubescent: peduncle of the antennæ elongate, and ferruginous; thorax with the shoulders and a small spot near the base of the wings yellow: abdomen with a yellow band on the hinder margin of the second, third, and fourth segments: legs rufous, the thighs brown. Five to six lines. *Ceria clavicornis*, Fab.; *Musca conopsoides*, Linn.; Curtis, *B. E.* 186 ♀. Very rare in Britain, but not unfrequent on the continent. There is an English specimen in the British Museum, presented by Dr Leach.

b. Antennæ with a dorsal seta.

GENUS MICRODON, Illig. Antennæ porrect, the first joint elongate, cylindrical, the third with a naked dorsal seta at the base: scutellum armed with two teeth: wings incumbent, parallel.

M. apiformis. The head and thorax are dark brassy, and shining; the hypostoma is covered with bright yellow pubescence, but on the forehead, thorax, and scutellum it is of a fulvous colour: abdomen black, clothed with shining golden-yellow pile, which forms a narrow band at the hinder margin of the first segment, and a broader one on the second, somewhat interrupted in the middle, and covers nearly the whole of the third and fourth segments: wing-scales and halteres white; wings brownish: thighs black, with ferruginous pile, the tibiæ and tarsi entirely ferruginous. Four to five lines. *Musca apiformis*, Degeer, pl. vii. fig. 18–20; *Musca mutabilis*, Linn.; Curtis, *B. E.* 70.

Meigen describes four European species, but the above is the only one known as British. It has been found in the New Forest, and near Lyndhurst, in Hants, but appears to be scarce in the country, although common in France and many other parts of Europe.

GENUS CHRYSOTOXUM, Meig. Antennæ inserted on a frontal tubercle, porrect; first joint cylindric, the rest somewhat compressed, equal, the terminal one with a naked dorsal seta at the base: scutellum unarmed: abdomen margined: wings divaricating.

C. arcuatum. Hypostoma shining yellow, with a black line down the middle; the forehead of the females black, with two yellow spots; antennæ black: thorax black, with an interrupted yellow line on each side, and two abbreviated cinereous lines on the back: abdomen without hairs, black, and having four arched interrupted bands of golden yellow; belly with four golden-yellow spots; the wings are yellow at the anterior margin, and behind the middle, near the anterior edge, there is a small brown spot. Five and a half lines. *Syrphus arcuatus*, Fab.; *Musca arcuata*, Linn. This insect occurs not unfrequently throughout the south of Scotland and England during the autumn, frequenting various flowers. We have often taken *C. bicinctum* in company with it, on the flowers of *Senecio Jacobæa*, in Roxburghshire. The species have a waspish look, from their prevailing hues of black and yellow. They feed on the juices of flowers. Their flight is rapid.

GENUS PSARUS, Fab. Antennæ inserted on a common peduncle, porrect, the radical joint cylindrical, second elongate and compressed, third oblong and compressed, with a naked seta placed on the middle of the back: wings incumbent, parallel.

P. abdominalis. Hypostoma black, with a grey play of colour on the sides; forehead black, with two white spots: thorax black and naked: scutellum semicircular and unarmed: abdomen naked, nearly linear, reddish brown; the base and apex black, sometimes having a black line along the back: wing-scales and halteres white: thighs

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black; tibiæ and tarsi inclining to brown. Four lines. *Syrphus abdominalis*, Fab.; *Psarus abdominalis*, Lat. Appears to be a rare and little-known species. Specimens found in this country are preserved in the British Museum.

GENUS PARAGUS, Lat. Antennæ with the two basal joints equal, the third elongate, compressed, with a naked dorsal seta before the middle: hypostoma somewhat convex, smooth: abdomen linear, transversely rugose; the hinder metatarsus somewhat thickened: wings parallel, incumbent.

P. obscurus. Female. Antennæ proportionally shorter than in most of the other species, and entirely dark brown: eyes pubescent: thorax with a slight grey play of colour, the sides covered with pubescence of a silvery hue: abdomen shining black: legs yellow; the thighs black, with the apex yellow: halteres white. Two and a half lines. Inhabits France and England.

GENUS ASCIA, Meg. Antennæ with the third joint oblong, compressed, having a naked dorsal seta before the middle: hypostoma impressed, smooth, produced beneath: abdomen contracted at the base: hinder thighs thickened, and spinose beneath: wings incumbent, parallel.

A. floralis. Abdomen black, and marked with two yellow fasciæ, which are entire in the male, and interrupted in the female: anterior legs yellow, the tibiæ with a black ring before the apex; the hinder legs black, with a metallic lustre, the thighs yellow at the base, the tibiæ yellow, with a black band in the middle, and the tarsi black: wings hyaline. Two and a half lines.

Found occasionally in gardens and fields in the southern counties of Scotland, and in England.

GENUS SPHEGINA, Meig. Antennæ with the terminal joint orbiculate, compressed, with a naked dorsal seta at the base: hypostoma impressed, smooth: abdomen contracted at the base: hinder thighs clavate, spinose beneath: wings parallel, incumbent. Meig. iii. 193.

S. nigra. Hypostoma whitish; antennæ rufous-brown: thorax and abdomen shining black, the former with a greenish tint: halteres yellowish white: the four anterior legs pale yellow; thighs of the hinder pair black, yellow at the base; the tibiæ with two brown bands; tarsi black. Three to three and a half lines. Two species only belong to this genus, both of which are to be found in Britain. Mr Duncan took a few examples of the above in the neighbourhood of Edinburgh in the summer of 1830. The other species, *S. chunipes* (Meig. pl. xxviii. f. 5) is of more frequent occurrence.

GENUS BACCHA, Fab. Antennæ with the third joint sub-orbicular, compressed, having a naked dorsal seta at the base: hypostoma tuberculated: abdomen elongate, attenuated before, and clavate behind: legs simple: wings parallel and incumbent.

B. nigripennis. Antennæ brown: thorax dark brassy, the abdomen inclining to golden green, and flat behind; at the base of the third segment there is a scarcely perceptible yellow spot on each side, and a yellow band on the fourth: anterior legs yellow; the hinder ones brownish, with the base of the thighs yellow: wings blackish. Three lines. Found in Austria by M. Megerle. It likewise occurs in Britain, along with six other species—nearly the whole that the genus contains.

GENUS EUMERUS, Meig. Antennæ with the third joint orbicular, compressed, and having a naked dorsal seta before the middle: hypostoma sub-convex, villose, smooth: hinder thighs thickened, and spinose beneath: wings incumbent, parallel.

E. grandis. Hypostoma covered with whitish pubescence; forehead of the males similar, that of the female black, with white pubescence under the eyes: antennæ

dark brown: thorax dark brassy, with two whitish lines anteriorly, the sides somewhat shining: abdomen black, the sides testaceous, and adorned with three pair of crescent-shaped spots: legs dark metallic green, the tibiæ and tarsi with ferruginous pubescence: halteres brown: wing-scales white; wings grey. Five lines. Meig. Zw. iii. pl. xxviii. f. 18. Five species of Eumeri are found in this country: *E. ruficornis*, *ornatus*, *strigatus*, *funeralis*, and *silene*. The one described above occurs on the continent.

GENUS XYLOTA, Meig. Antennæ inserted on a frontal tubercle, nutant, the third joint sub-orbicular, compressed, with a naked dorsal seta at the base: hypostoma impressed, blunt below, smooth, or somewhat tuberculated: hinder thighs thickened, and spinose beneath: wings incumbent, parallel.

X. sylvarum. Hypostoma yellowish white, and finely pubescent, the forehead similar in the male, but in the female shining black, with two white spots anteriorly: antennæ brown: thorax dark metallic green, with a grey spot on each shoulder; the pubescence on the sides golden yellow: scutellum dark green: abdomen black, the two first segments thinly clothed with golden pubescence; similar pubescence covers the base and sides of the third, leaving a triangular black spot behind, and the fourth segment is entirely covered with it; fifth segment minute and shining black: wing-scales and halteres yellowish white: wings brownish, with a ferruginous stigma: legs ferruginous, the thighs and two last tarsal joints black; hinder thighs club-shaped, and armed with small prickles; tibiæ crooked, and having a brown play of colour behind. Six lines. *Musca sylvarum*, Linn.; *Syrphus sylvarum*, Fab.; *Milesia sylvarum*, Lat. Found occasionally in various parts of the continent. We have taken single specimens near Edinburgh, and in the neighbourhood of Jedburgh. *X. segnis*, and *pipiens*, are comparatively common in England and the south of Scotland. The former is often plentiful at Roslyn. The larva of this genus, described by Degeer, was found in the dung of horses.

GENUS MILEZIA, Fab. Antennæ inserted on a frontal tubercle, the third joint lenticular, with a naked dorsal seta at the base; hypostoma impressed, smooth, or slightly tuberculated; legs simple, the hinder tibiæ compressed; wings incumbent, parallel, the intermediate transverse nerve oblique.

M. speciosa. Hypostoma and forehead ferruginous, with a yellowish-white play of colour on the sides; the crown black: antennæ ferruginous: thorax dark brassy green, finely pubescent, blackish on the sides, and yellow on the shoulders: abdomen dark brassy, cylindrical, and finely pubescent; having a line along the back, and the hinder margin of the segments covered with shining golden-yellow pubescence, and before this yellow edging there is a transverse band of black: wing-scales white: halteres bright yellow: wings brownish yellow along the anterior margin, but before the apex this colour passes into brown: thighs dark brown, with a ferruginous spot at the apex; tibiæ and tarsi ferruginous. Seven lines. Found, according to Meigen, near Paris, and likewise in Austria and Italy. "It is now several years," says Mr Curtis, who has given a beautiful representation of this insect in his *Brit. Entom.* fol. 34, "since this fine and rare insect was discovered in the New Forest by Mr D. Bydder, and the beginning of June of the present year (1824) I took four near Brockenhurst: they appear to delight in settling in the thickest parts of the Forest, where a partial shadow is thrown by the surrounding foliage upon the trunks of trees, or the flat surface remaining when they have been felled."

GENUS PIPIZA, Meig. Antennæ nutant, the third

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joint ovate and compressed, having a naked dorsal seta at the base: hypostoma smooth: hinder thighs somewhat thickened: abdomen oblong-elliptical: wings parallel, incumbent.

P. Artemis. Black, with whitish hair: the second segment of the abdomen with a lunate fascia of a red colour: thighs black, tibiæ ferruginous anteriorly, brown behind; tarsi ferruginous: halteres bright yellow: wing-scales white; outer half of the wings brown, the colour becoming paler at the apex: belly black, yellow anteriorly. Three lines. Inhabits Austria and England. There are fifteen British species of this genus, and twenty-nine are indigenous to Europe.

GENUS *PSILOTA*, Meig. Antennæ nutant, the terminal joint oblong-ovate, with a naked dorsal seta at the base: hypostoma impressed, truncated beneath: eyes hirsute: wings incumbent, parallel.

P. anthracina. Hypostoma and forehead bluish black; the body of a similar colour, and covered with very short pubescence; abdomen oval: legs black, the thighs all straight; the tarsi with fine ferruginous pubescence; the hinder legs somewhat elongate, and the tibiæ a little bent: wing-scales and halteres white; wings hyaline, somewhat yellowish at the base, and the stigma bright yellow. Three lines. Meig. *Zw.* iii. pl. xxix. f. 20. Found in Germany and Britain.

GENUS *RHINGIA*, Fab. Antennæ porrect, nutant, the third joint lenticular, the base with a naked dorsal seta: hypostoma somewhat impressed, elongate beneath, conical: wings incumbent, parallel. Meig. iii. 257; Lat. *Gen. Crust.* iv. 320.

R. rostrata. Hypostoma and rostrum ferruginous, shining, the latter brown at the tip; antennæ ferruginous; forehead of the females grey, with a dark streak: thorax grey, with three black-brown lines; scutellum shining, brownish yellow: abdomen ferruginous, the basal segment sometimes blackish, and a longitudinal brown line on the second: legs ferruginous, the hinder tarsi brownish: wing-scale and halteres light yellow: wings somewhat greyish, yellowish at the anterior margin. Four lines. Meig. iii. 258. *Conops rostrata*, Linn., &c. Common throughout the country. *R. campestris* (Curtis, *B. E.* pl. clxxxii.), which differs from the above chiefly in having the incisures of the abdomen, and a longitudinal dorsal line, of a black colour, is likewise of frequent occurrence, and is probably not specifically distinct. The name of a third species, *R. monostigma*, has been recently published, but we are unacquainted with its characters and history. We have but a slight knowledge of the metamorphoses of these insects. Indeed all that is yet known is inferred from the fact of Réaumur having found *Rhingia rostrata* in the perfect state in a sand-box (*poudrier*) in which he had previously enclosed some cow-dung containing unknown larvæ. The perfect insects occur in gardens and meadows. The species are by no means numerous.

GENUS *BRACHYOPA*, Hoff. Antennæ inserted on a frontal tubercle, nutant, the terminal joint lenticular, and having a hirsute dorsal seta at the base: hypostoma impressed and elongate beneath, truncated: wings incumbent, parallel, one half longer than the abdomen.

B. bicolor. Hypostoma, antennæ, and forehead (of the males) ferruginous, with a white play of colour; forehead of the females grey, with a yellow spot anteriorly: thorax dark grey or lead colour, with three brown lines, of which the central one is double: scutellum rust-brown: abdomen ferruginous, with a black dorsal line on the second segment, which however is sometimes wanting: legs ferruginous, with dark-brown tarsi: wing-scales white: halteres bright yellow: wings unspotted, slightly obscured with brown. Three lines. *Rhingia bicolor*, Fallen. The insects of this

genus are found on flowers, but seem to be in general rare. The above, and another species named *B. conica*, are said to have occurred in England.

GENUS *CHRYSOGASTER*, Meig. Antennæ nutant, the third joint compressed, orbiculate, or oblong, having a naked dorsal seta at the base: forehead of the female crenated on both sides: abdomen depressed: wings parallel, incumbent.

C. ænea. Shining brassy, except the apex of the abdomen, which is dull black; the belly dark green: antennæ testaceous: wings hyaline, partly of a yellowish-brown colour, with a ferruginous stigma. Three lines. Inhabits Austria and Britain, but seems everywhere rare.

GENUS *SYRPHUS*, Fab. (Plate CCXXXVIII. figs. 17 and 17 a.) Antennæ porrect, nutant, three-jointed; the third joint orbicular or oval, compressed, with a pubescent dorsal seta at the base: hypostoma tuberculated: feet simple, slender: wings incumbent, parallel, the ordinary transverse nerve nearly perpendicular.

S. Lucorum. Hypostoma white, with a shining black line down the middle; forehead whitish, having a black spot over the antennæ, and a brown line in the females: antennæ black, with a very finely pubescent seta: thorax black, with reddish-yellow pile; scutellum rufous: abdomen having the first segment whitish, with pubescence of the same colour, the male with a wide dark-coloured vitta; third segment deep black; fourth black, with whitish pubescence and somewhat glossy, especially on the sides: legs dark brown, the base of the tibiæ whitish: halteres and wing-scales brown; wings hyaline, having a dark-brown vitta in the middle of the anterior margin extending half way across. Five lines. Meig. iii. 313, pl. xxx. f. 27. *Musca lucorum*, Linn. Not unfrequent on umbelliferous plants in woods throughout the country. The genus *Syrphus*, as characterized by Meigen, comprehends nearly 100 species, of which upwards of one half, besides a considerable number of others recently discovered, are to be found in Britain. The dissimilarity in form and structure which prevails among many of these insects, has led to their distribution, by later writers, into three generic groups, distinguished by the names *Cheilosia*, *Scæva*, *Syrphus*; and they appear to be susceptible of still further subdivision. As the English species are comparatively well known, it may be interesting to mention such as we have ascertained to inhabit Scotland: *S. ostraceus* (frequent), *variabilis*, *lunulatus*, *Pyrastris*, *seleniticus*, *Ribesii* (common), *balteatus* (common), *cinctus*, *decorus*, *umbellatarum*, *teniatus*, *melliturgus*, *Rosarum*, *Oecymis*, *granditarsus* (three last near Edinburgh, not common). The larvæ of the Syrphi prey upon Aphides. Their form is that of an elongated cone. Their segments are very retractile.

GENUS *PELECOCERA*, Hoff. Antennæ porrect, the third joint somewhat patelliform, the apex furnished with a thick, short, three-jointed seta: hypostoma arched beneath.

P. tricolor. Hypostoma white, with a shining black vitta: thorax black, shining, the shoulders white, and the sides before the base of the wings marked with a white streak: scutellum shining black; abdomen likewise black, with a broad ferruginous band at the base of the second, third, and fourth segments: legs reddish yellow, the hinder pair with a brown ring on the thighs and tibiæ: wing-scales and halteres white: wings somewhat brownish, with a ferruginous stigma. Three lines. Found in some parts of the continent, but everywhere rare.

GENUS *SERICOMYIA*, Lat. Antennæ porrect, nutant, the third joint patelliform; the base with a plumose dorsal seta: hypostoma descending, tuberculated: wings parallel, incumbent, hirsute.

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S. borealis. Hypostoma ochreous, with a black line; antennæ dark brown; forehead of the males yellow, of the females black brown: thorax black, with a tuft of whitish pubescence on each shoulder, and golden-yellow pubescence on each side before the base of the wing: scutellum blackish brown: abdomen black, with four ochreous bands, the first, and sometimes the second also, somewhat interrupted; belly dull ochreous, brown at the base: legs rufous, base of the thighs black: wing-scales yellow: halteres brown: wings hyaline, with the anterior margin yellowish, and sometimes with a pale-brown tinge before the apex. Seven lines. *Syrphus borealis*, Fallen; *Musca lappona*, Degeer. Abundant in some parts of the south of Scotland during the autumnal months, and frequently seen on the flowers of *Senecio Jacobææ*, in company with numerous species of the genus *Eristalis*. Its appropriate locality seems to be elevated pasture lands, and the sides and summits of hills. In the latter situation we have occasionally heard it, in fine weather, emit a peculiarly shrill and strident note, which is sufficiently loud to be heard at a considerable distance. A nearly allied species, *S. lappona*, Linn., occurs among the Pentland Hills, near Edinburgh.

GENUS TROPIDIA, Meig. Antennæ nutant, third joint patelliform, with a naked dorsal seta: hypostoma carinated, smooth: hinder thighs thickened, with a single tooth at the apex beneath: wings parallel, incumbent, hirsute.

T. fasciata. Hypostoma greyish white, with a black longitudinal line, and covered with fine silky hairs; antennæ rufous: thorax with yellow pubescence, of a dark green, somewhat metallic, with two whitish abbreviated lines on the back, and a spot on each shoulder: abdomen with ferruginous pubescence, of a dark brown, and having a rufous interrupted band on the second, third, and fourth segments: thighs of the anterior legs blackish, the apex rufescent, the tibiæ and tarsi rufous, with a brown apex: hinder thighs blackish, the tibiæ crooked, reddish at the base, the other parts, as well as the tarsi, brown: halteres and wing-scales white: wings hyaline. Four lines. Found in some parts of the continent on *Achillæa ptarmica*, in the neighbourhood of Paris, and in Austria. The only other species described by Meigen, *T. milesiformis*, has been found in Britain, along with another, named *T. rufomaculata* (Curtis), which does not appear to be known to continental naturalists.

GENUS MERODON, Fab. Antennæ nutant, the terminal joint oblong or elliptical, compressed, with a naked dorsal seta at the base; hypostoma smooth and villose: hinder thighs thickened, with a single tooth at the apex beneath: wings incumbent, parallel, hirsute.

M. equestris. Male. Hypostoma and forehead with greyish white pubescence; antennæ black: thorax anteriorly dark brassy, with ferruginous pile, shining black behind, with pile of the same colour: scutellum and abdomen coloured and clothed like the anterior part of the thorax: legs black, the anterior tibiæ and tarsi with ferruginous silky hairs; the hinder tibiæ with a tubercle on the inner side behind the middle, and a hooked spine at the end: halteres brown: wings nearly hyaline. Six lines. *Syrphus equestris*, Fab. Réaumur, *Ins.* iv. tab. xxxiv. fig. 9, 10. This species has occurred in Italy and near Paris. *M. clavipes* is the only British species known. It is figured and described in Curtis' *B. E.* fol. xcvi.

GENUS HELOPHILUS, Meig. Antennæ porrect, nutant, the terminal joint patelliform, the base with a naked dorsal seta: hypostoma descending, gibbous beneath: eyes naked: hinder thighs thickened, unarmed: wings divaricating, hirsute.

H. pendulus. Hypostoma yellowish white, with a shining black vitta in both sexes; forehead whitish yellow, the crown dark brown, and a small black spot over the antennæ; the latter dark brown, with a yellow seta: thorax straw colour, with three black vittæ: scutellum shining brownish yellow: abdomen deep black, with three unequal interrupted yellow bands: the belly pale anteriorly, the three last segments black, with white incisures: wing-scales and halteres yellow; anterior legs rufous, nearly the whole of the thighs and the tarsi brown; hinder legs dark brown, the apex of the thigh and base of the tibiæ more or less yellow. Five lines. *Syrphus pendulus*, Fab.; *Musca pendula*, Linn.; *Elophilus pendulus*, Lat. Everywhere common. The species of this genus do not greatly differ from those of *Eristalis*. They are generally less hairy. Several exhibit the aspect of garden bees, as well as of other Hymenoptera. The larvæ, known under the name of rat-tailed worms (*vers à queue de rats*, Réaumur),¹ are remarkable for the great length and singular uses of their caudal extremity. It serves as a respiratory organ. The insect lies at the bottom of stagnant waters, generally concealed in the mud; but the point of its attenuated tail is meanwhile in contact with the surface. Réaumur found, by increasing the depth of water, that the larva could extend its respiratory tube to the height of five inches. After that, however, it was seen to leave the mud, and ascend the side of the vessel in which it was contained, that it might attain to the surface with greater ease. The tail seems composed of two parts, one of which slips into the other like the portions of a telescope. They are composed of annular fibres, and when these are contracted, each tube is greatly increased in length.

GENUS MALLOTA, Meig. Antennæ nutant, third joint nearly four-angled, compressed, with a naked dorsal seta in the middle: hypostoma descending, gibbous: wings divaricating, hirsute.

M. megilliformis. Male. Hypostoma black, thickly covered with silken hairs of a pearl-grey colour, and having a naked shining black vitta; forehead black, pearly on the sides beneath; the hinder part of the head with ferruginous pile; antennæ black, the third joint with a white seta: thorax and abdomen dark green, thickly clothed with ferruginous hair; belly and legs black; wing-scales ferruginous; halteres also ferruginous, with the knob brown: wings nearly hyaline, with brown nervures. Six lines. Rare: The females have not been described. The genus contains only three species, none of which appear to be British.

GENUS ERISTALIS, Fab. Antennæ porrect, nutant, three-jointed; the third joint patelliform, with a plumose or naked seta at the base: hypostoma elongate, tuberculated: legs simple: wings spreading, naked (in the greater number of species).

E. intricarius. Male. Hypostoma and forehead black, with yellowish-white hair; antennæ black at the base, the third joint rufous, with a plumose seta of the same colour at the base: thorax black, thickly clothed with reddish-yellow hair; scutellum yellow: abdomen black, with ferruginous lateral spots, and clothed anteriorly with ferruginous hair, which on the hinder parts passes into a whitish-yellow colour: wing-scales blackish: wings hyaline, the central cross nerve more or less distinctly margined with brown: legs black, the apex of the thighs and basal half of the tibiæ white. Six lines. Meig. iii. 391. *Syrphus intricarius*, Fab.; *Musca intricaria*, Linn. Of frequent occurrence during summer on flowers and

¹ *Mémoires*, t. iv. p. 442.

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plants. Several species of this extensive genus are very common in this country, particularly *E. tenax*, *similis*, *horticola*, &c. About a score inhabit Britain. The larva of *E. narcissi* (which inhabits the bulb of the plant from which it derives its name) is figured and described by Réaumur.¹

GENUS VOLUCELLA, Geoff. Antennæ decumbent, the third joint elongate, compressed, with a long plumose dorsal seta at the base: hypostoma impressed above, elongate beneath, conical, gibbous: wings divaricating. Meig. iii. 401; Lat. Gen. Crust. iv. 322.

V. pellucens. Hypostoma, forehead, and antennæ shining ferruginous, the latter with a black plume: thorax shining black, bristly: scutellum testaceous brown, sometimes black,² bristly: abdomen pubescent, shining black, the second segment yellowish white, pellucid, having a central line of black in the males, but usually uninterrupted in the females, except by a very faint black line; belly like the back, except the anterior part of the third segment, which is likewise transparent: legs black: wing-scales yellowish: halteres with a blackish stalk, the knob white: wings yellowish at the base, with ochreous veins, the rest greyish, with brown veins. Seven lines. Meig. iii. 405.

Musca pellucens, Linn. An insect of not unfrequent occurrence in Britain during the summer months, frequenting flowers in sheltered situations exposed to the sun. In the summer of 1829 it appeared in unusual abundance in the fields adjoining Duddingston wood, near Edinburgh. All the other species belonging to the genus (as now restricted) are to be found in Britain, with the exception of *V. zonaria* (Meig. iii. pl. xxxii. f. 27). The most common in Scotland next to the species described is *V. plumata*, which is found occasionally throughout the southern counties. *V. bombylans* appears to be considerably scarcer; the only examples which we have met with were from Dumfriesshire and East Lothian. The larvæ of these insects inhabit the nests of wasps and bees, and live at the expense of the proper owners. Réaumur has detailed their history at great length, and in a very interesting manner. "Lepelletier de Saint Fargeau a eu occasion d'observer que les volucelles de diverses espèces s'accouplent très-bien ensemble; il a lu un Mémoire à ce sujet à l'Académie des Sciences."³

FAMILY XV.—PLATYPEZINÆ.

Antennæ porrect, two or three-jointed, with a naked apical seta: proboscis concealed; thorax without a transverse suture: abdomen with six segments: wings incumbent: the small cross nerve of the middle bent towards the base: halteres naked.

GENUS CYRTOMA, Meig. Antennæ approximating, two-jointed, first joint small, cylindric; second elongate, conic, compressed, the apex with a two-jointed style: proboscis subporrect: hinder legs elongate: wings incumbent, parallel. Meig. iv. 1.

C. nigra. Black; halteres yellow; the legs brown; the hinder tibiæ club-shaped, the lowest joint of the tarsi thickened; wings somewhat brownish. Two lines. Found in Germany and elsewhere occasionally. This genus contains three species, none of which are known to inhabit Britain.

GENUS PLATYPEZA, Meig.; name derived from πλατύς, broad, and πῆζα, the foot. Antennæ straight, approximat-

ing, three-jointed, the lower joints sub-cylindric, third ovate, compressed, the apex with a three-jointed naked seta: proboscis concealed: hinder feet thickest, tarsi dilated, the joints nearly equal: wings incumbent, parallel.

P. boletina. Male. Velvet black; abdomen with greyish-black bands: legs brown: halteres black brown: wings hyaline.

Female. Clear ash-grey, abdomen with a narrow deep black cross band, somewhat widened in the middle, before the incisures; the first segment without a band: halteres and legs bright yellow: wings hyaline. One and a half line. Fallen. Occurs in Germany and England, rare.

GENUS CALLOMYIA, Meig. (Plate CCXXXVIII. figs. 18 and 18 a.) Generic name from καλός, beautiful, and μυία, a fly. Antennæ straight, three-jointed; the lower joints sub-cylindric, third compressed, acute; the terminal seta elongate, three-jointed: proboscis concealed: hinder legs elongate, thick, the metatarsus elongate: wings incumbent, parallel.

C. amæna. Male. Body velvet black: halteres rufous: fore legs honey-yellow, the thighs blackish brown: hinder legs entirely black brown: wings hyaline.

Female. Hypostoma and forehead bright blue: thorax bright blue on the sides, with a silvery lustre: this colour extends forwards along the thorax in the form of a bow, and before the scutellum there is likewise a silvery band: scutellum black: abdomen with the three first segments orange yellow, the fourth and sixth deep black, the fifth silvery blue, with a black line on the middle; fore legs rufous; hinder legs black, with rufescent thighs: halteres rufous: wings hyaline. Two lines. Meig. Zw. iv. pl. i. f. 13. This species has been recently taken in England.

FAMILY XVI.—MEGACEPHALI.

Antennæ three-jointed; the third joint deflexed, with an erect seta at the base: hypostoma linear, narrow: proboscis concealed: abdomen consisting of six segments: wings incumbent; the short transverse nervure in the middle: halteres naked.

GENUS PIPUNCULUS, Lat. (Plate CCXXXVIII. figs. 19 and 19 a.) Antennæ triarticulate; first joint minute, second cup-shaped, third deflexed, acute, compressed, with an erect naked seta at the base: hypostoma narrow, linear: proboscis concealed: wings incumbent, parallel. Meig. Zw. iv. 18, pl. xxxiii. f. 15-24.

P. spurius. Deep velvet black, the apex of the abdomen somewhat shining: hypostoma silver white, changing, with a play of colour, into black: forehead very narrow, black, silver white above the antennæ: the latter, together with the legs, black: wings brownish, with a dark-coloured stigma. One line. Meig. Zw. iv. pl. xxxiii. f. 24. Occurs in England, but is rare.

FAMILY XVII.—DOLICHOPODES.

Antennæ porrect, three jointed: the third joint flat, with an apical or dorsal seta: hypostoma linear: proboscis somewhat exserted, with compressed incumbent palpi: thorax without a transverse suture: abdomen consisting of six segments: wings incumbent; the short transverse nerve bent towards the base: halteres naked.

GENUS RHAPHIUM, Meig. Antennæ approximating, the

¹ Mémoire, t. iv. p. 499, and pl. xxxiv.

² The scutellum is usually ferruginous when the insect issues from the chrysalis, but becomes darker as it advances to maturity, till it ultimately acquire the colour of the thorax.

³ Diction. Class. d'Hist. Nat. t. xvi. p. 631.

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third elongate, compressed, with a two-jointed style at the apex: eyes separated: wings incumbent, parallel.

R. vitripenne. Hypostoma bluish white; forehead shining steel blue: antennæ black, slender, those of the male as long as the abdomen, those of the female much shorter; the body dark metallic green, legs black, the anterior tibiæ brown; halteres white: wings hyaline. Three lines. Meig. *Zw.* iv. pl. xxxiii. f. 4. Four species of this genus, nearly half the number known, have been found in Britain. The species described occurs on the continent.

GENUS DIAPHORUS, Meig. Antennæ with the third joint patelliform, having a villose dorsal seta: eyes meeting on the forehead; abdomen of the male with two filiform appendages on the under side of the apex: wings incumbent, parallel. Meig. *Zw.* iv. pl. xxxiv. f. 6-9.

D. flavocinctus. Hypostoma white; antennæ black: body black, with greenish reflections; the second segment of the abdomen, and sometimes the base of the third, ferruginous, transparent: anterior legs rufous, with blackish thighs, rufescent at the apex on the under side: middle pair of legs rufous, the basal half of the thighs black: hinder legs black, the upper half of the tibiæ rufous: halteres white: wings reddish brown. One and a half line. Meig. *Zw.* iv. pl. xxxiv. f. 8. Inhabits England, but is not common.

GENUS PSILOPUS, Meg. Antennæ with the third joint patelliform, villose; furnished with an inclined villose dorsal seta before the apex: eyes separated: wings incumbent, parallel, the transverse nerve at the apex curved.

P. platypterus. Male. Head white: antennæ pale yellow; the third joint brown: palpi white: thorax cinereous-green, with a faint metallic lustre: abdomen brassy, the apical segment blackish: legs long, pale yellow: halteres yellow: wings very broad, hyaline.

Female. Hypostoma somewhat wider than in the male: legs pale yellow, with brownish tarsi. Two and a half lines; the females rather less. This and seven other species of *Psilopi* are found in Britain, but none of them appear to be frequent.

GENUS CHRYSOTUS, Meig.; named from χρυσος, gold colour, bright golden green being the prevailing colour of the species.—Antennæ with the terminal joint patelliform, villose, having an inclined villose seta at the apex: eyes separated: abdomen of the male with two filiform appendages at the apex beneath: wings incumbent, somewhat spreading. Meig. *iv.* 40, pl. xxxv. f. 7-11.

C. neglectus. Hypostoma of the males minute, blackish; that of the female wider and of a whitish colour; eyes of a beautiful golden green, with light-blue reflections: forehead metallic green: body bright golden green; legs straw yellow, with dark-brown tarsi, which are yellowish at the base: halteres white: wings hyaline, with a play of colour: the terminal segment of the abdomen small, lying in a cavity of the belly, with two short threads at its extremity. Meig. *Zw.* pl. xxxv. f. 10. Found in Britain, with seven other species, all that are known to belong to the genus.

GENUS PORPHYROPS, Meig. (Plate CCXXXVIII. figs. 20 and 20 a.) Generic name compounded of πορφυρα, purple, and οψ, the eye. Antennæ with the terminal joint oblong, acute, the seta villose and bent downwards: eyes separated: abdomen of the male with two filiform appendages at the apex beneath: wings incumbent, parallel. Meig. *Zw.* iv. pl. xxxv. f. 1-6.

P. diaphanus. Male. Hypostoma narrow and black; antennæ black; forehead black above, shining white beneath: thorax metallic black with green reflections, and having a long mark of changeable white on the sides anteriorly: abdomen conical, bluish, with a silvery lustre, viewed in another direction dark slate grey; with two in-

terrupted reddish-yellow diaphanous bands on the second and third segments: legs dark brown, with ferruginous tibiæ which are brown behind: halteres white: wings vitreous. Three lines. *Musca diaphana*, Fab. Gmel.

The female has the thorax bright golden green with light-blue reflections; the abdomen more silvery than the male; and besides the two fasciæ, there is a yellowish spot on each side of the fourth segment: the anterior thighs are yellow at the apex. Inhabits England, and is not unfrequent in woods in the south of Scotland. Twenty-nine species have been described, ten of which are ascertained to inhabit Britain. All of them are minute insects, several being only a line in length, and none exceeding the size of the species described above. They are remarkable for beauty of colouring, which generally consists of changeable tints of metallic green, blue, and silver white. This circumstance, together with the activity of their motions, by which their colours are continually presented under varying lights, renders them more observable objects, in the shade and among the foliage of woods, where they usually prevail, than might be inferred from the smallness of their size.

GENUS MEDETERUS, Fischer. Antennæ with the terminal joint short, sub-ovate, compressed, with a two-jointed dorsal seta: eyes separated: abdomen of the male with two filets at the apex: legs elongate, slender: wings incumbent, parallel. Meig. *Zw.* iv. pl. xxxv. f. 12-17.

M. regius. Male. Hypostoma and palpi white: antennæ black: forehead cinereous, with a greenish lustre: thorax dark green, with a greyish patch over the middle, in which are two blackish approximating longitudinal lines: sides of the thorax cinereous: abdomen sea-green, the hinder margin of the segments with a blackish band, bordered anteriorly with grass green: legs dark green: halteres white: wings hyaline, with a brown spot behind the middle, and the anterior margin from the middle to the apex more or less dusky, the apex itself with a white spot encircled with brown.

Female. Hypostoma black, steel-blue beneath; palpi greyish black margined with white: wings hyaline, with only the brown spot, the other markings wanting. Three lines. Found in France, Holland, Austria, and England.

GENUS SYBISTROMA, Meg. Antennæ with the terminal joint oblong, compressed, having an elongate two-jointed seta on the back, the first joint longest: eyes separated: abdomen of the male incurved at the apex, and furnished with two flat ciliated processes. Meig. *Zw.* iv. pl. xxxiv. f. 18-20.

S. patellipes. Male. Hypostoma rather wide, white; forehead whitish with a metallic lustre: antennæ with the two basal joints black, the third ferruginous: body obscure brassy: legs yellow, the anterior tarsi of the male orbicular, and of a black colour: halteres white: wings brown. Two and a half lines. Communicated to Meigen by Dr Leach, who found the insect in England.

GENUS DOLICHOPUS, Lat. Antennæ with the third joint trigonate, compressed; the dorsal seta pubescent: eyes separated: abdomen of the male with the apex incurved, and furnished with two membranous ciliated lamellæ: wings incumbent, parallel.

D. unguatus. Hypostoma silver white, rather wide in the female, and having a protuberance on each side beneath: palpi blackish: antennæ black: forehead, thorax, and abdomen brassy green: sides of the thorax slate-grey: coxæ greyish black, the anterior pair rufous beneath: abdomen bluish grey with a play of colour, the incisures and a line on the back black: legs rufous: apex of the hinder tibiæ, and all the tarsi, black: wings slightly cinereous: halteres yellowish white: anal segment of the abdomen in the males black, with bright yellow lamellæ

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which are edged with black. Three lines in length. Lat. *Musca angulata*, Linn.; *Nemotelus æneus*, Degeer, *Ins.* vi. 78, 15, pl. xi. f. 14-22. Found in England, the south of Scotland, and various parts of the continent. The genus contains upwards of fifty species, none of them much exceeding three lines in length; nearly the half inhabit Britain. The larva of the one above mentioned is described by Degeer. He found it under ground in the month of May. It is white, cylindrical, eight lines in length, with a pointed or conical anterior. The head varies in form, being often sunk into the first segment. On the fourth of June it became a nymph, of a much shorter and thicker shape than the larva. It was then very restless, rolling about incessantly, with a constant movement of the abdomen. The perfect insect appeared on the 27th of the same month.

GENUS ORTHOCHILE, Lat. Antennæ porrect, the third or terminal joint compressed, sub-orbicular, and having a dorsal seta: proboscis exerted, perpendicular, with acute incumbent palpi: wings incumbent, parallel.

O. nigrocærulea. Thorax shining blue black, the sides of the breast slate-grey: abdomen dark metallic green; the anal segment in the males shining black: coxæ slate-grey; the thighs black, with a ferruginous apex: tibiæ rufous, the hinder pair with the half next the apex black; tarsi black: wings brown. One line. Meig. *Zw.* pl. xxxvi. fig. 5. Found in France and Germany.

FAMILY XVIII.—OCYPTERÆ.

Antennæ porrect, three-jointed: abdomen consisting of six segments: wings without a transverse nervure, pointed: proboscis concealed.

GENUS LONCHOPTERA, Meig. (Plate CCXXXVIII. figs. 21 and 21 a.) Antennæ with the basal joint thickened at the apex, second cup-shaped, third sub-orbicular, compressed, with an elongate three-jointed villose seta at the apex: proboscis retracted: abdomen linear, elongate: wings lanceolate, incumbent, without transverse nervures. Meig. *Zw.* iv. pl. xxxvi. f. 6-13.

L. tristis. Forehead dusky black; wings smoke colour: under side of the head yellow: thorax shining black, the sides yellow: abdomen black, the terminal segment of the males with yellowish lamellæ: legs yellow; the hinder tibiæ somewhat clavate, stouter in the male than in the other sex: halteres white. Has been taken by Dr Leach in England, and occurs in the vicinity of London. *L. lutea*, known by its yellow colour, and a narrow black line along the whole length of the back, has recently been observed in Dumfriesshire and some other southern counties of Scotland.

FAMILY XIX.—SCENOPINII.

Antennæ deflexed, three-jointed; the third joint truncated and without bristles: proboscis concealed: abdomen consisting of eight segments.

GENUS SCENOPINUS, Lat. (Plate CCXXXVIII. figs. 22 and 22 a.) Antennæ sub-deflexed, three-jointed, the lower joints small, third elongate, sub-cylindric, truncated, without a seta: proboscis retracted and concealed: abdomen linear, flat, eight-ringed: wings incumbent, parallel.

S. vitripennis. Head glossy black: body black; thorax with a faint metallic lustre: halteres brown: head

white beneath: legs yellowish red: wings hyaline. One and a half line. Not common. Near Moffat.

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FAMILY XX.—CONOPSARIÆ.

Antennæ porrect, three-jointed, angular at the base: proboscis porrect, geniculated: thorax without a transverse suture: abdomen consisting of five or six segments: halteres naked: wings incumbent. Meig. *Zw.* iv. xi.

GENUS CONOPS, Linn. (Plate CCXXXVIII. figs. 23 and 23 a.) Antennæ approximating, the first joint cylindric, second and third clavate, the apex with a two-jointed style: proboscis standing out, filiform, geniculated at the base: ocelli wanting: wings incumbent, parallel.

C. flavipes. Antennæ black; head rufous, with a reddish-brown inflated vesicle on the crown, in front of which there is a black line; from this a black vitta extends to the antennæ, where it becomes wider, but does not reach the margin of the eyes: thorax deep black, with a yellow spot on each shoulder, and another on each side behind under the base of the wing: scutellum black, margined with yellow: abdomen sub-cylindric, slightly clavate behind, black; the second and third segments in the male, and the fourth also in the female, with a bright yellow band behind; the basal segment with a yellow spot on each side; the two terminal ones ash-grey: halteres rufous: legs yellow; thighs black, yellow at the base; apex of the tarsi brown: wings with the anterior margin more or less brownish. Five lines. *C. flavipes*, Linn.; *C. macrocephala*, Samou. *Comp.* pl. ix. fig. 8. Upwards of twenty species have been described as belonging to this genus, only six of which have been ascertained to inhabit Britain. They are usually found on flowers, and seldom occur in large numbers. The individual described is found not unfrequently in the south of England, and occurs sparingly during the autumn in Roxburghshire, and the neighbourhood of Edinburgh, generally on the flowers of *Senecio Jacobæa*.

Con. melanocephala of one of Meigen's earlier works was merely a specimen of the above in which the head had become black.

It appears that the females of these insects deposit their eggs in the larvæ of humble-bees (*Bombus*), or even in the bodies of the perfect insects. Latreille, indeed, has frequently observed them issue from the abdomen of the latter. MM. Lachat and Audouin presented a memoir to the *Société Philomatique*, on an apodal larva which they found in the month of July, in the interior of *Bombus lapidarius*, and which they deemed the larva of *Conops flavipes*.¹ Bosc seems to have also noticed this parasite, but he mistook it for an intestinal worm properly so called.²

GENUS ZODION, Lat. Antennæ with the basal joint cylindric, second clavate, compressed at the base, third ovate, the back with a style: ocelli three: proboscis standing out, filiform, elongate, geniculated at the base: wings parallel, incumbent.

Z. cinereum. Hypostoma pale reddish yellow, the margin of the eyes white, the latter colour extending half way up the forehead: forehead reddish yellow anteriorly, passing into dark brown above: antennæ black, the third joint rufescent, with a blackish apex; sometimes the second joint is likewise rufescent anteriorly: thorax cinereous, with four blackish longitudinal lines on the back, of which the two central ones are abbreviated, the sides and hinder part spotted with black: abdomen cinereous,

¹ See *Mém. de la Soc. d'Hist. Nat.* t. i. p. 330, pl. xxii.

² *Diction. Class. d'Hist. Nat.* t. iv. p. 404.

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the incisures from the second to the fourth marked with a cross row of elevated black points; the back sometimes with four blackish evanescent spots: anal segment of the males shining black: legs cinereous, the tarsi blackish: wings somewhat brownish, slightly ferruginous at the base. Three lines. Meig. *Zw.* iv. pl. xxxvii. figs. 6, 7; *Myopa cinerea*, Fab.; *Zodion conopsoides*, Lat. Usually found on umbelliferous flowers. It is an inhabitant of England, France, and various parts of the continent of Europe.

GENUS MYOPA, Fab. Antennæ with the basal joint cylindric, second clavate, compressed at the base, third globose, with a dorsal style: ocelli three: proboscis standing out, filiform, elongate, geniculated at the base and middle: wings incumbent, parallel. Meig. *Zw.* iv. 140.

M. buccata. Hypostoma white, without spots; forehead dark brown, with grey spots; antennæ testaceous, third joint reddish yellow: thorax spotted with black and cinereous: shoulders testaceous: scutellum dark brown: abdomen testaceous or reddish brown, spotted with grey on the sides: legs testaceous; thighs blackish before the apex: tibiæ with a dark-brown ring at the middle, and another at the apex; tarsi rufous: wing-scales white: halteres pale yellow; wings clouded with pale brown, the small cross nervure not darker coloured. Meig. *Zw.* iv. 142.

Conops buccata, Linn. Occurs at times on umbelliferous flowers, in gardens and fields, throughout England and the south of Scotland. Botanic Garden, Edinburgh. *M. picta*, which does not differ much from the above, is likewise found in similar situations near Edinburgh.

FAMILY XXI.—STOMOXIDÆ.

Antennæ deflexed, three-jointed, obtuse beneath: third joint with a dorsal seta: proboscis porrect, geniculated: abdomen consisting of four segments: halteres covered with a double wing-scale. Meig. *Zw.* iv. xi.

GENUS SIPHONA, Meig. Antennæ with the lower joints small; third elongate, linear, obtuse; the base with a naked dorsal seta: proboscis exerted, horizontal, filiform, geniculated at the base and middle: wings divaricating. Meig. *Zw.* iv. 154.

S. tachinaria. Thorax and scutellum pale cinereous; the abdomen nearly conical, pale ferruginous; the first and second segments pellucid at the sides, the incisures whitish, with small wart-like spots: thorax, scutellum, and abdomen of the females likewise pale ferruginous; the latter elliptical, and the sides not so clearly pellucid; legs ferruginous, with brown tarsi. Two lines. Meig. *Zw.* pl. xxxvii. fig. 25; *Stomoxys cristata*, Fab. Inhabits Europe. Has been found in England, but is very scarce.

GENUS STOMOXYS, Fab. (Plate CCXXXVIII. figs. 27 and 27 a); from *στομα*, the mouth, and *ξύς*, sharp. Antennæ incumbent, with the lower joints small; third elongate, compressed, linear, obtuse, with a dorsal seta at the base; proboscis standing out, horizontal, geniculated at the base; wings divaricating.

S. calcitrans. Hypostoma yellowish white: proboscis stiff, porrect, shining black beneath, with filiform, short,

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ferruginous palpi: forehead wide with a black line, somewhat narrower in the males than in the females: antennæ brown, with a seta which is plumose on one side: thorax cinereous, with short hairs and a black line along the back: abdomen rounded, covered with short hairs, cinereous, with shining black spots: legs black brown: wing-scales white: wings uncoloured. Three lines. *Conops calcitrans*, Linn.; Degeer, *Ins.* vi. 39, 11; *Musca pungens*, pl. iv. fig. 12-18. Not unfrequent throughout Britain. This is the common well-known stinging-fly, which, in hot and sultry summer days, persecutes men and beasts with its painful bite. It attacks the legs in preference to any other part of the body. Even horses and cattle are not protected by their thicker hides. It is said to be most annoying before a storm. The *C. calcitrans* is so like a common house-fly, as to have induced the erroneous belief that the latter is also a blood-sucker. The females lay their eggs in dunghills. According to the observations of MM. Lepelletier and Serville (*Encyclop. Méth.*), many individuals survive the winter in a state of torpidity,—twenty having been sometimes found together in a mass, within the hollow of a tree.

FAMILY XXII.—ÆSTRACIDÆ.

Antennæ small, three-jointed; the third joint with a naked seta: mouth closed up, without a distinct proboscis: abdomen pubescent, consisting of four or five segments. Meig. *Zw.* iv. xi.

GENUS ÆSTRUS, Linn. (Plate CCXXXVIII. figs. 24 and 24 a.) Antennæ with the lower joints minute, the third globose, with a naked seta: mouth closed: halteres covered: wings spreading, the apex with a transverse nervure.

Æ. ovis. Hypostoma flesh red: forehead dusky red, with a reddish line, and blackish depressions: antennæ black: thorax cinereous, sprinkled with small blackish warts, each of which supports a fine hair; on the neck these warts form lines: scutellum pale brown, with blackish warts placed without order: abdomen arched, rounded, obtuse, silky white, with a yellowish play of colour in some places, and prettily sprinkled with irregular spots of a deep shining black: legs pale red: wing-scales large and white: wings clear hyaline, with a blackish transverse nervure at the middle. Five lines. Meig. *Zw.* pl. xxxviii. fig. 16; Linn. Fab.; Réaumur, *Ins.* iv. *Mém.* xii. tab. xxxv. fig. 10-15; Clark, *Linn. Trans.* iii. tab. xxiii. fig. 14-17. Of the nine European species of *Æstrus*, as now restricted, only three inhabit Britain, viz. the one above described, and *Æ. pictus* (Curtis, *Brit. Ent.* iii. pl. cvi.), and *Boris*. *Æ. ericetorum* of Dr Leach is not regarded by Meigen as essentially distinct from that last named.

The injury and annoyance which the insects of this genus, familiarly known under the names of breeze, gad-fly, &c. cause to sheep and cattle, render them deserving of our careful consideration. Mr Bracy Clark, to whom we still owe the best account of their economy,² procured, about the middle of June, some full-grown larvæ of *Æ. ovis*, from the inside of the cavities of the bone which

¹ Meigen's expression, *mund geschlossen*, is obscure. It has in fact been doubted whether the insects of this and the following genus had any mouths. Linnæus says, "Os nullum punctis tribus;" but, according to Mr Bracy Clark, when the hairs, which in all the species greatly obscure the oral organs, are removed, two clavated palpi are seen, and between the opening of the mouth;—"and by laying open the vesicular or inflated part of the face, the continuation of it is visible in the form of a membranous *haustellum*, which is generally coloured with some dark-brown matter lodging on the inside: though I confess, after repeated dissections, I have not been able to trace this *haustellum* farther than the inside of the inflated part of the head, where it appears to enlarge and terminate. Fabricius has minutely described labia to the *haustellum*, and other apparatus to the mouth, which I have not been fortunate in obtaining a sight of. At the same time I cannot help being surprised that he should have overlooked the palpi, which he expressly denies the existence of, though tolerably visible even without the aid of glasses." (*Linn. Trans.* vol. iii. p. 322.)

² Observations on the Genus *Æstrus*, *Linn. Trans.* vol. iii. p. 289; see also the author's later work, *An Essay on the Bots of Horses and other Animals*, 4to, 1815. It is quoted and referred to by a recent French writer under the title of "The Bost of Horse!"

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supports the horns of the sheep. They were nearly an inch long, of a delicate white colour, flat on the under side, and convex on the upper; having no spines at the divisions of the segments of the body, though provided with tentacula at the smaller end. When young they are entirely white, but as they increase in size their upper side becomes marked with two transverse brown lines on each segment, and some spots become visible upon the sides. They move with considerable quickness, holding with the tentacula as a fixed point, and drawing up the body towards them. There is a broad line of dots on the under surface, which appear as rough points under a microscope, and probably serve both for locomotion, and for exciting such a degree of inflammation in the membrane on which they rest, as to cause the secretion of lymph or pus. Mr Clark has usually found these larvæ in the horns or frontal sinuses, though he has remarked that the membranes of those cavities were scarcely at all inflamed, while those of the maxillary sinuses were highly so. From this he is led to suspect that they inhabit the maxillary sinuses, and crawl, on the death of the animal, towards the horns and frontal sinuses. In common with *Æ. Bovis*, they do not seem confined to any particular season, for young and old are found together at the same time. When full grown they fall through the nostrils, and change to the pupa state, lying on the earth, or adhering by the side to a blade of grass. The fly bursts the shell of the pupa in about two months.

The manner in which the perfect insect lays its eggs is difficult to determine, owing to its obscure colour and extremely rapid movements. The great agitation of the sheep also interferes with accurate observation, but its general motions and method of defence leave little doubt that the eggs are deposited on the inner margin of the nostril. "The moment," Mr Clark observes, "the fly touches this part of the sheep, they shake their heads, and strike the ground violently with their fore feet; at the same time, holding their noses close to the earth, they run away, looking about them on every side, to see if the fly pursues; they also smell to the grass as they go, lest one should be lying in wait for them. If they observe one, they gallop back, or take some other direction. As they cannot, like the horses, take refuge in the water, they have recourse to a rut, or dry dusty road, or gravel pits, where they crowd together during the heat of the day, with their noses held close to the ground, which renders it difficult for the fly to get at the nostril." Mr C. imagines that the last-named part, from the constant attacks, and the consequent rubbing upon the ground, becomes inflamed and painful, which occasions their touch to be so greatly dreaded by the sheep.

The *Æstrus Bovis*, in the perfect state, is a very beautiful insect, and one of the largest of the European species. The wings are without spots; the abdomen has a central band of black, and is clothed at the extremity by reddish-yellow hairs. Although its effects on cattle have been often remarked, yet the fly itself, as Mr Clark has observed, is rarely seen or taken, "as the attempt would be attended with considerable danger." It inflicts greater pain in depositing its eggs than any other species. "When one of the cattle is attacked with this fly, it is easily known by the extreme terror and agitation of the whole herd: the unfortunate object of the attack runs bellowing from among them to some distant part of the heath, or the

nearest water, while the tail, from the severity of the pain, is held with a tremulous motion straight from the body, in the direction of the spine, and the head and neck are also stretched out to the utmost. The rest, from fear, generally follow to the water, or disperse to different parts of the field. And such is the dread and apprehension in the cattle, of this fly, that I have seen one of them meet the herd when almost driven home, and turn them back, regardless of the stones, sticks, and noise of their drivers; nor could they be stopped till they reached their accustomed retreat in the water. When oxen are yoked to the plough, the attack of this fly is attended with real danger, as they become perfectly uncontrollable, and will often run with the plough directly forwards, through the hedges, or whatever obstructs their way." The attack of this small but dreaded foe has indeed been often described, and by none with more of taste and accuracy than by the "Mantuan Bard."

Est lucos Silari circa, ilicibusque virentem
Plurimus Alburnum volitans, cui nomen Asilo
Romanum est, Æstron Graii vertere vocantes:
Asper, acerba sonans: quo tota exterritu sylvis
Diffugiunt armenta; fusit mugitibus æther
Concussus, sylvæque et sicci ripa Tanagri.¹

The female deposits her eggs with great rapidity, and does not remain above a few seconds on the back of the animal. The larvæ live beneath the skin, between it and the cellular membrane, in a proper sack or abscess, rather larger than the insect. When young they are smooth, white, and transparent, become darker as they increase, and when full grown are of a deep-brown colour. After a time they work their way out, fall to the ground, and assume the state of chrysalis, in which they continue from about the latter end of June till towards the middle of August, when the perfect insect makes its appearance.

GENUS *GASTRUS*, Meig.; *Æstrus*, Linn.; *Gasterophilus* Leach. (Plate CCXXXVIII. fig. 25, 28, and 28 a.) Antennæ with the lower joints small, the third compressed and furnished with a naked dorsal seta: mouth closed: halteres naked: wings without a transverse nervure at the apex. Meig. *Zw.* iv. tab. xxxviii. fig. 18-23.

G. Equi. Head with fine hairs, yellowish grey, the forehead rather darker, with two reddish-brown vittæ: antennæ ferruginous: thorax anteriorly with ferruginous pubescence, that on the hinder part of a darker colour, the sides with rather long glistening hairs passing into whitish yellow: scutellum with black pubescence behind: abdomen ferruginous, the pubescence fine, with a silky gloss; the back with a triangular blackish spot on each of the segments, and sprinkled with several small spots, at least in the male: legs and halteres ferruginous: wing-scales white: wings whitish; having a waved brownish-grey band across the middle, and two spots of the same colour at the apex: the ovipositor of the females is thick, cylindrical, and of a shining black colour. Five lines. Meig. *Zw.* iv. pl. xxxviii. 21, 22; *Æs. Bovis*, Linn.; *Æ. Equi*, Linn. *Trans.* iii. 298, pl. xxiii. f. 7-9.

Not common in Britain. This species, likewise known by the name of breeze or gad-fly, usually frequents elevated heathy districts, and we have observed it flying about the summits of the Westmoreland hills,² and those of Roxburghshire. Mr Bracy Clark has also furnished us with some valuable information on the manners and metamorphosis of this insect, the larvæ of which are com-

¹ *Georg.* lib. iii.

² On one occasion particularly, on crossing some hill pasture above Elleray, the seat of Professor Wilson, we were suddenly attacked by three of these insects. They flew round about us in a state of angry excitement, coming sometimes within a few inches of the face, and keeping so close to each other, that, having the forceps in hand, we captured the whole three at once, to their great surprise, and probably disappointment.

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monly called *bots*. "The mode pursued by the parent fly to obtain for its young a situation in the stomach of the horse is truly singular, and is effected in the following manner:—When the female has been impregnated, and the eggs are sufficiently matured, she seeks among the horses a subject for her purpose, and approaching it on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards: in this way she approaches the part where she designs to deposit the egg, and suspending herself for a few seconds before it, suddenly darts upon it, and leaves the egg adhering to the hair: she hardly appears to settle, but merely touches the hair with the egg held out on the projected point of the abdomen. The egg is made to adhere by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and, poisoning herself before the part, deposits it in the same way. The liquor dries, and the eggs become firmly glued to the hair: this is repeated by various flies till 400 or 500 eggs are sometimes placed on one horse. The horses, when they become used to this fly, and find it does them no injury, as the *Tabani* and *Conopes*, by sucking their blood, hardly regard it, and do not appear at all aware of its insidious object."¹ The inside of the knee is the part usually chosen, although other places are sometimes selected. It is worthy of note, however, that these ova are always laid where they are most liable to be licked off by the horse's tongue. It is not, however, precisely the eggs themselves which are conveyed into the interior of the animal. Mr Clark found that after they have remained four or five days on the hairs, they became *ripe*,—after which the slightest application of warmth and moisture is sufficient to bring forth the latent larva in an instant. "At this time, if the tongue of the horse touches the egg, its *operculum* is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach." Mr Clark has often clipped off some hairs with eggs on them, and holding them in his hand, moistened with saliva, has seen them hatched in a few seconds. If the larvæ pass the dreadful ordeal of mastication, and are transmitted uninjured to the horse's stomach, they attach themselves to every part of it, but are generally most numerous about the *pylorus*. Sometimes, but much less frequently, they occur in the intestines. Their numbers are very various,—from half a dozen to above a hundred. They generally hang in clusters, being fixed by the small end to the inner membrane of the stomach, to which they adhere by means of two small hooks or *tentacula*. When removed from the stomach they will attach themselves to any loose membrane with which they may come in contact, and even to the skin of the hand. On attaining to their full size, they pass by the intestinal canal, drop to the ground, and enter the chrysalis state. Upon the whole, Mr Clark does not regard these insects as hurtful to horses, but rather views them favourably, as natural *stimuli*. Valisnieri, however, considered them as the cause of the epidemic malady which in 1713 carried off so many horses in the territories of Mantua and the Veronese.²

Four other species are found in Britain, besides the one to which the preceding observations more particularly ap-

ply,—viz. *Æ. hæmorrhoidalis*, *nasalis*, *Clarkii*, and *salutiferus*.³

FAMILY XXIII.—MUSCIDES.*

Antennæ inclined, three-jointed, obtuse beneath: the third joint with a seta on the back: proboscis concealed, geniculated at the base: thorax with a transverse suture: abdomen having from four to six segments. Meig. *Zw.* iv. xi.

GENUS XYSTA, Meig. Antennæ incumbent, shorter than the hypostoma, second and third joints nearly equal, compressed; the terminal one with a naked dorsal seta at the base: mouth with a mystax: abdomen convex, consisting of five or six segments: wings divaricating.

X. cilipes. Hypostoma and forehead greyish white, the last with a black line: palpi ferruginous, the apex brown: thorax dark grey, with three blackish lines: abdomen shining black, consisting of six segments; the two terminal segments grey, the apex having a shining black bent appendage: legs black, strong: the hinder tibiæ arched, dilated, and fringed with long black bristles: wing-scales white; halteres slender, black: wings hyaline, yellowish at the base. Three and a half lines. Meig. *Zw.* iv. 182, pl. xxxix. f. 5.

Two species only belong to this genus, both of which appear to be scarce on the continent, and neither of them has been observed in Britain.

GENUS PHASIA, Lat. Antennæ incumbent, shorter than the hypostoma, third joint rather longer than the second, obtuse; the base with a naked dorsal seta: mouth villose: abdomen depressed, pubescent, consisting of five segments: wings divaricating. Meig. *Zw.* iv. pl. xxxix. f. 6–16.

P. subcoleoptrata. Hypostoma whitish, with a pearly play of colour; forehead white, with a changeable dark grey line; antennæ blackish brown; thorax light grey, with four black lines, the two central ones abbreviated behind: scutellum cinereous: abdomen oval, flat, black brown in the male, with cinereous, and sometimes reddish-brown reflections, the apex golden yellow: that of the female black brown, with a dark dorsal line: wing-scales of the male brownish, of the female white: legs blackish: wings of the male broad, yellowish at the base, the anterior margin having a brown vitta extending rather beyond the middle, and there is another of the same colour along the centre, which is dilated at the apex so as to appear somewhat curved forwards; wings of the female comparatively narrow, hyaline, somewhat yellowish at the base. Male four, female three lines. Meig. *Zw.* iv. 190, pl. xxxix. f. 13.

Occurs in the northern parts of the continent of Europe and in Britain, but appears to be rare. *P. hemiptera*, *semicinerea*, and *pusilla*, are the only other kinds hitherto found in Britain, although the genus contains upwards of thirty species.

GENUS GYMNOSOMA, Meig.; from *γυμνος*, *naked*, and *σῶμα*, *the body*. Antennæ with the second and third joints nearly equal; the terminal one compressed, linear, obtuse; with a naked dorsal seta at the base: mouth naked: abdomen nearly naked, globose, consisting of four segments: wings spreading. Meig. *Zw.* iv. pl. xxxix. f. 17–22.

¹ See Linn. *Trans.* vol. iii. p. 293; and the Essay mentioned in preceding note.

² *Ragionamento intorno all' Æstre de Buoi.* Opere, t. i.

³ Stephens' *Systematic Catalogue*, part ii. p. 296.

* The tribe Muscides of Latreille (excepting, we believe, the genera *Diopsis*, *Scenopina*, and *Achias*) has been recently created into a separate order, named MYODABIE, by M. Robineau Desvoidy. See an abstract of his views in the *Diction. Class. d'Hist. Nat.* t. xi. p. 365.

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G. rotundata. Male. Hypostoma straw-colour, silky; forehead golden yellow, with a brownish vitta changing into red: antennæ black; the third joint ferruginous on the inner side at the base; thorax dull-ferruginous, with four brownish longitudinal lines, and a shining black transverse band behind: scutellum black: abdomen ferruginous, pellucid, with black spots on the back: legs black: wings brownish, ferruginous at the base: wing-scales dirty white.

Female. Hypostoma and forehead pearl-white; the frontal vitta brown: thorax cinereous on the sides and beneath. Four lines. *Musca rotundata*, Linn. Fab.; *Ocyptera rotundata*, Lat. On flowers and shrubs: found near London, and on the continent, not unfrequently.

GENUS OCYPTERA, Meig. (Plate CCXXXVIII. figs. 26 and 26 a.) Antennæ somewhat deflexed, third joint longer than the second, linear, compressed, obtuse, having a naked dorsal seta at the base: mouth furnished with a mystax: abdomen elongate, cylindric, subsetose, four-ringed: wings spreading. Meig. *Zw.* iv. pl. xxxix. f. 23-29.

O. brassicaria. Hypostoma and forehead silky white, the former with two narrow black lines, the latter with a broad black vitta: antennæ blackish: thorax anteriorly slate grey, with four black lines, the two in the centre narrow: abdomen with the first and second segments sanguineous, the former with a large triangular mark of black on the back, the two terminal segments black, the penultimate one silvery on the anterior margin: legs black: wing-scales pale white: wings brownish grey, the base ferruginous. Five to six lines. Meig. iv. 211, pl. xxxix. f. 29. Apparently a scarce species. It occurs near Edinburgh.

M. Leon Dufour, in a memoir on the insects of this genus, has shown that the larvæ of two species, *O. cassidæ* and *bicolor*, are parasitical,—the first in the visceral cavity of *Cassida bicolor*, the second in that of *Pentatoma grisea*. Each feeds upon the epiploon or fatty matter of his host.¹

GENUS LOPHOSIA, Meig. Antennæ deflexed, the two basal joints minute, the third very large, compressed, triangular, with a naked dorsal seta at the base: mouth with a mystax: abdomen cylindric, composed of four segments: wings spreading. Meig. *Zw.* iv. pl. xl. f. 1-4.

L. fasciata. Hypostoma silky white; antennæ with the two first joints black, the third brown: thorax bristly, shining black above, dark grey on the sides, with a changeable cinereous spot on each shoulder: abdomen sub-cylindric, arched, slightly narrowed at the base, bristly, of a shining black colour, the anterior margin of the second and third segments changeable white: thighs black, somewhat pubescent, bluish white beneath, with a naked white spot on the inner side at the apex; anterior tibiæ blackish brown, posterior rufous: tarsi black: wings hyaline, with a broad obsolete cross band of a brownish colour before the apex. Five lines.

This genus is readily distinguishable from all the allied genera by the large and distinctly trigonate terminal joint of the antennæ. It contains but one species, which occurs on the continent.

GENUS PHANIA, Meig.; named from *φανος*, because most of the species are pellucid. Antennæ deflexed, third joint elongate, linear, compressed, obtuse; the base with a naked dorsal seta: mouth with a mystax: abdomen consisting of four segments, the apex elongate, and bent inwards: wings spreading. Meig. *Zw.* iv. pl. xl. f. 5-10.

P. curvicauda. Head silver white, with a black play of colour: palpi and antennæ black brown; the third joint with a finely pubescent seta, thickened at the base; forehead with a deep black line, broadest in the female: body shining black, bristly, except on the shoulders, where there are white spots: wing-scales white: halteres black brown: wings brownish grey, the base yellowish: legs black. Meig. iv. 221, pl. xl. f. 10. Rare: it occurs in Britain along with two other species, *P. vittata* and *thoracica*.

GENUS TRIXA, Meig. Antennæ incumbent, short; second and third joints equal, terminal ovate, having a naked dorsal seta at its base: hypostoma villose, without a mystax: wings spreading, with a transverse nervure at the apex. Meig. *Zw.* iv. pl. xl. f. 11-16.

T. dorsalis. Hypostoma cinereous; palpi and antennæ black brown: thorax ash grey, with four black lines: scutellum black: abdomen rufous, having a broad dorsal line of black, which at the base of the segments changes with a play of colour into whitish grey; the third and fourth segments have a similar play of colour on the sides; wing-scales white: wings greyish; the small cross nerve of the middle rather thick, black, edged with brown: legs black; tibiæ and tarsi faintly rufescent. Five lines. Inhabits Britain, but is scarce. Only one other species of the six described by Meigen is known to be British,—*T. variegata*, which has occurred in the neighbourhood of London, in Dumfriesshire, and near Edinburgh.

GENUS MILTOGRAMMA, Meig. Antennæ incumbent, third joint elongate, linear, compressed; the base with a naked dorsal seta: mouth setose: wings spreading, the apex with a transverse nervure. Meig. *Zw.* pl. xl. f. 17-26.

M. fasciata. Hypostoma white, with flesh-coloured play of colour: palpi and antennæ clear reddish yellow; the frontal vitta rather broad: thorax and scutellum cinereous, with three black lines: abdomen conical, the first segment black, the following white anteriorly, and banded with black behind; on the sides the white passes with a play of colour into brownish red: legs black: wing-scales white. Four lines. Meig. iv. 227, pl. xl. f. 26.

The males have been found in Germany, the females are unknown.

GENUS TACHINA, Illig. Antennæ deflexed or incumbent, the third joint truncated beneath; the base with a naked dorsal seta: mouth with a mystax: wings spreading, having a transverse nervure at the apex. Meig. *Zw.* iv. 234, pl. xl.

T. grossa. Head ferruginous, with a brown frontal line changing into ferruginous; palpi ferruginous, with black bristles; antennæ blackish brown at the base; second joint ferruginous, third sub-quadrate, brown with a yellowish play of colour: seta black: body shining black: wing-scales dark brown: wings greyish, the base ferruginous: legs black. Eight lines. Meig. iv. 239. *Musca grossa*, Linn.; *Echinomyia grossa*, Lat. Found occasionally in most parts of Britain. We took it in Sutherland. It is one of the largest of the European Diptera. The larva lives in the dung of cattle, and is described by Réaumur. We may observe that the genus Tachina, notwithstanding the labours of recent writers, is still a great magazine of ill-assorted species. Considerably above three hundred occur in Europe.

GENUS GONIA, Meig.; from *γωνία*, an angle, referring to the form of the antennal seta. Antennæ deflexed, incumbent, the third joint elongate, prismatic, the base with a naked seta, which is three-jointed and geniculate:

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¹ *Annales des Sciences Nat.* t. x. p. 248. See also *Règne Animal*, t. v. p. 513.

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eyes remote: wings spreading, the apex with a transverse nerve.

G. capitata. Head reddish-yellow, with a whitish play of colour; palpi ferruginous; antennæ dark brown; the second joint ferruginous: thorax blackish, passing into brown on the back, with an ash-grey play of colour, and marked with four black lines; scutellum brownish yellow: abdomen pellucid, ferruginous, shining, with an indistinct dorsal line of black; the first and second incisures have a very narrow, and the third a wider edge of changeable whitish yellow: belly ferruginous; legs black: wing-scales white: wings somewhat grey, with the base yellowish. Six to seven lines. *Musca capitata*, Degeer, *Ins.* vi. 12, 2.

This genus is of limited extent, not including more than a dozen species. Two of these, besides the above, occur in Britain, but are by no means common. *G. capitata* seems to be most plentiful in Sweden.

GENUS ZEUXIA, Meig. Antennæ incumbent, the second and third joints equal, the third or terminal one compressed and obtuse, having a plumose dorsal seta at the base: mouth with a mystax, and clavate projecting palpi: wings spreading, the apex with a transverse nerve.

Z. cinerea. Hypostoma white: forehead wide, bristly, white with a small black line: palpi extended horizontally, large and clavate, ferruginous; antennæ brown: thorax bristly, having a suture across the back, the colour pale grey, with four black lines anteriorly, and three behind, the central ones much narrower than those at the sides: abdomen bristly, conical, four-ringed, and of an ash-grey colour changing into brown: legs black: wing-scales large, the halteres covered: wings nearly hyaline. Three lines. Has been found in Germany.

GENUS IDIA, Meig. Antennæ incumbent, the third or terminal joint oblong, having a dorsal seta at the base, plumose on one of the sides: palpi projecting, clavate: wings with a transverse nerve at the apex.

I. fasciata. Hypostoma shining black, spotted with white, and not furnished with a mystax: antennæ shorter than the hypostoma, and of a brown colour: thorax ash-grey, the colour playing into black, with three broad lines of black down the middle: scutellum grey, with a blackish play of colour: abdomen oval, black, with three rufous interrupted bands: belly yellowish red: legs black: wing-scales white, entirely covering the halteres: wings greyish. Three lines. Has been found at Marseilles, and on the hills near Frejus, but is very rare.

GENUS MESEMBRINA, Meig. The generic term is a Greek word signifying meridian. Antennæ incumbent, the third or terminal joint oblong, prismatic, having a plumose dorsal seta at the base: body hirsute: wings spreading, and furnished with a transverse nerve at the apex.

M. meridiana. Hypostoma black, with a large angular spot of a bright gold colour on each side: forehead shining black, with a dull black streak: palpi black: antennæ dark brown, the seta ferruginous at the base: body and legs shining black; the two last joints of the anterior tarsi brown in the males, all the onychii yellow: halteres brown: wing-scales, and likewise the base of the wing, ferruginous. Six lines. *Musca meridiana*, Linn. Fab. Common throughout Britain during the summer and autumnal months, on flowers and in woods—often seen resting on the stems of trees.

The larva of this species lives in cow-dung. It is yellow, conical, and composed of many segments. At the mouth or narrowest end it has only one hook, and four short fleshy horns or warts. The hinder end or anus is, as it were, four-cornered and truncated, and has two circular brown spots, which are slightly raised, and are each

perforated by a single air-hole. The two anterior air-holes are placed on the sides of the first segment. The larva changes itself in its own skin into a dark-brown nymph, which is nine-cornered behind, or nearly circular, and the posterior air-holes are observable. In summer the fly appears in a few weeks, but the nymphs formed late in the season continue throughout the winter, and produce the perfect insect in the spring.

The species of this genus are not regarded as generically distinct by Latreille, but form part of his genus *Musca*, or *Mouches proprement dites*.

GENUS SARCOPHAGA, Meig. Named from *σαρξ*, *flesh*, and *φαγω*, *I eat*. Antennæ incumbent, the third or terminal joint oblong, prismatic, the base with a plumose seta, naked at the apex: eyes not united: wings spreading, and furnished with a transverse nerve at the apex. Meig. *Zw.* v. 14, pl. xliii. fig. 1-10.

S. mortuorum. Head silky golden yellow, with a reddish play of colour; palpi ferruginous; antennæ fulvous, changing into whitish grey; line down the forehead reddish brown, changing into golden yellow: thorax blackish, with a grey play of colour, and black lines: abdomen shining steel blue; belly and legs black: wing-scales white: wings greyish. Five to six lines. *Musca mortuorum*, Linn. Fab. Frequent in the south of Scotland, in England, and apparently throughout the north of Europe, except Germany, where it is said to be rare.

In this genus the eggs are not unfrequently hatched within the body of the mother, which has induced their being regarded as viviparous,—strictly, *ovoviviparous*. Of this kind is the *S. carnaria* (*Musca carnaria*, Linn.), a species somewhat larger than the common flesh-fly (*M. vomitoria*). The female deposits her living larvæ on meat, carcasses, and even on wounded or diseased subjects of the human race.

GENUS DEXIA, Meig. Antennæ incumbent, the third or terminal joint elongate and compressed, with a densely plumose seta at the base: abdomen conical (in the male) or oblong-elliptical (in the female): wings spreading.

D. compressa. Hypostoma of a shining silvery hue, with a black play of colour; forehead shining black, with a deep-black vitta; palpi rufous; antennæ nearly the length of the hypostoma, slender, the seta with a short plume: thorax bluish grey, with two wide shining black lines, which are continued over the grey scutellum to the sides: abdomen somewhat compressed on the sides, shining rufous, with a blackish line on the back spotted with grey; the incisures bright silver white, with a play of colour; legs black, with rufous thighs: wing-scale large and white: wings with a marginal spine, brown, clouded, and yellow at the base. Four to five lines. *Ocyptera rufa*, Fab.; *Musca rufiventris*, Fallen. Rather scarce: has been found in Germany, Spain, England, and some other parts of Europe. Twenty-four species are referred to this genus, fourteen of which seem to be indigenous to Britain.

GENUS MUSCA, Linn. Antennæ incumbent, the third joint elongate, obtuse, compressed in a prismatic form, the base with a plumose dorsal seta: abdomen ovate, setose: wings spreading, the apex with a transverse nerve.

M. maculata. Male. Hypostoma white, with a brown play of colour; forehead white, with a blackish vitta, which becomes narrow above; palpi black: thorax whitish, with four broad black lines, the two central ones united behind the cross suture, and drawn over the scutellum in the form of a lozenge; the scutellum having a black spot on the side: abdomen globose, grey, with a light testaceous-red play of colour, and several deep black spots of different form and size: legs black; wing-scales dirty white: wings somewhat brownish.

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Female. Forehead wide, whitish, with a deep-black double vitta: thorax light grey, the lines narrower than in the male: abdomen light grey, rarely inclining to testaceous; the spots and other characters as in the other sex. Four lines. *Musca maculata*, Gmelin. Degeer. *Ins.* vi. 41, 13. In summer and harvest in hedges and on flowers; not rare. It is frequent in Roxburghshire during the autumn on the flowers of *Senecio Jacobææ*. Many of the insects of this genus are very common. *M. Caesar*, distinguished by its brilliant golden-green colour, and *M. vomitoria*, commonly called the *flesh-fly*, are abundant on carcasses throughout Europe. The common house-fly, *M. domestica*, is remarkable for its extensive distribution, being found in Pennsylvania, New Orleans, and other parts of the new world.

We may observe in regard to the last-named species, that it is subject to a singular disease, of which the cause is not yet known. A white crust forms upon the abdomen, which becomes greatly distended, and the segments become distant from each other, so as to produce a ringed appearance. In this condition it is frequently found dead, adhering to walls, and sometimes to the stalks or leaves of plants. Its body is at this time filled with a fatty matter, which has been observed to have exploded on all sides through the pores.

GENUS ANTHOMYIA, Meig.; from *antos*, a flower, and *myia*, a fly. Antennæ deflexed, the third or terminal joint oblong, compressed, obtuse, the base with a plumose, pilose, or naked seta; the frontal vitta obscure, narrowed above in the male: mouth with a mystax: abdomen consisting of four segments, setose: wings spreading or incumbent, without a transverse nerve at the apex.

A. Angelicæ. Hypostoma and forehead white, the former with a blackish play of colour: thorax bright grey in the male, inclining to ferruginous in the female: scutellum and abdomen ferruginous, the last without a brown play of colour; the black dorsal line does not extend to the hinder extremity, and in the female it is usually interrupted on the third segment: legs rufous, with brown tarsi. Four lines. *Musca Angelicæ*, Scop. *Ent. Cariol.*; *Musca deceptoria*, Gmel. Schrank. Abundant in woods in the south of Scotland, and apparently equally plentiful in England.

The genus *Anthomyia* contains upwards of two hundred European species, more than the half of which have been found in Britain. In addition to the one described above, we may name two other well-known species of the genus *A. meteorica* and *pluvialis*, Linn.

GENUS DRYMEIA, Meig. Antennæ deflexed, the third joint oblong, compressed, obtuse at the apex, with a pubescent dorsal seta at the base; forehead with an obscure vitta; the eyes of the male united: mouth with a mystax: proboscis slightly projecting, the capitulum oblong, and furnished with a hook: abdomen four-ringed, setose: wings incumbent, parallel, without a transverse nerve at the apex.

D. obscura. Hypostoma white, with a blackish play of colour; antennæ half the length of the hypostoma, black; thorax shining black, bristly, with a cross suture; that of the female inclining to grey, and having two indistinct longitudinal lines of a dark colour: abdomen rather long, bristly, ash-grey, with spots and a line along the back of changeable black; flat in the male, arched in the female, and acute behind: wing-scales small and white: halteres black: legs of the same colour: wings somewhat brownish. Three to four lines. Found in August and September, not unfrequently, in many parts of the continent. Another insect, presenting generic characters somewhat similar to the above, has been found in England, and is

named *D. hispida*: some doubt, however, attaches to the propriety of referring it to this genus.

GENUS ERIPHIA, Meig. Antennæ incumbent, the third joint oblong and compressed, the apex obtuse, and having a naked dorsal seta at the base: mouth very hirsute: eyes of the male united: abdomen four-ringed, the apex very hirsute in the male: wings without a transverse nerve at the apex.

E. cinerea. Male. Hypostoma grey, shining white on the sides; forehead black, changing into grey; antennæ black: thorax bristly, rather glossy black, with a faint grey play of colour, and marked with three black lines: abdomen with the first segment black, the following three ash-grey, having a dark-brown play of colour, and a black line on the back; the second and third with a black band behind: wing-scales small, yellowish: halteres black: wings somewhat brownish: legs black. Four lines. Found by M. Baumhauer at Genisberg.

GENUS DIALYTA, Meig. Antennæ incumbent, the length of the hypostoma, the third joint long, compressed, obtuse at the apex, with a naked dorsal seta at the base: mouth with a mystax: eyes equally remote: abdomen four-ringed, pilose: transverse nerve at the apex of the wing wanting.

D. erinacea. Hypostoma silky white, with a black play of colour; forehead shining black, with a deep black vitta changing into whitish grey; palpi black, bristly; the antennæ likewise black: body shining black; thorax somewhat hoary, having two scarcely perceptible longitudinal lines, and a distinct prominence on the shoulders: abdomen of the males rather long, elliptical, flat, arched, somewhat greyish, the incisures and a line on the back black, but very faintly marked; that of the female oval, pointed, much arched, and shining black: wing-scales white; halteres black: wings broad, ferruginous at the base: legs black. Three to four lines. A rare species, the native country of which is not yet known.

GENUS COENOSIA, Meig. Antennæ incumbent, the third or terminal joint long, linear, compressed, with a seta at the base, which is either plumose, or pubescent, or naked: mouth with a mystax: eyes distant, those of the male somewhat approximating: abdomen four-ringed, setose, clavate at the apex in the male: wings incumbent, without a transverse nerve at the apex. The insects of this genus, which is of considerable extent, are found in hedges and on flowers, the smaller kinds are most abundant among grass. With the exception of the species described below, we are not acquainted with their habits and metamorphoses.

C. fungorum. Hypostoma white, changing into brown; forehead black, the hinder part of the head ash-grey; palpi and antennæ black, the seta of the last distinctly plumose: thorax grey, with four black lines, which, however, are often indistinct: abdomen rather long, rufous, sometimes with a brownish dorsal line: legs rufous, with black tarsi: wing-scales and halteres white: wings somewhat clouded. The scutellum is sometimes ferruginous, as well as the shoulders. Three and a half lines. The larva of this insect lives in mushrooms, is four and a half lines long, of a whitish-grey colour, with two hooks on the head, the hinder part thick and obtuse. It undergoes its metamorphosis in the earth.

GENUS LISPE, Meig. Antennæ incumbent, the terminal joint elongate, compressed, obtuse at the apex, and having a plumose seta at the base: eyes distant: palpi somewhat projecting, slender, spoon-shaped at the apex: abdomen ovate, four-ringed: wings incumbent.

L. tentaculata. Male. Hypostoma silky whitish yellow; the frontal vitta wide, and blackish grey; palpi of a shining silvery hue, with a yellow play of colour: thorax

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greyish black, with dark indistinct longitudinal lines: abdomen flat, ovate; the first segment grey, the following black; the second and third segments with a rounded white spot on the back, and another on each side of a triangular form placed at the anterior edge; the fourth having only the two triangular spots: legs black; the anterior tarsi have the first joint somewhat shorter than the second, and black, the rest yellowish; wing-scales and halteres white; wings rather grey.

Female. Hypostoma bright yellow; the spots on the abdomen grey; the legs wholly black, the tarsi all alike. Three lines. *Musca tentaculata*, Degeer. Found in Germany, and various other parts of the north of Europe. In Britain it has occurred near London, and seems to be the only species of the genus belonging to this country.

GENUS CORDYLURA, Fallen. Antennæ deflexed, the terminal joint oblong, compressed, truncated at the apex, the base with a seta, which is either plumose or villose: head spheroidal, the hypostoma scarcely descending, and furnished with an imperfect mystax; eyes distant, globose: abdomen five or six ringed, that of the male linear and clavate at the apex; wings incumbent, parallel, the length of the abdomen.

C. pubera. Hypostoma white; palpi black: antennæ shorter than the hypostoma, black, with a plumose seta: forehead of the male not so wide as that of the female, black, with a greyish-white play of colour, sometimes changing anteriorly into reddish yellow: body bristly, shining black; thorax with a line of changeable white in the middle of the front: the sides of the thorax changing into bluish white: wing-scales and halteres white: wings rather dull, the base and anterior margin ferruginous: thighs black, the tibiæ and tarsi testaceous, the latter in the male spotted on the under side with black. Four lines. *Musca pubera*, Linn. Fab. Meig. Zw. pl. xlv. fig. 22, female. Of occasional occurrence in the southern parts of England.

GENUS SCATOPHAGA, Meig.; from *σκατος*, dung, and *φαγω*, to eat. Antennæ deflexed, the terminal joint elongate, prismatic, obtuse, the base with a seta, which is either plumose or naked; head spheroidal, the hypostoma descending, and furnished with a mystax: eyes distant, rounded: abdomen five-ringed, linear in the male: wings incumbent, parallel, much longer than the abdomen.

S. scybalaria. Hypostoma, antennæ, and frontal vitta rufous, the latter very wide; palpi whitish; thorax brownish yellow, with obsolete lines: abdomen brownish yellow, that of the male thick, and clothed with rufescent hairs; legs ferruginous, pubescent; wing-scales small and yellow: halteres yellow: wings large, ferruginous, with brown nervures, the transverse nerve in the middle black, and usually a little bent. Five lines. *Musca scybalaria*, Linn. Fab. This species is of frequent occurrence in Britain. *S. stercoraria* and *S. merdaria* are among our most common insects, and most of the species described by Meigen, amounting to fifteen in number, are inhabitants of this country.

GENUS DRYOMYZA, Fallen. Antennæ incumbent, approximating, the third or terminal joint oblong, obtuse, prismatic, with a villose seta at the base: head spherical; the hypostoma descending, coarctate, naked, blunt below: eyes remote, rounded: abdomen oblong, five-ringed: wings incumbent, very much longer than the abdomen.

D. flaveola. Light ferruginous, shining: hypostoma bright yellow, especially on the sides; antennæ black brown, with a dark-yellowish base, and a long black pubescent seta: thorax with two brownish approximating lines on the back; on the abdomen are likewise four brownish lines, but these, properly speaking, are the interior vessels shining through: legs ferruginous, becom-

ing brownish at the extremity: halteres clear yellow; the wings hyaline. Five lines. *Musca flaveola*, Fab. Not rare in Britain, nor in most other parts of Europe.

GENUS SAPROMYZA, Fallen. Antennæ deflexed, the third or terminal joint oblong, compressed, obtuse at the apex, the base with a seta, which is either shortly plumose or villose: head sub-hemispheric, the hypostoma somewhat descending, naked, flat: eyes distant, rounded; abdomen oblong, five-ringed: wings incumbent, parallel.

S. rorida. Entirely pale yellow, the seta of the antennæ short and plumose: hypostoma and incisures of the body whitish: wings of a yellowish tint. Two lines. Found during summer, not unfrequently.

GENUS ORTALIS, Fallen. Antennæ deflexed, oblique, the third or terminal joint oblong, compressed, and having a naked seta at the base: hypostoma arched in the middle, naked; the forehead hirsute; eyes oblong; abdomen five-ringed: wings erect (vibrating).

O. vibrans. Hypostoma and forehead very bright orange yellow, with the margin of the eyes whitish: antennæ rufous, with a finely pubescent seta: body shining bluish black: halteres white: wings hyaline, the first longitudinal nerve thick, and of a black colour; the apex of the wing occupied by a triangular blackish-brown spot: legs black. Two and a half lines. *Musca vibrans*, Linn. Fab. Degeer. Don. x. 54, pl. ccxlv. fig. 3. *Tyrophaga vibrans*, Curtis, B. E. fol. 126. This insect, which forms the genus *Seioptera* of Kirby, is of frequent occurrence throughout England and the southern district of Scotland. It is rare in Germany, but is plentiful in Sweden and most other northern countries.

GENUS SEPSIS, Fallen. Antennæ incumbent, the terminal joint oblong, obtuse, compressed, with a naked seta at the base: head globose; the hypostoma flat, and furnished with a mystax; eyes rounded, distant: abdomen four-ringed, petiolate, sub-cylindric, naked: wings erect (vibrating). These lively little insects, which are in constant motion, are found on bushes, in hedges, and among grass, almost everywhere, and are for the most part very common from the first bright warm days of spring to the end of harvest: they probably continue during winter. Their natural history is not known.

S. cynipsea. Head shining black; antennæ brown: body shining black, with metallic lustre: legs black; anterior coxæ yellow, the thighs black; tibiæ rufous, inclining to testaceous; and in the hinder legs the base of the thighs is rufescent. One and a half line. *Musca cynipsea*, Linn.; *Micropeza cynipsea*, Lat. Common in England and the south of Scotland. In the vicinity of Edinburgh *S. cylindrica* is common, and we have likewise observed *S. nigripes*, *S. violacea*, and *S. punctum*.

GENUS CEPHALIA, Meig. Antennæ incumbent, the third joint elongate, compressed, gradually attenuated, with a pubescent dorsal seta at the base: hypostoma descending, naked; the proboscis standing out: eyes distant, rounded: abdomen four-ringed: wings . . .

C. rufipes. Hypostoma testaceous; forehead black; palpi black; antennæ blackish brown, rufescent at the base: body black, naked: sides of the thorax, breast, and scutellum testaceous: halteres white, not covered; scarcely a trace of the wing-scales is perceptible; legs slender, testaceous: wings hyaline, the first longitudinal nerve thick and black, the apex with a brown spot. Has been found at Berlin and in Austria.

GENUS LAUXANIA, Lat. Antennæ projecting obliquely, remote, the third or terminal joint elongate, compressed, obtuse, with a shortly plumose seta at the base: hypostoma somewhat descending, impressed in the middle: eyes remote, oblong: abdomen ovate, five-ringed: wings parallel, incumbent.

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L. cylindricornis. Shining black; eyes during life green, with four purple bands; antennæ projecting straight forwards, longer than the head, dark brown, with a whitish pubescent seta; hypostoma shining black, with the lateral edge glistening white; forehead with a dull-black vitta; wing-scales and halteres black; legs black, the hinder tarsi yellow; wings yellow, black at the base. One and a half line. *Sargus cylindricornis*, Fab.; *Musca chrysoptera*, Schrank. Frequent in summer among grass and brushwood.

GENUS LONCHÆA, Fallen. Antennæ incumbent, approximating, the third or terminal joint oblong, compressed, obtuse at the apex, and having a naked seta at the base: hypostoma flat, somewhat descending, naked: eyes oblong, the forehead of the male narrow, of the female wide: abdomen ovate, villose, six-ringed: wings incumbent, parallel.

L. nigrimana. Male. Antennæ brown, shorter than the hypostoma, the third joint ovate, flat: forehead flat, dull black: body shining greenish black: wings pale yellow: legs black: the middle and hinder tarsi rufescent. Two lines. Found in the vicinity of London, along with eight other species of this genus.

GENUS TRYPETA, Meig. (Plate CCXXXVIII. fig. 29.) Antennæ incumbent, approximating, the third joint oblong, compressed, obtuse at the apex, and having a seta at the base which is either naked or pubescent: hypostoma somewhat descending, flat, naked: eyes somewhat rounded, distant; the forehead wide and setose: abdomen five-ringed, the apex obtuse in the male, but furnished with a projecting style in the female: wings erect (vibrating).

T. Zoë. Honey-yellow, shining, the metathorax bright black: the wings of the male have two dark-brown spots at the anterior border, the smaller one lying above the small cross nerve, and having a small branch projecting forwards from behind; the other, which is much larger, occupies the apex, extending scarcely beyond the fourth longitudinal nerve: in the female the wings have a large brown spot before the middle, and another at the apex, with a narrow cross band, sometimes interrupted, at other times indistinctly marked, in the space between. Male one and a half, female two lines. In the neighbourhood of Edinburgh, and near Jedburgh; not common.

Several different names have been bestowed on this genus. It is named *Traupanea* by Schrank, and *Tephritis* by Latreille: the latter seems to be most generally adopted. To this genus belongs the insect which, in the Isle of France, is so destructive to the lemon crop, by depositing its eggs in that fruit. Its multiplication is sometimes extreme.

GENUS TETANOPS, Fallen. Antennæ small, distant, projecting obliquely, the third joint ovate, compressed, the base with a naked dorsal seta: hypostoma reclined, descending, carinated, naked; forehead projecting, flat, naked: abdomen five-ringed, the style of the female incurved and jointed.

T. myopina. Hypostoma and forehead greyish white; antennæ reddish yellow: thorax light grey, the scutellum of a similar hue: abdomen in the male with the two first segments light grey, unspotted, the two following shining black, having the hinder margin and a line on the back grey, the fifth entirely black; in the female it is light grey, with a black spot on each side of the segments: legs reddish yellow; wings hyaline, with light-brown spots and black transverse nerves. Two to three lines. This seems to be a rare insect. It has been found in England.

GENUS PSILA, Meig. Antennæ deflexed, oblique, somewhat remote, the third or terminal joint oblong, compressed, obtuse at the apex, and having a villose dorsal seta at the base: hypostoma reclined, flat, naked, descending:

eyes remote, rounded; forehead naked: -abdomen six-ringed, the style of the female jointed and acute: wings incumbent, parallel, the first longitudinal nerve simple.

P. Rosæ. Shining black, slightly glossed with brassy: head rufous; forehead occasionally with a black longitudinal line; palpi yellow, the apex black: antennæ rufous, the apex blackish, the seta white and pubescent: legs bright yellow; halteres white; wings hyaline. Found in May and September in England and elsewhere. Seven of the thirteen species described by Meigen are natives of Britain.

GENUS LOXOCERA, Meig. Antennæ projecting obliquely, longer than the head, the third or terminal joint very long, linear, compressed, with a villose dorsal seta at the base: hypostoma reclined, flat, naked, descending: eyes distant, rounded: forehead somewhat projecting, naked: abdomen elongate, six-ringed, naked: wings incumbent, parallel; the first longitudinal nerve simple.

L. ichneumonea. Hypostoma rufous, the sides with a silvery play of colour; forehead testaceous, with a shining black triangular spot: antennæ half the length of the head, black, the first two joints red: thorax testaceous, the upper part of the neck shining black, the prominences on the shoulders, and two lines on the back, of the same colour; scutellum testaceous; abdomen black and shining; legs and halteres yellow; wings somewhat brownish. Three to four lines. Lat. *Musca ichneumonea*, Linn.; *Musca aristata*, Panz. Found in the southern parts of England, along with two other species, *L. elongata* and *L. sylvatica*.

GENUS CHYLIZA, Fallen. Antennæ deflexed, the third or terminal joint elongate, compressed, obtuse, with a villose dorsal seta at the base: hypostoma perpendicular, flat, without a mystax: eyes distant, oblong, the forehead pubescent: abdomen elongate, pubescent, six-ringed: wings incumbent, parallel, the first longitudinal nerve simple.

C. atriseta. Head thick, nearly quadrangular, shining black, with a whitish lustre at the margin of the eyes: antennæ sulphur-yellow, the first joint black, the seta longer than the antennæ, of a deep black, and having a short plume: body shining black; abdomen of the males slightly contracted at the base: legs bright yellow; the apex of the hinder thighs brownish: halteres light yellow: wings greyish, the margin from the middle to the apex brown. Three and a half lines. This insect occurs in Britain, as well as *C. leptogaster*.

GENUS LISSA, Meig. Antennæ projecting obliquely, small, the third or terminal joint ovate, compressed, with a villose dorsal seta at the base: hypostoma reclined, somewhat carinated, naked: eyes distant, oblong; the forehead tuberculated anteriorly: abdomen elongate, slender, six-ringed: anterior legs remote: wings incumbent, parallel, the first longitudinal nerve double.

L. loxocerina. Hypostoma black, with a silvery-white play of colour: forehead shining black: antennæ with the two first joints small and black, the third reddish yellow; hinder part of the head black, the margin of the eyes white: thorax black, clothed with fine white pubescence: abdomen elongate, cylindrical, black, with a white streak on each side at the incisures; that of the male club-shaped behind, in the female pointed: legs reddish yellow; the anterior pair remote from the hinder; anterior coxæ reddish yellow, thickly clothed with silver-white hairs; hinder coxæ black; the hinder legs longer than the others, and having the tibiæ brown in the middle: halteres yellow: wing-scales wanting. Four lines. Meig. *Zw.* vol. v. pl. lii. fig. 1-4. *Ocyptera dolium*, Fab. Inhabits Britain and some parts of the continent. The generic name is objectionable, as it was previously used by Dr Leach to designate a tribe of crustaceous animals.

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GENUS TETANURA, Fallen. Antennæ projecting obliquely, the third or terminal joint elliptical, compressed, and obtuse, having a villose seta in the middle of the back: hypostoma perpendicular, carinated, nearly naked: eyes distant, rounded; the forehead flat and setose: abdomen elongate, cylindric, five-ringed: wings incumbent, parallel; the first longitudinal nerve simple.

T. pallidiventris. Hypostoma yellow; forehead shining dark brown, yellow in front, and having a spot of yellow on the crown; antennæ yellow: thorax black, bristly, the sides of the breast reddish yellow: scutellum black: abdomen pubescent, black, the first segment and hinder extremity of the terminal one pale yellow: legs rather long, ferruginous; the anterior pair rather remote from the hinder: halteres white, uncovered: wing-scales not visible: wings large, somewhat brownish. Two lines. Found by Professor Fallen at Esperod in Sweden, during the months of July and August. It is the only species of the genus, and has not hitherto been noticed in Britain.

GENUS TANYPEZA, Fallen. Antennæ somewhat incumbent, approximating, the third joint oblong, compressed, having a naked dorsal seta at the base; hypostoma somewhat reclined, flat, and naked: eyes oblong, remote; the forehead narrow and naked: abdomen elongate, six-ringed: wings incumbent, parallel; the fourth longitudinal nerve recurved.

T. longimana. Hypostoma blackish, with a white play of colour; forehead deep black, margined anteriorly with white, and having a white spot on the crown; palpi and antennæ deep black; the proboscis yellow: body shining black: thorax with an oblique slightly interrupted pubescent band, of a changeable white, on the sides: scutellum black and bristly: abdomen in the male with a small projecting piece behind, which bears a two-jointed seta near the apex, and a small protuberance anteriorly; in the female this appendage is short, pointed, and articulated: legs elongate, bright yellow; the first tarsal joint likewise yellow, and as long as the four following, which are brown: halteres white and naked: wing-scales white, so minute as to be scarcely perceptible: wings hyaline. Three lines. Examples of this species are preserved in the collections of Baumhauer and Fallen. We are unacquainted with its native country.

GENUS CALOBATA, Meig. Antennæ incumbent, small, the third joint elliptical, compressed, the base with a dorsal seta, which is shortly plumose or naked: hypostoma flat, naked: eyes rounded; forehead nearly naked: abdomen elongate, cylindric, five-ringed: legs very long and slender; the tarsi short: wings incumbent, parallel.

C. petronella. Hypostoma whitish; palpi and antennæ yellow, the last black at the base, and furnished with a scarcely pubescent seta; forehead reddish yellow, margined with white, and having a black spot on the crown: thorax ash grey, with a yellowish callosity on each shoulder: scutellum grey: abdomen black, with whitish incisures; belly dark grey, wrinkled; style of the females rufous anteriorly, the second joint shining rust-brown, carinated: halteres white: wings hyaline: legs ferruginous, the hinder thighs brown at the apex. Three lines. *Musca petronella*, Linn. Found in England, likewise in the neighbourhood of Edinburgh, and other parts of the southern district of Scotland.

GENUS MICROPEZA, Meig. Antennæ projecting, small, the third joint patelliform and compressed, having a long pubescent dorsal seta at the base: head elongate, elliptical; the hypostoma reclined and naked: eyes rounded, somewhat prominent, remote: abdomen elongate, cylindric, six-ringed: legs filiform, very long, the tarsi short; anterior legs remote: wings incumbent, parallel, the length of the abdomen

M. corrigiolata. Hypostoma white; antennæ deep black, with a white seta; forehead black, deepening in the middle: body black: the sides of the thorax without a yellow vitta: abdomen with white incisures: halteres white: wings hyaline: legs yellow, with black tarsi; all the thighs having a black ring before the apex, and the apex itself black; tibiæ behind passing into black. Two lines. The female larger. Meig. *Zw.* v. 384, pl. liii. fig. 6. *Calobata filiformis*, Lat. Rather frequent. We once found it in very great abundance in the month of June, on flowers, by the sides of the Esk, near Dalkeith.

GENUS ULIDIA, Meig. Antennæ incumbent, small, distant, the third or terminal joint elliptical, compressed, with a naked dorsal seta at the base: hypostoma descending, impressed, naked, the proboscis somewhat prominent: eyes rounded, distant; the forehead broad, rugose, naked: abdomen ovate, depressed, five-ringed; wings incumbent, parallel.

U. demandata. Hypostoma fulvous, wrinkled, whitish above; antennæ dark yellow, the third joint with a brown spot anteriorly: forehead shining dark green, somewhat metallic, wrinkled: thorax more or less brassy; abdomen shining black: legs black; the tarsi rufous, with the apex black: wing-scales very small, and, together with the halteres, white: wings clear, with slender nerves. Two lines. *Musca demandata*, Fab. Meig. *Zw.* v. pl. liii. fig. 12. Has been taken near Paris, and in England.

GENUS TIMIA, Meig. Antennæ distant, small, inserted in a foveola, the third joint oval, compressed, with a naked dorsal seta at the base: hypostoma descending, impressed in the middle, naked, the proboscis and palpi somewhat projecting: eyes oblong, distant; forehead villose: abdomen ovate, six-ringed: wings incumbent, parallel.

T. apicalis. Head black; forehead wide, and covered with fine pubescence: body shining black, somewhat setaceous, with a small prominence on each shoulder: abdomen finely pubescent: halteres and wing-scales small and white; wings clear, with the base yellowish, and a triangular brown spot at the apex. Three lines. Meig. *Zw.* v. pl. liii. fig. 16. Examples of this insect are preserved in Wiedemann's collection, and others have been obtained from Portugal.

GENUS PLATYSOMA, Meg. Antennæ deflexed, short, the terminal joint oblong, prismatic, obtuse, with a naked dorsal seta at the base: hypostoma somewhat descending, impressed, naked, the proboscis and palpi rather projecting; eyes rounded, remote, the forehead nearly naked; abdomen ovate, four-ringed: wings divaricating.

P. seminationis. Variegated with ash-grey and black: hypostoma and palpi black; antennæ dark brown: body grey, with black wartz-like points; abdomen pale beneath, the fourth segment as long as the others taken together: legs entirely black: halteres dark brown: wings marbled with fuscous. Two lines. *Musca seminationis*, Fab. Found in the southern parts of Britain, and on the continent.

GENUS PIOPHILA, Fallen. Antennæ incumbent, the third joint elliptical, compressed, with a naked dorsal seta at the base: hypostoma subreclined and provided with a mystax: eyes rounded, remote: the forehead broad, glabrous, convex, and setose: abdomen ovate, somewhat setose, glabrous, five-ringed: wings incumbent, parallel, longer than the abdomen.

P. casei. Shining black, glabrous: hypostoma and anterior part of the forehead rufous; antennæ rufous, the third joint, with the anterior edge and the apex, more or less black: hinder part of the head black: anterior legs black; base of the thighs and tibiæ rufous, the middle pair of legs entirely rufous; hinder legs rufous, the thighs before the apex with a black ring, more or less wide: anterior coxæ rufous: halteres white: wings hyaline. One

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and a half line. *Musca casei*, Linn. Var.; *Tyrophaga casei*, Curtis, *B. E.* vol. iii. fol. 126. Meig. *Zw.* v. pl. liv. fig. 4. The maggot lives in cheese, and leaps.

GENUS HOMALURA, Meig. Antennæ deflexed, distant, the third joint patelliform, compressed, with a naked dorsal seta at the base: hypostoma descending, perpendicular, naked: eyes rounded and remote; the forehead broad, flat, and naked: abdomen ovate, depressed, naked, five-ringed: wings incumbent, parallel, the length of the abdomen.

H. tarsata. Body shining black, everywhere thickly covered with tubercular dots: thorax without a distinct cross suture: legs black, with yellow tarsi: stalk of the halteres black, the head globose and white. One and a half line. Meig. *Zw.* v. pl. liv. figs. 8 and 9. Inhabits Austria and England.

GENUS THYREOPHORA, Lat. Antennæ very minute, inserted in a foveola, the terminal joint lenticular, and having a naked dorsal seta at the base: hypostoma descending, reclined, and having a mystax: eyes small and round; the forehead broad, rather prominent, convex, and villose: abdomen oblong, six-ringed: wings incumbent, parallel, longer than the abdomen.

T. cynophila. Head bright orange yellow; forehead pubescent, with two black spots: body dark steel blue, shining, everywhere beset with long black hairs: scutellum of the male nearly half the length of the abdomen, truncated at the apex, and bearing a strong seta at each side; that of the female small and triangular: legs dark steel blue, pubescent, the four anterior tarsal joints rufous at the base: wing-scales blackish: halteres white: wings hyaline, with two black dots on each. Four lines. Meig. *Zw.* v. pl. liv. figs. 10, 15. Has occurred in France.

GENUS ACTORA, Meig. Antennæ small, distant, the third joint sub-globose, with a naked dorsal seta at the base: hypostoma perpendicular, descending, pubescent, without a mystax: eyes rounded, distant; the forehead broad, flat, villose: abdomen elongate, six-ringed: wings longer than the abdomen.

A. æstum. Hypostoma white; forehead ferruginous and pubescent; antennæ dark brown: thorax light brown, finely pubescent, with small black dots; sides light grey, with a brownish spot before the base of the wings: scutellum semicircular, light brown: abdomen cinereous: legs dark grey, with rufescent tarsi; in the males the anterior tibiae and tarsi are thickly covered beneath with shining whitish-yellow hair: wing-scales small and white: halteres white: wings hyaline. Four lines. Meig. *Zw.* v. pl. liv. figs. 19, 20. This insect has been taken in England by Dr Leach.

GENUS LIPARA, Meig. Antennæ distant, small, the terminal joint lenticular, with a naked dorsal seta: hypostoma descending, pubescent, the forehead broad, rather prominent, and pubescent: eyes rounded, small: abdomen elliptical, pubescent, five-ringed.

L. lucens. Head nearly round, finely pubescent; antennæ brown: thorax finely pubescent, brownish grey; when seen in certain directions four dark-brown lines are perceptible, the two central ones abbreviated: abdomen oval, pubescent, the colour of the thorax: halteres brown: wing-scales wanting: thighs dark brown: tibiae and tarsi yellow: wings yellowish brown. Three lines. Inhabits Germany.

GENUS LUCINA, Meig. Antennæ distant, the third joint ovate, compressed, with a naked dorsal seta at the base: hypostoma descending, naked, and impressed; the forehead broad, somewhat prominent, slightly pubescent, the vertex setose: eyes rounded, small; abdomen flat, oblong, six-ringed: wings longer than the abdomen.

L. fasciata. Hypostoma pearly grey, with a silky gloss;

forehead ferruginous; antennæ brown: thorax grey, with brownish longitudinal lines, and black spots and bristles; scutellum grey with a black spot: abdomen grey, with a black band on each segment from the second to the fifth, which is widened anteriorly in the middle, and on the second segment there is a longitudinal streak of white: legs reddish grey, the thighs spotted with black: wings somewhat greyish, with two black spots. Three and a half lines. Germany; Marseilles.

GENUS EURINA, Meig. Antennæ distant, short, the third joint ovate, compressed, with a naked dorsal seta: head trigonate, pubescent, hypostoma reclined; forehead broad, flat, rather prominent: eyes small and rounded: abdomen oblong, six-ringed; wings incumbent, longer than the abdomen.

E. lurida. Forehead ferruginous; hypostoma whitish; antennæ ferruginous at the base, the third joint entirely brown on the outside, the inside yellow with a brown apex: thorax and scutellum dark brown with deep punctures; abdomen and also the legs ferruginous: halteres white: wings somewhat clouded with brown. Two lines. Examples of this insect are preserved in Baumhauer's collection. Its native country is unknown.

GENUS ORYGMA, Meig. Antennæ small, distant, deflexed, the terminal joint ovate, compressed, with a naked dorsal seta at the base: hypostoma reclined, naked: the forehead broad, flat, and setose: eyes rounded, small: abdomen elliptical, villose, six-ringed: legs strong.

O. luctuosa. Forehead black and bristly; hypostoma shining ferruginous, the antennæ of a similar colour: thorax flat and bristly: abdomen elliptical, covered with strong hairs; legs ferruginous and pubescent: halteres uncovered, the wings somewhat brownish. Three lines. Meig. *Zw.* vi. pl. lv. fig. 17. Taken by Dr Leach in the neighbourhood of London.

GENUS CAMAROTA, Meig. Antennæ porrect, small, the third joint oblong, obtuse, with a thick villose dorsal seta at the base: hypostoma reclined, naked: forehead wide, flat, somewhat arched anteriorly, pubescent: eyes transversely elliptical: wings incumbent, arched.

C. flavitarsis. Hypostoma white; forehead ferruginous and finely pubescent; antennæ black: thorax metallic black, covered with small depressions, and marked with two longitudinal furrows behind: abdomen black: legs of a similar colour, the apex of the tibiae and the tarsi yellow: halteres dark brown, uncovered: wings brownish grey. Found in Germany, at Paris, and near Marseilles.

GENUS CÆLOPA, Meig. Antennæ small, the terminal joint small and rounded, with a naked dorsal seta at the base: hypostoma excised, villose, the mouth rather prominent; forehead flat, wide, setose: eyes somewhat rounded: abdomen oblong, setose, five-ringed: wings incumbent, longer than the abdomen.

C. frigida. Hypostoma thickly covered with hair, the forehead black and thickly covered with bristles; antennæ ferruginous: thorax bristly, and of a black colour: abdomen black, that of the male thickly pubescent and truncated, that of the female pointed and bristly: halteres white, uncovered; wings somewhat greyish: legs reddish brown, thickly covered with hair. Two lines. *Musca frigida*, Fab. This insect is found in Lapland and the most northern countries of Europe.

GENUS SCIOMYZA, Meig. Antennæ somewhat distant, small, obliquely deflexed, the third joint oblong, obtuse, with a dorsal seta at the base, which is either plumose, or pilose, or naked: hypostoma descending or reclined, the forehead broad, setose, or villose: eyes rounded: abdomen oblong, flat, shortly setose, five-ringed: wings incumbent, longer than the abdomen.

S. simplex. Shining ferruginous, except the thorax and

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the last four joints of the tarsi, which are dark brown: the abdomen is marked with a brown longitudinal line: halteres white, the wings somewhat brownish. Three lines. This genus contains twenty-nine species, none of which have been yet detected in Britain.

GENUS DACUS, Meig. Antennæ deflexed obliquely, as long as the hypostoma, the third or terminal joint narrow, elongate, obtuse, compressed, with a naked dorsal seta at the base: hypostoma perpendicular, naked, the forehead broad, somewhat setose: abdomen naked, four-ringed.

D. *Oleæ*. Antennæ ferruginous: thorax cinereous on the back, with three longitudinal lines of black, the sides ferruginous anteriorly, black behind; the shoulders, a small spot at the base of the wings, and another of an elliptical form beneath them, sulphur-yellow; the scutellum of the same colour: abdomen rufous, with three interrupted black bands: legs rufous: halteres white: wings hyaline, having a dark-brown spot at the apex. Two lines. Inhabits Germany, France, and Italy.

GENUS PLATYCEPHALA, Meig. Antennæ projecting obliquely, rather remote, the two terminal joints equal, the third with a naked dorsal seta at the base: hypostoma reclined, naked, the forehead flat, broad, naked: eyes rounded: wings incumbent, longer than the abdomen, the transverse nerves approximating on the disc.

P. *umbraculata*. Forehead ferruginous, with a black impression in the middle; hypostoma likewise ferruginous; antennæ with the first and second joints black, the third ferruginous, the apex black and the seta white: thorax ferruginous, marked with three broad vittæ of a dark-brown colour on the upper side: abdomen wholly dark brown, ferruginous on the under side: legs ferruginous: wings greyish. Two lines. *Musca umbraculata*, Fab. Only three species have been described as pertaining to this genus. The one described above, and P. *planifrons*, have been found in Britain. P. *nigra* occurs in Germany and France.

GENUS SEPEDON, Lat. Antennæ porrect, longer than the head, the second joint elongate, compressed, setose; third acute, emarginate above, and having a naked dorsal seta at the base: hypostoma perpendicular, descending, naked, the forehead broad and somewhat prominent: eyes rounded and rather prominent: abdomen elongate, five-ringed, naked: hinder thighs thick and spinose beneath: wings incumbent.

S. *sphægeus*. Shining bluish black; antennæ dark brown, the seta black above, white beneath; eyes green, with a dark purple fascia: thorax cinereous, with two dark lines along the back; the sides shining metallic black: halteres white: wings brownish yellow, unspotted; legs bright ferruginous. Three lines. *Sepedon palustris*, Lat. Found during the summer in various parts of the continent, and in England, but is nowhere common.

GENUS DORYCERA, Hoff. Antennæ remote, the length of the head, the second and third joints equal in length, second linear, compressed, and setose; third conical, ventricose at the base, and furnished with a naked seta on the back: hypostoma reclined, arched, and naked; forehead flat, somewhat prominent, villose, and flat: eyes rounded and a little prominent: abdomen oblong, five-ringed, the style of the female jointed: wings incumbent, longer than the abdomen.

D. *graminum*. Hypostoma shining ferruginous, spotted with black; forehead ferruginous, with two black lines and a white ring round the eyes: antennæ ferruginous, black at the apex: thorax grey, with six black lines; scutellum grey, spotted with black on the sides: abdomen blackish, inclining to reddish brown in the female, and having a pale interrupted line on the back: legs ferruginous, with brown tarsi: halteres bright yellow: wings

greyish. Four lines. *Musca graminum*, Fab.; *Tetanocera graminum*, Lat. Inhabits France; apparently not found in Britain.

GENUS TETANOCERA, Dum. Antennæ porrect, remote, the second joint compressed and setose, third excised on the upper side, compressed, with a plumose or naked dorsal seta: hypostoma descending (rarely reclined) furrowed, naked; the forehead broad and setose: eyes rounded and somewhat prominent: abdomen oblong, five-ringed, somewhat setose: wings incumbent, projecting beyond the abdomen.

T. *Hieracii*. Hypostoma and palpi white; forehead ferruginous, without impressions, with brown spots on the crown, and four black points at the margin of the eyes: antennæ rufous: thorax bright yellow, finely shagreened, and covered with black spots: scutellum yellow, with a black spot: abdomen bluish grey, with three confluent deep-black spots on each segment: legs bright yellow, the apex of the hinder thighs spotted with black: halteres white; wings white, variegated with dark brown. Two lines. *Tephritis Hieracii*, Fab.; Meig. *Zw.* vi. pl. lvii. fig. 18. Not unfrequent in summer among grass. It is found in Britain, along with eleven other species.

GENUS HETEROMYZA, Meig. Antennæ porrect, somewhat remote, the third joint orbicular, compressed, with a naked dorsal seta: hypostoma descending, perpendicular, furnished with a mystax: forehead broad and setose: eyes rounded: abdomen oblong, five-ringed: wings longer than the abdomen, the rib without bristles.

H. *atricornis*. Hypostoma white, with a longitudinal furrow on each side: forehead rufous, having a white ring round the eyes; the crown and hinder part of the head bluish grey; palpi rufous: antennæ deep black, furnished with a long seta: thorax and scutellum bluish grey: abdomen and legs rufous. Three lines. Meig. *Zw.* vi. pl. lvii. fig. 21. Meigen describes four species of *Heteromyza*, of which the only one hitherto detected in England is H. *buccata*, Fallen. No locality is cited for H. *atricornis*.

GENUS HELOMYZA, Meig. Antennæ somewhat deflexed, remote, the third joint oblong or orbicular, having a plumose or naked dorsal seta at the base: hypostoma perpendicular, descending, furnished with a mystax; forehead wide and setose: eyes rounded: abdomen oblong, six-ringed: wings incumbent; the costa setose.

H. *rufa*. The male is ferruginous, with black bristles; the third joint of the antennæ is elliptical, and bears a long plumose seta: abdomen with black bands, which are widened in the middle: hinder knees and two last joints of the tarsi black: wings somewhat brownish, with two white marginal spots at the apex. This species has been found in England by Dr Leach. H. *ustulata*, figured by Curtis (*B. E.* fol. 66), and by Meig. (*Zw.* pl. lvii. fig. 30), is also a native of Britain.

GENUS DICHÆTA, Meig. Antennæ distant, somewhat deflexed, short, the third or terminal joint oblong, compressed, having a pectinated dorsal seta at the base: hypostoma somewhat descending, convex, setose; the forehead wide, setose: eyes rounded: abdomen ovate, five-ringed, that of the male with long setæ at the apex: wings incumbent; the transverse nerves remote.

D. *caudata*. Hypostoma brownish yellow; forehead dark grey; two lower joints of the antennæ brown, the third bright yellow: body dark grey, somewhat bristly; thorax with three broad lines of black: legs dark grey, the tarsi yellow: halteres white: wings greyish. Two lines. A rare insect on the continent. According to Curtis, it has occurred in Britain.

GENUS NOTIPHILA, Meig. Antennæ somewhat remote, deflexed, short, the third joint oblong or orbicular,

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compressed, with a pectinated dorsal seta at the base; hypostoma somewhat descending, rather naked, convex; the forehead broad, setose: eyes rounded: abdomen rather flat, ovate or oblong, five-ringed: wings incumbent, longer than the abdomen; the transverse nerves remote.

N. cinerea. Hypostoma fulvous, without lustre, furnished with short bristles on each side of the eyes, which are surrounded with a whitish ring: forehead, thorax, and scutellum ferruginous; on the thorax there are six rows of small tubercles of a black colour: antennæ brown, the third joint yellow at the base: abdomen cinereous, with three black spots on both sides: legs ferruginous, with black thighs: halteres white: wings nearly hyaline. One line and a half. During spring and summer very common in some countries on the *Equisetum palustre*. It occurs in Britain, but does not seem common.

GENUS DISCOMYZA, Meig. Antennæ deflexed, short, third joint oblong, compressed, obtuse, with a pectinated dorsal seta at the base: hypostoma short and rugose; forehead broad, short, and naked: eyes oblong: abdomen depressed, suborbicular, naked, four-ringed: wings deflexed, the length of the abdomen.

D. incurva. Black and glossy, the tarsi yellow: halteres small and white: wings somewhat greyish, the anterior margin brown. One line and a half. Meig. *Zw.* vi. pl. lviii. fig. 16, 17. Inhabits Austria and other parts of the continent.

GENUS OCHTHERA, Lat. Antennæ incumbent, short, the third joint elliptical, compressed, with a pectinated dorsal seta at the base: hypostoma descending, naked, convex, coarctate at the apex; forehead broad, impressed, naked: eyes rounded and somewhat prominent: abdomen flat, elliptical, naked, five-ringed: anterior thighs swollen, and spinose beneath: wings incumbent, the fourth longitudinal nerve recurved at the apex.

O. Mantis. Hypostoma brownish, with a white play of colour; forehead black: body naked, black, with a metallic lustre, the thorax marked with three black lines; abdomen with a small white spot on each side of the second, third, and fourth incisures: legs black: halteres white: wings somewhat cinereous. Two lines. *Musca manicata*, Fab. Found in August and September.

GENUS STEGANA, Meig. Antennæ incumbent, the third joint oblong, obtuse, compressed, with an irregularly plumose dorsal seta at the base: hypostoma somewhat impressed, and furnished with a mystax; forehead broad and setose: eyes oblong: abdomen oblong, six-ringed: wings longer than the abdomen, incurved, deflexed.

S. nigra. Hypostoma and forehead ferruginous, the latter bristly; antennæ yellow: body shining black, somewhat bristly; legs yellow, the hinder thighs brownish: halteres yellow: wings smoke colour. One line and a fourth. Meig. *Zw.* vi. pl. lviii. figs. 24, 25. *Drosophila curvipennis*, Fallen. A scarce insect on the continent, and not occurring at all in Britain.

GENUS DROSOPHILA, Meig. Antennæ incumbent, the third joint oblong, obtuse, compressed, with an irregularly plumose dorsal seta at the base: hypostoma with a mystax, the forehead broad and setose; eyes rounded: abdomen oblong, six-ringed: wings incumbent, longer than the abdomen.

D. funebris. Hypostoma and forehead rust-brown: antennæ dark brown, the base yellow: thorax shining testaceous: abdomen shining black, each of the incisures behind with a rather broad yellow band: legs ferruginous: wings rather obscured with brown, but not spotted. One line and a half. *Musca funebris*, Gmel.; *Musca cellaris*, Linn. Found during spring and summer occasionally.

GENUS ASTEIA, Meig. Antennæ deflexed, the terminal joint patelliform, with an irregularly pectinated dorsal

seta at the base: hypostoma naked; the forehead broad, and somewhat setose: eyes rounded (fasciated): abdomen naked, five-ringed: wings incumbent, large; the ordinary transverse nerve wanting.

A. concinna. Straw colour, the hypostoma with two black spots, and two black longitudinal streaks on the crown: thorax shining black, pale round the outer side; the sides and breast straw-colour: scutellum straw-colour, with a black spot at the base; abdomen and legs entirely straw-colour; wings large and hyaline. One line. Both this and the only other species of the genus, *A. amæna*, occur in England.

GENUS OCHTHIPHILA, Meig. Antennæ deflexed, the terminal joint oblong, compressed, obtuse, with a naked dorsal seta at the base: hypostoma nearly naked; the forehead broad and setose: eyes rounded: abdomen oblong, five-ringed: wings incumbent.

O. Juncorum. Light cinereous: antennæ yellow, with the apex black; the abdomen with two rows of black spots: thighs grey; the apex, tibiae, and first joint of the tarsi bright yellow, the four other joints brown: wings hyaline. One line. Meig. *Zw.* vi. pl. lix. fig. 11. Common in Germany. None of the species, which are seven in number, have been detected in Britain.

GENUS DIASTATA, Meig. Antennæ incumbent, the terminal joint compressed and obtuse; have a dorsal seta at the base, which is densely plumose or naked: hypostoma with a mystax: the forehead broad and setose: eyes somewhat rounded: abdomen oblong, five-ringed: wings incumbent, longer than the abdomen, the transverse nerves remote.

D. obscurella. Hypostoma whitish; antennæ and forehead rufous, the margin of the eyes and the crown light grey; the third joint of the antennæ brown at the apex: thorax cinereous: abdomen black, with some lustre: legs rufous: halteres white. One line. Meig. *Zw.* pl. lix. fig. 15. Rather scarce: not indigenous to this country.

GENUS OPOMYZA, Meig. Antennæ deflexed, the terminal joint ovate and compressed, having a dorsal seta at the base, which is shortly plumose or pubescent: hypostoma naked, or furnished with an imperfect mystax; the forehead broad and setose: eyes rounded: abdomen elongate, six-ringed: wings incumbent.

O. combinata. Palpi and proboscis white; head, antennæ, thorax, and legs rather bright shining rufous: abdomen of the males linear, shining black, rufous at the base; that of the female more elliptical, flat, rufous, with black bands at the incisures: halteres white: wings small, hyaline, the cross nerves and a spot at the apex dark brown. One line and a third. *Tephritis combinata*, Fab. Inhabits Britain and Germany.

GENUS EPHYDRA, Fallen. Antennæ deflexed, the terminal joint oblong, compressed, and obtuse, with a naked dorsal seta at the base: hypostoma arched or convex, villose; the forehead broad and setose: eyes rounded, somewhat prominent: abdomen elliptical, depressed: wings incumbent, longer than the abdomen.

E. palustris. Hypostoma brownish black, setaceous, at least about the mouth; forehead dark green, shining: antennæ black, with a rather thick seta: body shining dark green: scutellum arched: halteres white: wings pale brown: legs black. One line. Found in marshy places.

GENUS HETERONEURA, Meig. Antennæ porrect, the second joint the same length as the third, the latter orbiculate, with a pubescent seta inserted in the middle of the back; forehead flat, furnished with a mystax; the forehead broad and setose: eyes rounded: abdomen elongate, five-ringed; wings incumbent, the transverse nerves approximating in the middle of the disc.

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H. nubilæ. Hypostoma and forehead ferruginous, with a whitish lustre round the margin of the eyes; antennæ ferruginous, the third joint somewhat brownish; thorax shining ferruginous, passing into brown, with four dark-brown lines on the back, and a white one on the sides, reaching to the base of the wings; the sides ferruginous: abdomen black: legs rufescent: halteres white: wings somewhat greyish. Male one and a half, female nearly two lines. Inhabits Austria and other European countries.

GENUS GITONA, Meig. Antennæ incumbent, the terminal joint elliptical, compressed, having a naked dorsal seta at the base: hypostoma carinated in the middle, and provided with a mystax; the forehead broad and setose: eyes rounded: abdomen ovate, flat, five-ringed: wings incumbent, longer than the abdomen; the transverse nerves approximating.

G. distigma. Hypostoma, palpi, and antennæ rufous; forehead of a similar colour, with two brown lines; thorax setaceous, light grey, with three dark somewhat undulating lines: scutellum light grey or yellowish: abdomen shining rufous, with four bands and a dorsal line of black: legs and halteres rufous; wings hyaline. Two lines. Meig. *Zw.* vi. pl. lx. fig. 19. Found in the south of France, and elsewhere.

GENUS MILICHIA, Meig. Antennæ porrect, the terminal joint patelliform, with a naked dorsal seta at the base; hypostoma impressed, and provided with a mystax; the forehead broad and setose; eyes rounded: abdomen ovate, four-ringed: wings incumbent, longer than the abdomen.

M. speciosa. Male. Hypostoma white, setaceous about the mouth and sides; palpi black and pubescent; forehead slate-grey with a white play of colour, and when seen in some directions two brownish lines are perceptible: antennæ black: thorax greyish white: scutellum black: abdomen shining silver-white; the belly, halteres, and legs, black: wings hyaline, the anterior edge brown from the middle to the apex. Two lines. Meig. *Zw.* pl. lx. fig. 23. Has been taken near Marseilles, and in Provence.

GENUS LEUCOPIS, Meig. Antennæ porrect, the third joint patelliform, with a naked dorsal seta at the base: hypostoma somewhat impressed, naked; the forehead broad and naked: eyes rounded: abdomen ovate, five-ringed, depressed: wings incumbent, longer than the abdomen.

L. griseola. White with a bluish tinge; antennæ deep black: thorax with four pale-brown lines, the central one narrowest: abdomen with a black play of colour at the base, and marked with two black dots: halteres white: wings hyaline, with brown nerves: thighs grey, the apex yellow; the tibiae and tarsi rufous, the former encircled with a pale-brown ring. One line. *Anthomyza griseola*, Fallen; Meig. *Zw.* vi. pl. lx. fig. 28. Found on the continent, but the special localities are not mentioned.

GENUS GYMNOPIA, Meig. Antennæ incumbent, the third or terminal joint somewhat oblong, compressed, and obtuse, with a naked dorsal seta at the base: hypostoma descending, naked, tuberculated; the forehead broad, and nearly naked: eyes rounded: abdomen ovate, glabrous, five-ringed: wings incumbent, longer than the abdomen; the fifth longitudinal nerve abbreviated behind.

G. subsultans. Dark metallic green, shining: head and legs black: halteres white. One line and a half. *Syrphus subsultans*, Fab. Found in August and September. The genus contains four species, none of which have been hitherto noticed in Britain.

GENUS CHLOROPS, Meig. Antennæ deflexed, porrect, the terminal joint patelliform, with a naked or pubescent dorsal seta at the base: hypostoma descending, naked;

forehead broad and pubescent: eyes rounded: abdomen elliptical, naked, five-ringed: legs simple: wings incumbent, the transverse nerves approximating on the disc.

C. gracilis. Straw-colour, as well as the antennæ and legs: forehead rufous: thorax marked with three dark-grey lines, of which the central one is abbreviated behind, and the others in front; and on each side of the breast there is a black spot; there is also a black spot on each side of the first incisure of the abdomen. Three lines. Meig. *Zw.* vi. pl. lxi. fig. 17. Has been taken near Paris on the flowers of *Chrysanthemum leucanthemum*, in Russia, and in Austria. The genus is composed of sixty species, all of them minute insects; and a considerable number appear to inhabit Britain.

GENUS MEROMYZA, Meig. Antennæ deflexed, porrect, the third or terminal joint nearly patelliform, with a naked dorsal seta at the base; hypostoma descending, naked; the forehead broad, rather prominent and pubescent; eyes rounded and somewhat prominent: abdomen conical, naked, five-ringed: hinder thighs thickened: wings incumbent, the transverse nerves approximating in the middle of the disc.

M. pratorum. Pale-greenish yellow, as well as the antennæ and legs; hinder part of the head unspotted: thorax with three greenish-grey lines, the central one running along the scutellum also; abdomen, with an interrupted dorsal line of black, and a black spot on each side at the base. Two lines. Meig. *Zw.* vi. pl. lxi. fig. 25. Inhabits Germany and Britain.

GENUS AGROMYZA, Fallen. Antennæ deflexed and porrect, the third joint orbicular, with a naked dorsal seta at the base: hypostoma with a mystax; the forehead broad and setose: eyes rounded: abdomen five-ringed: wings incumbent, longer than the abdomen, the transverse nerves approximating.

A. denticornis. Head yellow, with a black point on the crown; antennæ black, with a yellow base; the third joint having a small horn before the apex: thorax with a yellow streak on the sides: scutellum yellow: halteres white: legs black, with yellow thighs. One line. Meig. *Zw.* vi. pl. lxi. figs. 33, 34. *Chlorops denticornis*, Panzer; *Chlorops Meigenii*, Fallen. Found in England and on the continent. The genus is extensive, comprehending sixty-nine species. Few of these have been detected in this country, although there can be little doubt that a large proportion inhabit Britain.

GENUS PHYTOMYZA, Fallen. Antennæ porrect, the terminal joint patelliform, with a naked dorsal seta: hypostoma with a mystax; forehead broad and setose: eyes rounded: abdomen elongate, six-ringed: wings incumbent, longer than the abdomen, the transverse nerves placed at the base of the wings, the ordinary one generally wanting.

P. flavicornis. Blackish; thorax and scutellum dark grey; antennæ entirely yellow: halteres white: wings somewhat grey: the incisures of the abdomen and the legs yellow. Two thirds of a line. Meig. *Zw.* vi. pl. lxii. fig. 6. Found on the continent, but is not common.

GENUS THERINA, Meig. Antennæ porrect, the third joint patelliform, with a long naked dorsal seta at the base: hypostoma impressed, and furnished with a mystax; the forehead broad and pilose: eyes rounded: abdomen oblong, five-ringed: wings incumbent, the transverse nerves remote.

T. femoralis. Hypostoma ferruginous, forehead of the same colour anteriorly, grey behind; antennæ black: thorax dark grey, with four rather indistinct dark lines: abdomen black: halteres white: wings hyaline: legs ferruginous; the anterior thighs thickened. Scarcely one line. Found on the continent.

Diptera
Eproboscideæ.

GENUS BORBORUS, Meig. Antennæ porrect, the terminal joint spheroidal, with a naked dorsal seta: hypostoma impressed, and furnished with a mystax; forehead broad, setose, declined: eyes rounded: abdomen flat, five-ringed: hinder metatarsi abbreviated and thickened: wings incumbent, longer than the abdomen (or wanting).

B. chunipes. Hypostoma and anterior part of the forehead testaceous: body dark brown: scutellum elongate, flat, setaceous: halteres brown: wings hyaline: the two first joints of the hinder tarsi thickened, the second somewhat longer than the first. One half line. Found in dung; but is rare. It occurs in England.

FAMILY XXIV.—TRINEURÆ.

GENUS PHORA, Lat. (Plate CCXXXVIII. fig. 30.) Antennæ inserted at the opening of the mouth, globose, with an elongate erect naked seta; palpi exserted, clavate, setose: abdomen six-ringed: hinder legs elongate: wings incumbent.

P. incrassata. Black, the forehead tuberculated: palpi and antennæ black: the first incisure of the abdomen margined with white: legs black, the anterior pair with the apex of the thighs, the tibiæ, and tarsi, ferruginous: halteres brown: wings nearly hyaline, somewhat brownish. One and a half line. In September; not rare.

GENUS CONICERA, Meig. Antennæ erect, conical, with a naked terminal seta: palpi exserted, setose: abdomen six-ringed: wings incumbent.

C. atra. Velvet black; forehead pitch-brown; anterior tibiæ and tarsi rufous; wings clear hyaline. Half a line. Found in September; but nowhere common. Apparently not indigenous to Britain.

DIVISION II.—EPROBOSCIDEÆ.¹

FAMILY CORIACEÆ.

GENUS HIPPOBOSCA, Linn. (Plate CCXXXVIII. figs. 31 and 31 a.) Antennæ gemmiform, inserted into the sides of the hypostoma, and having a naked apical seta: ocelli wanting: the tarsi with equal bidentate claws: wings parallel, incumbent, obtuse, with many nerves.

H. equina. Forehead and hypostoma shining ferruginous: eyes pitch-brown: thorax shining dark brown, the shoulders ferruginous; before the scutellum there are three yellow spots, of which the central one forms an

acute triangle: scutellum yellow, with black spots on the sides: abdomen pubescent, brownish grey: legs ferruginous, the thighs and tibiæ of the middle pair with a dark ring, the hinder pair with two: halteres black: wings brownish, the marginal nerves dark brown. Four lines. Linn. Fab. On horses and cattle.

We are still indebted to Réaumur for the greater part of our knowledge regarding the very singular mode of production in the genus Hippobosca, or forest-flies, as these insects are sometimes called. That delightful observer has named them *Mouches Araignées*. The larva is hatched and nourished within the body of the mother, and remains there till after its transformation to the nymph state. Hence the term *pupiparous*, as applied to the Hippoboscæ and other genera of the tribe. The nymph, or rather cocoon, is at first of a milky whiteness, with a large plate (plaque) at one end, black and shining, like ebony. It is of a round and flattened form, emarginate at the plated end, where it forms two rounded or horn-like eminences. It becomes entirely black soon after exclusion, and the skin or covering, of a cartilaginous or scaly texture, resists a strong pressure of the fingers, and is even difficult to cut with the sharpest scissors. The body of the mother scarcely equals the dimensions of the nymph, and it has often been a subject of marvel how the greater should proceed from the less. It appears, however, that the cocoon is possessed of an expansive power, which is probably exercised the moment after its exclusion from the body of the parent. The hardness and solidity of the skin, though well qualified to defend the nymph from injury, might seem to present a serious obstacle to the escape of the perfect insect. But nature, so complete and bountiful in all her doings, and so pervaded even in her minutest operations by the perfect wisdom of her great AUTHOR, has provided against this seeming inconvenience by a beautiful contrivance. When we examine the larger end by means of a microscope, we shall perceive the feeble trace of what in fact constitutes a kind of cap or cowl, and which may sometimes be made to spring off even by the touch of a penknife. When the perfect insect is ready for exclusion, it finds it an easy matter to manage this piece of natural mechanism. The coriaceous envelope to which we have alluded is, in fact, the distended and somewhat altered skin of the larva, and within it Réaumur succeeded in detecting the exuviae of the nymph. The phenomena of transformation are, therefore, so far analogous to what we observe in the coarctate pupæ of some other dipterous tribes, and the chief anomaly consists in the larva passing the entire period of its exis-

¹ In our copy of Meigen's *European Diptera*, the work by which we have been guided in the systematic portion of our exposition of the order, there is (at page xxxiii. of the first volume) a brief exposition of the characters of DIVISION I. PROBOSCIDEÆ. This we have given at page 258 of the present treatise. In the sixth and last volume of the German author we do not, however, find any indication of DIVISION II. Presuming, nevertheless, from the strong disparity of character presented by the CORIACEÆ, when compared with the preceding families, that they must constitute the other principal branch of the dipterous order, we have applied the name of EPROBOSCIDEÆ, as significative of the division sought for. It was so applied by Latreille (*Gen. Crust. et Insect.* t. iv. p. 360), as well as (excepting *Nycteribia*) by Dr Leach (*Werncrian Memoirs*, vol. ii. p. 547), to the family in question. The species of which it is composed are in truth of a very singular structure and economy, and altogether of a nature so anomalous, as to cause some doubts as to their proper position in the system. They are now regarded as constituting a separate order, under the name of HOMOLOPTERA, by Leach, Macleay, Stephens, and other English naturalists, and form the family PUPIPARA of Latreille. Some contrariety of opinion still exists regarding the structure of the mouth. We shall here satisfy ourselves by a quotation from the last-named entomologist, to whom we have been already so deeply indebted. "La tête de ces insectes, vue en dessus, est divisée en deux aires ou parties distinctes, dont l'une postérieure et principale, ou composant plus spécialement la tête, porte les yeux, et reçoit, dans une échancrure antérieure, l'autre partie. Celle-ci se partage aussi en deux, dont la postérieure plus grande et coriace porte latéralement les antennes, et dont l'autre constitue l'appareil manducateur. La cavité inférieure et buccale de la tête est occupée par une membrane; on voit sortir de son extrémité un suçoir, naissant d'un petit bulbe ou pédicule avancé, composé de deux filets ou soies très rapprochés, et recouvert par deux lames coriaces, étroites, allongées et velues, qui lui font l'office de gaine. Que ces lames ou valvules représentent, ainsi que je l'ai présumé, les palpes des autres diptères, ou qu'elles soient les pièces d'une gaine proprement dite, comme le pense M. Dufour, à l'occasion d'une espèce d'ornithomyie (*Annales des Scienc. Nat.* x. 243, xi. 1), où il a découvert deux petits corps, qu'il prend pour des palpes, il n'en serait pas moins vrai, que la trompe de ces insectes différerait sensiblement de celle des diptères précédents, et que la gaine, dans ce cas, aurait plus de rapports avec celle de la trompe de la puce, dont elle s'éloignerait cependant par l'absence d'articulations. (*Règne Animal*, t. v. p. 538.)

diptera
robosci-
deæ. tence within the body of the mother, and being *born* in the pupa state.¹

GENUS ORNITHOBIA, Meig. Antennæ small, immersed, inserted on the sides of the hypostoma, papillary, naked: ocelli wanting: tarsi with unequal bidentate claws: wings parallel, incumbent, with three nerves.

O. pallida. The colour of the head is ferruginous; the proboscis of a similar colour, shorter than the head: thorax flat, rounded, shining black, with a rather large ferruginous spot on each shoulder, and two lines of the same colour in the middle; the hinder part setaceous, at least on the sides; scutellum transverse, ferruginous, the hinder margin bristly: halteres white: abdomen ferruginous, oval, pubescent: wings nearly hyaline, with pale nerves: legs ferruginous, pubescent, robust: the first four joints of the tarsi very short, the fifth longer, with two long unequal claws, the outer claw shorter than the interior one. Two lines. Rare; apparently not found in Britain.

GENUS ORNITHOMYIA, Lat. Antennæ gemmiform, setose, inserted into the sides of the hypostoma; vertex with three ocelli; tarsi with tridentate claws: wings incumbent, obtuse.

O. avicularia. Greenish yellow: antennæ and proboscis ferruginous; eyes pitch-brown: thorax blackish on the sides, with a yellowish longitudinal line: wings smoke colour with dark-brown nerves, the longitudinal nerves not very distinct: legs pubescent. Two to two and a half lines. *Hippobosca avicularia*, Linn. Degeer, vi. 114, pl. xvii. fig. 21-27. These insects occur on different species of birds, but never on quadrupeds,—a fact in their history which, in connection with the difference of structure, renders their generic separation from *Hippobosca* the more advisable. Latreille thinks that their metamorphoses resemble those of the last-named genus. The species above described is extremely vivacious, runs swiftly, sometimes side foremost like a crab, and flies with considerable facility.

GENUS STENOPTERYX, Meig. Antennæ gemmiform, setose, inserted into the sides of the hypostoma: vertex with three ocelli: tarsi with tridentate claws: wings very narrow, acute, longer than the abdomen.

S. hirundinis. This species is very closely connected with those of the preceding genus, differing chiefly in the long, narrow, pointed wings: the colour is ferruginous, with pitch-brown eyes: the antennæ are covered with long black setæ. Two lines. *Hippobosca hirundinis*, Linn.; *Stenopteryx hirundinis*, Leach; *Ornithomyia hirundinis*, Lat. Meig. Zw. vi. lxiv. fig. 5. Found on different kinds of swallows, especially the *Hirundo Apus* of Linn. The wings of this species are not well adapted for flight. Réaumur once found as many as thirty in a swallow's nest.

GENUS ANAPERA. Antennæ gemmiform, setose, inserted into the sides of the hypostoma: ocelli wanting: tarsi with tridentate claws: wings short and acuminate.

A. pallida. Ferruginous; the abdomen brown: antennæ with numerous long black hairs: thorax rhomboidal, the anterior part embracing the head on both sides; sinuated on each side, but widened in the middle, and the back impressed with a deep longitudinal line: the hinder part setaceous, especially towards the sides: scutellum transverse: legs robust, especially the thighs, and covered with long hair: wings short, scarcely longer than the

abdomen, somewhat greyish, with ferruginous nerves, the apex acute. Two and a half lines. *Ocypterum pallidum*, Leach; *Mouche-araignée*, Geoff. *Ins.* ii. 547, 2. Found on swallows, especially the swift. Genus Nycteribia.

GENUS MELOPHAGUS, Lat. Antennæ papillary, immersed, inserted in the sides of the hypostoma: eyes linear and small: ocelli wanting: tarsi with bidentate claws: wings wanting.

M. ovinus. Ferruginous; the abdomen brown; forehead wide, with the crown smooth and without ocelli, the other parts setaceous: proboscis as long as the head, and porrected: thorax embracing the head anteriorly: abdomen oval: legs robust, pubescent; the tarsi short, with bidentate claws. Two lines. *Hippobosca ovina*, Linn. Found in considerable numbers among the wool of sheep. Another species occurs upon the stag.

Allied to the preceding genus is that named BRAULA by Dr Nitzsch. The only known species lives upon the honey-bee, and is figured by Germar.² It is absolutely blind.³

We shall conclude this lengthened exposition of the dipterous order by a few observations on the genus NYCTERIBIA of Lat., *Phthiridium* of Hermann, concerning the true position of which very various opinions have been entertained. The species are in fact entirely apterous, having neither wings nor halteres. They bear a general resemblance to spiders. The head is extremely small, and as it were implanted on the anterior and dorsal portion of the thorax, in the form of a little capsular tubercle. The eyes seem composed of minute grains. The thorax is semicircular. Even Latreille (in his earliest work) was so far misled by the anomalous aspect of these insects as to mistake the very CLASS to which they belonged. He consequently placed them among the Arachnides. In this he was followed by Dr Leach,⁴ who was probably not aware that the great French entomologist had long before rectified his error. When a species of the genus was first observed on a bat by Colonel Montagu, he thought it an entirely new insect, and named it, on account of its rapid movements, *Celeripes Vespertilionis*.⁵ It appears, from an expression in the *Fauna Suecica*, that Linnæus described it as a *Pediculus*. The generic name of *Phthiridium*, bestowed by Hermann the younger,⁶ being posterior in date to that of Latreille, ought not to be adopted. We may add, that the antennæ, which the German author did not observe, and which he stated did not exist, have been detected by Latreille.⁷ They are extremely short, advanced, bi-articulate, and inserted close to each other, on the emargination of the upper edge of the head. The eyes are placed immediately beneath them.

These curious insects, as far as yet known, occur on bats, over which they move with great rapidity; but when withdrawn from their natural nidus they become quite confused, and almost incapable of locomotion. Their heads being placed as it were upon their dorsal aspect, it was difficult to understand how they satisfied their appetite; and we owe to Colonel Montagu the observation, that when they suck the blood of bats they place themselves in a reverse position on their backs. Of the few species known, two are found in Britain, on the greater and the lesser horse-shoe bats. Another species occurs in the Isle of France.⁸

¹ For a detailed account of the internal structure of these insects, see M. Dufour's *Recherches Anatomiques sur l'Hippobosque des Chevaux*, in the *Ann. des Sciences Nat.* t. vi. p. 299. For their classification, and that of the allied genera, consult Dr Leach's *Insecta Eproboscidea*, in *Memoirs of the Wernerian Society*, vol. ii. p. 547; and *Règne Animal*, t. v. p. 543.

² *Fauna Insect. Europ.* vi. 25.

³ In the *Supplement* to the preceding edition of this Encyclopædia, vol. i. p. 446.

⁴ *Linn. Trans.* vol. ix. p. 166, note.

⁵ *Mém. Aptérologique*, p. 124.

⁶ *Règne Animal*, t. v. p. 545.

⁷ See also *Zool. Miscell.* vol. iii. p. 55.

⁸ *Nouv. Diction. d'Hist. Nat.* art. *Nyctéribie*.

⁹ *Diction. Class. d'Hist. Nat.* t. xii. p. 25.

ORDER IX.—SUCTORIA, DEGEER.¹

In this order the mouth consists of a sucker of three parts (two maxillæ and a ligula), contained between two articulated blades (the labium), forming by their union a trunk or beak, cylindrical or conical, and covered at the base by a pair of scales, supposed to represent the palpi. The species undergo a genuine metamorphosis analogous to that of several Diptera, such as the *Tipulariæ* of Latreille.

The genus *PULEX* of Linnæus composes the entire order. The body is oval, compressed, covered by a tough integument, and divided into twelve segments, of which the anterior three constitute a short thorax, and the remainder the abdomen. The head is small, much compressed, rounded above, truncated and ciliated in front, and furnished on each side with a little circular eye, behind which, and lodged in a groove, we find certain small moveable articulated bodies, which are the true antennæ. Towards the anterior part of the head, and near the origin of the sucker, are placed another pair of appendages, which Latreille and others have regarded as the antennæ, but which are now with greater propriety considered as maxillæ, or parts of the mouth. Between these is placed the sucker, composed of a bivalvular articulated sheath, and three setæ. The sheath, according to Dugès, corresponds to the labial palpi, while two of the setæ represent the mandibles, and the remaining one is regarded as the analogue of the ligula.

In regard to the species,—“Chacun,” says Latreille, “connait la Puce commune.” In this country we call it *flea*; and, presuming that it is nearly as well known here as in France, we shall not trouble our readers with a detailed description. The female lays about a dozen eggs, of a white colour, and slightly viscous. From these are long proceed little lively worms, which move like serpents, or roll themselves about spirally, or in circles. They are at first white, but become ere long of a reddish hue, and are composed of a scaly head, without eyes, furnished with two minute antennæ, and of numerous segments bearing little tufts of hair, and two hooks at the caudal extremity. The mouth exhibits some small moveable pieces, of which the larva makes use in pushing itself forward. They remain about twelve days in that condition, and then each larva encloses itself in a little silk cocoon, where it becomes a nymph, and from which, after about an equal lapse of time, the perfect insect issues forth. The common flea (called by naturalists *Pulex irritans*, see the figure last referred to) occurs in almost all countries. It is parasitical on the bodies of several other animals besides the human kind (of which it prefers children and the gentler sex, owing to the superior softness of their skin), such as dogs, cats, hares, among quadrupeds,—and pigeons, poultry, and swallows, among birds. DeFrance, who has published some interesting observations on the eggs and larvæ, has also shown that bathing domestic animals has no effect in ridding them even of the perfect insect, which he has seen resume its wonted functions after a continuous immersion of twenty-two hours. The process, however, is useful, in as far as it appears to annoy the pregnant females, which do not endure immersion above eleven hours. In Dalecarlia the natives place hare-skins in their beds, and other parts of their houses, for the fleas to nes-

tle in. They then destroy them by dipping the skins in hot water, or holding them over a fire. Thysan-
oura.

The genus *Pulex* is by no means numerous in species. A large yellow kind occurs upon the mole, and a banded species (*P. fasciatus* of Bosc) is found upon the fox. Professor Graham thinks he caught it in Clova. The *Pulex penetrans* of Linn., known to the French colonists of America by the name of *Chique* (Plate CCXXXIX. fig. 14), is by some regarded as belonging to a distinct genus. Its sucker is as long as its body (fig. 14, *b*). It introduces itself beneath the toe nails, or under the skin of the feet, where the female speedily acquires a considerable bulk in consequence of the growth of her eggs (fig. 14, *a*). The numerous young to which these give birth sometimes occasion malignant ulcers, difficult to cure, and occasionally mortal. They are extirpated by using a lavement of tobacco juice, or other acrid infusion. The negroes, from frequent practice, extract them with great skill.²

ORDER X.—THYSANOURA, LAT.

The insects of this order, like those of the preceding, are apterous, or without wings. In addition to the usual number of legs, they are provided, either along their sides, or at the extremity of the abdomen, with peculiar organs, which assist the purposes of locomotion. They are masticators, that is, furnished with mandibles and maxillæ. They do not undergo metamorphoses. All the species are of small size, of rather soft consistence, and are generally covered either with shining silvery scales or hairs. They avoid strong light, and seldom quit their retreats till the shades of night have fallen. Some inhabit the interior of houses, keeping themselves concealed in presses, in the interstices of shutters, window-sashes, and other wooden fabrications;—others occur under stones and in humid places. The order is divisible into two families.

FAMILY I.—LEPISMENÆ, LAT.

This family corresponds to the genus *Lepisma* of Linnæus. The antennæ are setaceous, usually very long, and divided from their base into many small articulations. The palpi are distinct and projecting. The abdomen is furnished inferiorly on each side with a range of moveable appendages in the form of false legs, and is terminated by articulated setæ, of which three are more obvious than the others. The body is of an elongated form, and covered with small shining silvery scales. The mouth is composed of a labrum, two almost membranaceous mandibles, a pair of maxillæ, each furnished with a palpus of from five to six articulations, and of a labium of four emarginations, bearing two quadri-articulate palpi. The thorax consists of three perceptible portions. The abdomen, which becomes gradually narrower towards its posterior extremity, is provided, in addition to the false legs just mentioned, with an anal appendage or scaly style, compressed, and composed of two pieces, after which we may observe the three articulated setæ prolonged beyond the body. The legs are rather short—the haunch often very large, much compressed, and squamiform. Several species occur in window-sashes which are seldom opened, beneath the planks of presses where there is any damp or moisture.

¹ APTERA (pars) Linn.; SIPHONAPTERA, Lat.; APHANIPTERA, Kirby.

² See *Recherches sur les Caractères Zoologiques du genre Pulex*, par M. Ant. Dugès, in the *Annales des Sciences Nat.* Octobre, 1832; Curtis's *British Entomology*, pl. ccccxvii.; and Mr Westwood *On the Structure of the Antennæ in the Order Aphaniptera*, *Ent. Mag.* vol. i. p. 359.

A few seek the protection of stones. They run swiftly, and some leap well by means of their caudal appendages. The Linnæan genus is now divided into two.

In the genus *MACHILIS*, Lat. (*Petrobius*, Leach), Plate CCXXXIX, fig. 8, the eyes are extremely composite, almost contiguous, and occupy the larger portion of the head. The body is convex and arched above, and the abdomen is terminated by small setæ, adapted for leaping, and of which the central one, placed above the others, is much the longest. The maxillary palpi are very large, and pediform. The thorax is narrowed, with its first segment smaller than the others, and arched. These insects leap well and frequently. They dwell in stony and covered places. The species are few in number, and, as far as yet known, are European. We found the *P. maritimus* of Leach¹ in Fingal's Cave, in the island of Staffa.

In the genus *LEPISMA* properly so called (*Forbicina*, Geoffroy, Leach), Plate CCXXXIX, fig. 7, the eyes are very small, distant, and less composite than in the preceding genus. The body is flattened, and the three terminal setæ are inserted on the same line, and are not adapted for leaping. The haunches are very large. The greater number are found in the interior of houses. They run swiftly, and when seized their silvery scales come off upon the fingers. The softness of the masticating organs in this genus would induce us to believe that they are incapable of gnawing hard materials. The most common species, *L. saccharina*, is said by Linnæus and Fabricius to feed on sugar and decayed wood,—and, according to the former, it likewise gnaws books and woollen garments. Geoffroy, however, is of opinion that it preys on the little *Psocus pulsatorius*, a small neuropterous insect, usually without wings, which we find both in houses and beneath the bark of trees. This *Lepisma* measures about four lines in length. It is of a silvery white, with a tinge of lead colour, and without spots. It is said to have come originally from America. Another species, which is represented by the figure last referred to, is distinguished by its ash-coloured body, spotted with black, and marked down the back by four black lines. Its localities are similar to those of the preceding species.

FAMILY II.—PODURELLÆ, LAT.

In this family, which corresponds to the genus *Podura* of Linn., the antennæ consist of only four articulations. The mouth does not exhibit distinct and projecting palpi. The terminal seta is forked, and when not in action is kept bent beneath the abdomen. These insects are extremely small, the body soft, elongated, with an oval head and two eyes, each formed of eight small granules. The legs exhibit only four distinct joints. The tail is soft, flexible, and composed of an inferior piece, moveable at the base, with two articulated appendages at the extremity, susceptible of being approximated, separated, or crossed. By striking this caudal process against the plane of their position, these insects possess the power of leaping into the air like fleas, although with less activity. They generally fall upon their backs, with their tails stretched out behind. Some are found on plants, beneath the bark of trees, or under stones; others on the surface of stagnant waters. They even occasionally occur, during time of thaw, in great quantities, on snow. When collected in numbers, they resemble a sprinkling of gunpowder.

These insects are oviparous, and undergo no transfor-

mations. They are completely formed on leaving the egg, although they speedily increase in size, and frequently change their skins. Degeer informs us that he observed them in Holland, alive and active, during the prevalence of a strong frost. The aquatic species do not long survive a removal from the water. They speedily shrivel up and die. But the terrestrial species support uninjured the heat of the mid-day sun even in dry and dusty regions. As far as we know, all the ascertained species are European, though we doubt not the genera exist in other quarters of the globe.

In *PODURA* properly so called (Plate CCXXXIX, figs. 12 and 12 a), the antennæ are of nearly equal thickness throughout, and without annuli or small articulations at their extremity. The body is almost linear or cylindrical, with the thorax distinctly articulated, and the abdomen narrow and oblong.

In the genus *SMYNTHURUS*, Lat. (*Podura*, Linn.), the antennæ become attenuated towards the extremity, and are terminated by an annulated portion, composed of small articulations. The thorax and abdomen seem united into a single globular or ovate mass. This genus corresponds to the second section of the *Poduræ* of Degeer. When touched, these insects make great leaps into the air by means of a setiform process at the end of the abdomen, resembling that of the preceding genus;—but they are moreover furnished with a very extraordinary organ, which we do not find in *Podura* proper. Beneath their body, and just between the points of the two forks of the tail, there exists an elevated cylindrical portion, from which issue two long membranous threads, transparent, extremely flexible, and glutinous or humid. They are rounded at the extremity, almost as long as the insect's body, and are thrown out with force and celerity, one on either side, from the cylindrical portion just mentioned, according to the insect's pleasure.

In regard to the uses of these peculiar parts of structure, Degeer observed that some *Smynthuri* which he had placed in an earthen vessel ejected their slimy organs whenever they found themselves, against their will, slipping down the sides of their prison. They then hung, as it were, suspended by these filaments, until they had time to take up a fresh position.² It may thus be reasonably inferred that their natural use or function is to prevent the insect's falling, when, after the execution of a powerful leap, it happens to alight upon a perpendicular or inclined surface. Degeer's observations apply to *Sm. fuscus*, Lat.,³ a comparatively large species, synonymous with *Podura atra* of Linn.

ORDER XI.—PARASITA, LAT.⁴

The insects of this, our concluding order, are apterous, like those of the preceding; but their bodies are unprovided with articulated appendages, or other organs of locomotion, except the legs. Their organs of sight seem to consist solely of smooth or simple eyes (*yeux lisses*). Their mouth is in great part internal, and exhibits externally either a muzzle or projecting protuberance, enclosing a retractile sucker, or two membranaceous approximate lips, with a pair of hooked mandibles. These insects form in the Linnæan system the genus *PEDICULUS*, containing an extensive and varied group, known under the general and repulsive name of *lice*, and exhibiting in their structure and economy a great deal to interest the philosophi-

¹ *Zoological Miscellany*, cxlv.

² *Mémoires*, t. vii. p. 35, pl. iii. figs. 7, 8.

³ *Genera Crustac. et Insect.* t. i. p. 166.

⁴ *APTERA* (pars) Linn.; *ANOPLURA*, Leach.

Parasita. cal naturalist, notwithstanding the associations by which we unavoidably connect their existence with that of wretchedness and vice.

The unrestricted genus may be said to be generally characterized by a flattened body, almost transparent, and divided into eleven or twelve distinct segments, of which the anterior three bear the six legs. The first of these segments often assumes the form of a thorax. The stigmatic openings are very distinct. The antennæ are short, of uniform thickness, composed of five articulations, and frequently inserted in an emargination. On each side of the head there are one or two small simple eyes. The legs are rather short, and are terminated by a very strong claw, or by a couple of hooks directed one towards the other. These parasites, as many know by experience, attach themselves to man, beast, and feathered fowls. They likewise fix their eggs to hair and feathers; and as their generations are neither few nor far between, their superabundant increase under certain circumstances, not yet clearly understood, is sometimes such as to produce disease and death. The malady is called *phthiriasis*, from *φθίρις*, the Greek for louse.¹ Fabricius placed the *Pediculi* in his order *Antliata* (or *Diptera*), guided no doubt by a consideration of the parts of the mouth; while Dr Nitzsch, who has studied these insects with great attention, now ranks them with the Hemiptera, and at the same time classes the cognate genus *Ricinus* in the orthopterous order.

In the genus *PEDICULUS* properly so called (Plate CCXXXIX. fig. 11 and 11 a), the mouth is very small, mammillæform, and tubular, placed at the anterior extremity of the head, and, while not in action, enclosing a sucker. The tarsi consist of an articulation almost equal in size to the tibia, and terminated by a very strong claw, which, bending inwards upon a small projection, forms as it were a kind of nipper. Such of the species as Latreille has examined presented only a pair of simple eyes, one on each side.

Of the three species which infest the human race, *P. humanus corporis* is without spots. It infests the inner garments of beggars, and others who attach no importance to personal cleanliness, and is the cause of the disease above alluded to. The second species, *P. humanus capitis*, is more of an ash colour, with brown or blackish spots around the stigmatic openings, and the lobes of the abdomen are more salient. It occurs on the heads of children, and of dirty adults. In both these species the head and thorax are obviously distinct from the abdomen. In the third species, which forms the genus *Phthirus* of Dr Leach, the body is broad and rounded, the thorax very short and almost confounded with the abdomen, and the four posterior legs are very strong.

Of all these insects the powers of multiplication are great. Swammerdam viewed them as hermaphrodites, in as far as he could not satisfy himself regarding their distinctive sexual characters. But Leeuwenhoek and Degeer, and recently Latreille and Doctors Nitzsch and Alibert, have shown that they do not differ essentially in these respects from other allied tribes. They are all oviparous, and their eggs are deposited on hair (see Plate CCXXXIX. fig. 11 b) or garments. The young are hatched in five or six days, and after several castings of their skin, or in about eighteen days, they become fit to reproduce their kind. In this way it has been calculated that a brace of

females may prove the parents of *eighteen thousand young* in the space of two months. Oviedo remarked that the pediculi left the Spanish sailors at a certain latitude during their voyage to the Indies, and made their appearance again on the homeward progress about the same latitude. This we think was somewhere near the tropics; but the observation does not seem to have been confirmed by any special observations in more modern times. It is said, however, that in India they occur only on the head. These insects, however disgusting to people of refinement, are greedily sought after and *eaten* by those who may by some be regarded as belonging to the inferior orders, viz. Negroes, Hottentots, and Monkeys.

In the genus *RICINUS* of Lat. (Plate CCXXXIX. fig. 10), which corresponds to *Nirmus* of Hermann and Leach, the mouth is placed beneath, and consists exteriorly of two lips, and a pair of hooked maxillæ.² These insects, with the exception of a species found on dogs, are all bird-lice, that is, parasitical on the feathered creation. Their head, which, in common with the antennæ, occasionally differs in the sexes, is usually very large,—in some of a triangular form, in others semicircular or lunate,—and is frequently furnished with angular projections. Latreille has perceived a pair of simple eyes on each side of the head in several species. Besides the parts of the mouth just mentioned, Savigny satisfied himself of the presence of maxillæ, each bearing a very small palpus, and concealed by the labium or lower lip, which is also palpigerous. There is likewise a kind of tongue. The *Ricini* are much less sluggish in their movements than the *Pediculi* properly so called. They glide about among the feathers of birds with considerable agility, and are captured with difficulty, by reason of the flatness of their forms and adhesive propensities. When a bird dies, however, they assemble together about the base of the beak, and other parts of the head, and moving about with an air of inquietude, they seem to watch for an opportunity of making their escape to some living prey. M. Leclerc de Laval detected portions of the plumage in their stomachs, and he is of opinion that these constitute their sole subsistence; but Degeer found the *Ricinus* of the chaffinch gorged with blood; and their extreme anxiety to change their quarters the moment that circulation ceases, argues a fancy for something more than feathers.

We have at last brought to a conclusion an article which the reader may possibly regard as of inordinate length, but which the writer has certainly found far too narrow for the proper elucidation of several departments of his subject. "And here it is not out of place to remark, that it is the very perfection of the divine workmanship which leads every inquirer to imagine a surpassing worth, and grace, and dignity, in his own special department of it. The fact is altogether notorious, that in order to attain a high sense of the importance of any science, and of the worth and beauty of the objects which it embraces, nothing more is necessary than the intent and persevering study of them. Whatever the walk of philosophy may be on which man shall enter, that is the walk which of all others he conceives to be most enriched by all that is fitted to entertain the intellect or arrest the admiration of the enamoured scholar. The astronomer who can unravel the mechanism of the heavens, or the chemist who can trace the atomic processes of matter

¹ It is well described by M. Alibert, in his treatise *Sur les Maladies de la Peau*.

² The genus *Ricinus* was established by Degeer, who first recognised that these insects were distinguished from *Pediculi* by the existence of mandibles. The name was applied by the ancients to certain acarideous species of the genus now called *Ixodes*, and for that reason has not been adopted by some modern naturalists, who prefer the name of *Nirmus*.

Index. upon earth, or the metaphysician who can assign the laws of human thought, or the grammarian who can discriminate the niceties of language, or the naturalist who can classify the flowers, and the birds, and the shells, and the minerals, and the insects which so teem and multiply in this world of wonders,—each of these respective inquirers is apt to become the worshipper of his own theme, and to look with a sort of indifference, bordering on contempt, towards what he imagines the far less interesting track of his fellow-labourers. Now each is right in the admiration he renders to the grace and grandeur of that field

which himself has explored; but all are wrong in the distaste they feel, or rather in the disregard they cast on the other fields which they have never entered. We should take the testimony of each to the worth of that which he does know, and reject the testimony of each to the comparative worthlessness of that which he does not know; and then the unavoidable inference is, that that must be indeed a replete and a gorgeous universe in which we dwell,—and still more glorious the Eternal Mind, from whose conception it arose, and whose prolific fiat gave birth to it in all its vastness and variety."¹ (T.)

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¹ Chalmers' Bridgewater Treatise On the Adaptation of External Nature to the Moral and Intellectual Constitution of Man, vol. ii. p. 173.
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A N T.

Ant.

THE history of a tribe of insects so long celebrated for their industry and frugality, and for the display of that sagacity which characterizes some of the higher orders of animals, is peculiarly calculated to occupy the attention of modern naturalists. The ancients, indeed, had often noticed the habits and economy of the ant; but their accounts, at all times deficient in accuracy, from the want of precise definitions and logical arrangement of the objects they describe, are in this instance so mixed up with fanciful notions and chimerical doctrines, and so coloured by the vivid imagination and credulity of the narrators, as to have retarded rather than advanced the progress of real knowledge. Aristotle and Pliny report, for instance, that the labours of ants are in a great measure regulated by the phases of the moon; and the latter mentions a species found in the northern parts of India, whose size was said to equal that of the wolves of Egypt, whose colour was the same as that of a cat, and whose occupation in winter consisted in digging up gold from the bowels of the earth; while the inhabitants in the summer robbed them of their treasures, after having decoyed them, by stratagem, from their nests. Great mistakes have prevailed, even in later times, from the circumstance of the larvæ of ants bearing a resemblance to grains of corn, which it was supposed these insects hoarded up as a provision for winter consumption. The form of the eggs and of the larvæ, and the attention paid to them by the ants, were described by Dr King in the 23d number of the *Philosophical Transactions*; but Leeuwenhoeck was the first who distinguished with precision the different forms which the insect assumes in the several stages of its growth. He traced the successive changes from the egg to the larva, the nymph, and the perfect insect. Swammerdam pursued his scrutiny into these successive developments with greater minuteness; and, unrivalled in the art of microscopic dissection, discovered the wonderful encasement of all the parts of the future ant at every preceding stage, and showed that it appears under such different forms only from the nature of its envelopes, each of which, at the proper period, is in its turn cast off. Linnæus (*Memoirs of the Royal Academy of Sciences at Stockholm*, vol. ii.) ascertained some of the leading facts with regard to the distinction between the sexes, and determined that the ants which are furnished with wings are the only individuals that exercise the sexual functions. Several particulars with regard to the economy of the ants were published by Mr. Gould, in a book entitled *An Account of English Ants*, of which an abstract is given in the *Philosophical Transactions* for 1747, by the Rev. Dr Miles. The facts are there stated with tolerable correctness; but some errors have been committed by following too closely the analogy with bees. Geoffroy (*Histoire des Insectes qui se trouvent aux Environs de Paris*), though a good naturalist on other topics, is a bad authority on the subject of ants. The most complete series of observations on the natural history of these insects, is that for which we are indebted to the celebrated Swedish entomologist De Geer (*Mémoires pour servir à l'Histoire des Insectes*), an observer on whose fidelity the most implicit reliance may be placed.

In the *Encyclopédie Méthodique*, under the article *Fourmi*, Olivier has drawn up an able statement of all the material facts that had been established by preceding naturalists; without, however, adding any original observations of his own, excepting the description of five or six undescribed species. A full account of the habits of those

ants which for a long time infested the island of Martinique, is contained in some of the earlier numbers of the *Journal de Physique* (vols. ix. and x.). The author of these memoirs, M. Barboteau, has given many curious details on this subject, and has cited a number of facts on various authorities; and the account might now be swelled by the reports of subsequent travellers in different parts of the world; but these statements are often made upon slender authority, and are too much tinctured with the marvellous to admit of much credit being attached to them. The narrative given to us by Bonnet in the second volume of his *Observations sur les Insectes*, of the proceedings of a colony of ants which had established itself in the head of a large thistle, and which he transported into his house, is highly interesting; but it elucidates only a few points of their economy, and leaves us to regret that so patient and indefatigable an observer had not bestowed more of his attention to the study of this tribe of insects. In the *Philosophical Transactions* for 1790 we find an interesting memoir on the sugar-ant, a species which, for a period of ten years, committed dreadful ravages in the sugar plantations throughout the whole island of Grenada. The most methodical account of this tribe of insects that has yet appeared is that of Latreille, in his *Histoire Naturelle des Fourmis*, published at Paris in 1802, a work which alone would have secured the reputation of the author as an able and scientific naturalist. His merit is particularly conspicuous in the clearness and accuracy of his descriptions of each species, and the luminous method of arrangement which he has adopted in their classification. He gives an account of one hundred species which he had himself observed, and of twenty-four which he has described from the reports of others: these he distributes into nine natural families, according to the situation and structure of the antennæ, and the form of the abdominal scales. But the work which contains the most copious collection of facts relative to the habits and economy of ants is that of Mr P. Huber of Geneva, entitled *Traité des Mœurs des Fourmis Indigènes*, published in 1810. By means of an apparatus which he contrived so as to admit of his obtaining a view whenever he pleased of the inmost recesses of their habitation, he was enabled to observe what was going on in the interior of the nest, and to investigate with success some of the most important and interesting features of their history. The results of his researches, as they are reported in his work, are highly curious and instructive, and open a wide field of speculation and inquiry to the philosophical entomologist. They have not only elucidated many obscure points with regard to one tribe of insects, but have disclosed some general views of the instincts and faculties of this order of the creation, which are totally new, and must tend, in a considerable degree, to exalt our conceptions of the inexhaustible powers and resources of nature.

Having thus pointed out the principal sources of information in this department of entomology, we shall proceed to give an outline of the leading facts that have been ascertained relative to the economy and domestic policy of these remarkable insects.

In common with many tribes of hymenopterous insects, ants present the remarkable peculiarity of a threefold division of sex among the individuals of the same species; a circumstance which is met with in no other order of the animal kingdom, and which appears, as far as observation has extended, to be totally excluded from the plan

Ant. of the vegetable creation. Besides males and females, there exists an apparently intermediate order of *neuters*, which are also denominated labouring or working ants. The neuters, thus exempted from every sexual function, exercise, on the other hand, all the other offices necessary for the existence and welfare of the community to which they belong. It is they who collect supplies of food, who explore the country for this purpose, and seize upon every animal substance, whether living or dead, which they can lay hold of, and transport to their nest. It is they who construct every part of their dwelling-place, who attend to the hatching of the eggs, to the feeding of the larvæ, and to their removal, as occasion may require, to different situations favourable to their growth and development; and who, both as aggressors and as defenders, fight all the battles of the commonwealth, and provide for the safety of their weaker and more passive companions. Thus all the laborious and perilous duties of the state are performed solely by this description of ants, who act the part of helots in these singularly constituted republics of insects. We find, however, on closer examination, that, in all probability, this anomaly in point of sex is more apparent than real; and that, however different in external conformation from the productive females, they nevertheless originally and essentially belong to the same sex. There is every reason to believe that the development of the sexual organs in the former is the consequence of some difference in the circumstances in which the larva is placed during its growth. That such is the case with bees, is now perfectly well established; and the analogy of bees with ants, in many points of physiology, must be admitted as a strong argument in corroboration of this theory. In all the essential features of internal structure, the supposed neuters agree with the female, and differ from the male of the same species. In all hymenopterous insects, which are armed with stings, a difference exists in the two sexes, as to the number of articulations composing the antennæ; those of the female consisting of fewer pieces than those of the male. The accurate observations of Mr Kirby (*Monographia Apum*) have determined that in the bee the antennæ of the male have fifteen articulations, while those of the female and the neuter have only fourteen. In the ant, likewise, we find thirteen articulations in the male, and only twelve in the female; and likewise only twelve in the neuter. In the male ant the abdomen has seven rings, in the female and neuter only six. In the two latter classes the head is broader, and the mandibles very large and powerful compared with those of the male, and are furnished with serrated edges, and a sharp and often hooked point. The external sexual organs of the female and of the neuter are so nearly similar in appearance, that Latreille declares he was unable to perceive the least difference between them. On the other hand, it is to be observed, that in the neuter the principal deviation from the model of the female consists in the absence of wings; a circumstance which, as it regards the organs of locomotion only, is one of subordinate importance in the economy; and their presence may, without difficulty, be conceived to be connected with a certain condition of the sexual organs, as are the horns of the deer, and the beard in the human species. But although of so little consequence in a physiological point of view, it is a circumstance materially affecting their external condition. It dooms them to severe toil and exertion in traversing the ground, and in climbing up the steep paths that may lie in their route; while their more luxurious and favoured associates are fluttering in the spacious realms of air in search of amusement, and wafted to the objects of their gratification on the light breezes of the summer.

Ant. Ants appear to be endowed with a greater share of muscular strength than almost any other insect of the same size. Of this we have sufficient proofs in the vivacity of their movements, the incessant toil which many undergo, the great loads which they are seen to carry, often exceeding ten or twelve times their own weight, and the agility which they exert in making their escape from danger. This high degree of irritability is conjoined, apparently, with a corresponding share of the power of sensation; a power which is manifested in their susceptibility to a variety of impressions capable of affecting the organs of sense. They have a quick perception of all changes of temperature, as well as of other conditions of the atmosphere; and are readily and disagreeably affected by moisture. In the perfection of the sense of sight they seem to be nearly on a level with other insects; and the males and females are provided with both the descriptions of eyes peculiar to this class, namely, the composite and the simple eyes. The labouring ants, indeed, who never fly, are frequently destitute of the latter kind; a circumstance which appears to confirm the suspicion that has often been entertained, that the simple eyes are chiefly instrumental in the vision of distant objects. Latreille describes two species of ants, in which he could not discover the least appearance whatsoever of eyes, although he employed a high magnifying power in examining them. One of these (the *Formica ceca*) is a foreign species, inhabiting the forests of Guiana, and of which the history is therefore little known. The other (the *Formica contracta*) is met with in the vicinity of Paris. It always conceals itself during the day under stones, or in obscure recesses, where no light can penetrate; and emerges from its retreat only during the night. It is much less social in its habits than other ants, collecting in groups only of about a dozen individuals, and appears to be far inferior in sagacity to the rest of the tribe.

Ants possess a considerable acuteness of smell, a sense which appears to be useful not only in directing them to their food, but also, as Bonnet first remarked, in enabling them to follow by the scent the track of their companions. If the end of the finger be passed two or three times across the line of their march, so as to brush off the odorous particles with which the ants who had already passed that way may have impregnated the track, those who follow immediately stop on arriving at the place where the experiment has been made, and afterwards direct their course irregularly, till they have passed over the space touched by the finger, when they soon find the path, and proceed with the same confidence as before. Bonnet repeated this experiment frequently, and always with the same result. Latreille has endeavoured to discover the seat of smell, which had long been suspected to reside in the antennæ. He, with this view, deprived several labouring ants of these organs, and replaced them near their nests. When thus mutilated, they wandered to and fro in all directions, as if they were delirious, and utterly unconscious of where they were going. Some of their companions were seen to notice their distress, and, approaching them with apparent compassion, applied their tongues to the bleeding wounds of the sufferers, and anointed them with a liquor which they caused to flow from their own mouths. This trait of sensibility was repeatedly witnessed by Latreille, while he was observing their actions with a magnifying lens.

It is indeed evident that, in all insects, the antennæ are organs of the greatest utility in conveying impressions from external objects. But in the ant, independently of their importance as organs of touch, they appear to be of still greater consequence to the welfare of the individual, and of the community to which it belongs, by being the

Ant. Sensitive powers of ants.

Ant. chief instruments which enable them to communicate to one another intelligence in which they are mutually interested, and on which they are called upon immediately to act. Mr Huber, to whom we are indebted for a variety of curious observations on this subject, has given the name of *Language Antennal* to this species of intercourse. The situation of the antennæ, which are placed in front of the head, their great mobility, their peculiar mechanism, which presents a series of phalanges having great freedom of play, and endowed with exquisite sensibility, conspire to fit them admirably for the function which he assigns to them,—that of producing a variety of different impressions, when applied in different ways to the antennæ or other parts of those ants with which they come in contact. Thus the signal of danger, which consists in the ant which gives the alarm striking its head against the corslet of the other, is propagated from ant to ant with astonishing quickness, throughout the whole society. For a few minutes a general ferment prevails, as if they were deliberating what measures to pursue; but their resolution is soon formed, and they are ready to rush in a body against the enemy. Any small animal that is discovered to have insolently invaded their repose is certain of falling a victim to their resentment, unless he can make a precipitate retreat, which he seldom effects without being covered with the bites of these furious insects. They are not, however, equally jealous of the intrusion of every kind of insect, for woodlice are often found in the interior of the nest, to whom, according to Latreille, they offer no molestation. Ants appear to be incapable of emitting sounds, so as to communicate with one another at a distance; and there is, indeed, no evidence that they possess the sense of hearing. The consideration of the sense of taste naturally comprehends that of their food, to which we shall therefore next proceed.

their
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tions.

Very erroneous opinions were prevalent with regard to the food of ants, which have often been supposed to consume corn, and to do great injury to plants by devouring their roots or stems. The truth is, that they are chiefly carnivorous insects, preying indiscriminately on all the softer parts of animals, and especially the viscera of other insects. These, indeed, they will often attack when alive, and overpower by dint of numbers; either devouring their victim on the spot, or dragging it a prisoner into the interior of the nest. If, however, the game should be too bulky to be easily transported, they make a plentiful meal, and exert, like the bee, a power of disgorging a portion, and of imparting it to their companions at home: and it appears that they are even able to retain at pleasure the nutritious juices unchanged for a considerable time. The rapidity with which they consume, and in fact anatomize, the carcass of any small bird or quadruped that happens to fall in their way, is well known, and furnishes an easy method of obtaining natural skeletons of these animals, by placing their dead bodies in the vicinity of a populous ant-hill. In hot climates, where they multiply to an amazing extent, their voracity and boldness increase with their numbers. Bosman, in his description of Guinea, states that, in one night, they will devour a sheep, leaving it a fine skeleton; while a fowl is for them only the amusement of an hour. In these situations they will venture to attack even living animals of considerable size. Rats and mice often become their victims. The sugar-ants of Grenada cleared every plantation which they visited of rats and other vermin, which they probably effected by attacking their young. Poultry, or other small stock, could not be raised without the greatest difficulty; and the eyes, nose, and other excretories of the bodies of dying or dead animals, were instantly covered with them. They generally, indeed, begin their attacks on the most

sensible parts, which have the finest cuticle; and, accumulating in great numbers about the nostrils, destroy the animal by interrupting respiration. Negroes with sores had difficulty in keeping the ants from assailing them. Their power of destruction keeping pace with their increase of numbers, it is hardly possible to assign limits to either; and the united hosts of this diminutive insect have often become formidable to man himself. A story is related by Prévost, in his *Histoire Générale des Voyages*, of an Italian missionary, resident in Congo, who was awaked by his negroes in great alarm at the house being invaded by an immense army of ants, which poured in like a torrent, and before he could rise had already mounted upon his legs. They covered the floor and passages, forming a stratum of considerable depth. Nothing but fire was capable of arresting their progress. He states that cows have been known to be devoured in their stalls by these daring devastators. Smith, in his *Voyages to Guinea*, reports that at Cape Corse the castle was attacked by legions of ants, who were preceded by thirty or forty, apparently acting as guides. It was at day-break when they made this incursion, entering first by a chapel, on the floor of which some negro servants were lying. Assailed by this new enemy, they fled with precipitation, and gave the alarm to their master, who, on awaking, could hardly recover from his astonishment at beholding the advancing multitude, which extended for a quarter of a mile before him. There was not much time for deliberation; and a happy expedient was adopted of putting a long train of gunpowder across the line of their march, and extending it to their flanks, which had already begun to deploy, and, setting fire to the whole, millions were destroyed at one blow; which so intimidated the rest, that the whole army retreated in disorder, and did not renew the attack.

Descriptions of ant-hills of immense size abound in books of travellers who have visited tropical regions. Mr Campbell (*Account of Travels in South Africa*, published in 1815) observed in the district of Albany, at the Cape, an ant-hill, five feet high, and twelve in circumference. In the forests of Guiana, according to M. Malouet, they attain the height of from fifteen to twenty feet; and, when viewed from a distance on these widely extended savannas, resemble the rude huts of savages; but they contain a race more ferocious than the savage or the tiger himself, and cannot be approached by men without the utmost danger of being devoured. When new settlers, who are clearing the country, meet with any of these in their progress, they must immediately desist from their task, and even abandon the neighbourhood, unless they can speedily destroy the enemy in the very heart of the citadel which protects him, and from which he is able to pour an overwhelming number of combatants. The only method of accomplishing this is to dig a trench all round the ant-hills, and, after having filled it with dry wood and set fire to it on every side, by lighting it quickly in different places, so as to cut off all retreat to the ants, to batter down the edifice with cannon. The ants, thus scattered, soon perish in the flames.

The chief, if not the only vegetable substance which is at all alluring to their appetite, is *sugar*. They not only eat it in substance, but are fond of all fluids that contain it in any quantity,—such as the secretions which exude from many trees, and compose what has been termed the honey-dew; and the saccharine juice which is excreted from the bodies of many of the insects belonging to the genus *Aphis*. This latter species of food they appear to relish above all others: it resembles honey in its qualities, and is sucked with avidity from the insect which yields it, and which appears in no respect to suffer from the operation. Boissier de Sauvages was the first who noticed this

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singular fact; and Mr P. Huber has ascertained a number of curious circumstances attending it. He conceives that the liquor is given out voluntarily by the aphid, at the solicitation of the ant, who for this purpose strikes it gently and repeatedly with its antennæ, using the same motions as it does when caressing its young; and remarks, that the aphid retains this liquor for a longer time, where the ants are not at hand to receive it. A single aphid may often be seen surrounded by three or four ants who are feeding on the honey, and deriving from it a plentiful meal. It does not appear that the aphid uses any exertion to avoid the ants, who are thus dependent on its bounty; for those provided with wings are quite as passive under these circumstances as the rest. They are, however, of an extremely sluggish nature, and may be seen for days on the same stem, in a state of indolent repose, and averse to use their wings.

A singular observation has been recently made by Professor Savi (the younger) of Pisa, in relation to a species of Italian ant, the nest of which is inhabited by a small grasshopper. These animals do not appear to dwell in the same excavations in a merely casual manner, but they are united by some unaccountable bond of union, which renders the society of the one indispensable to the comfort of the other. The association of the ant and the aphid before alluded to is of a dissimilar nature, being the result of force on the one hand, and of necessity on the other. But, as far as it is possible to judge from the observations hitherto recorded, the cohabitation of the ant and the grasshopper is of a more refined and disinterested kind. It is really impossible at present to account for it on any other principle than that of an affectionate interest in each other's society; for no direct advantage appears to result to either party. On this account Signor Savi has named the grasshopper *gryllus myrmecophilus*.¹ He proved the friendly alliance which subsists between these species, by watching the migratory and other movements of the ants themselves, during which he discovered that they always carried their little grasshoppers along with them. These latter, during fine weather, are seen to sport and play in the vicinity of the ant-nests, into which they immediately betake themselves during any unfavourable change of the air, or the approach of threatened danger.

The cultivation of the sugar-cane in the West Indian islands has often been severely checked by the ravages of ants; but the injury they occasion arises altogether from their undermining the roots, in order to establish their nests where they can be protected from heavy rains, and secured against agitation from violent winds; advantages which the sugar-cane affords them in a very great degree. No part of the plant constitutes their food; and the same is true of those trees among the roots of which they burrow, and of which they speedily occasion the destruction, by preventing the access of moisture.

Ripe fruits are often attacked by ants, probably on account of the sugar they contain; and, for the same reason, the buds of trees are infested with these insects, and often injured by their depredations. There is no evidence that they at any time feed upon corn or other vegetable seed. This point has been well established by Mr Gould; and Bonnet, who kept a colony of ants prisoners in his study, observed, that, however long they had been kept without food, still they never touched the corn that he put before them. Honey and sweetmeats have strong attractions for ants, who, if they once discover their way to a magazine of these dainties, will immediately communicate the tidings to the rest of the society, and, leading them to the spot,

a regular path will soon be established, which will continue to be crowded with a train of depredators so long as any thing remains to be pilfered. It is, however, certain, notwithstanding the assertion of Bomarc, who compares them to the miser, whose chief pleasure consists in contemplating the riches he has amassed in his coffers, that ants are not in the habit of hoarding provisions for future consumption. They grow torpid when the cold exceeds 27° of Fahrenheit, and in that state require no food; and the aphid affords them sufficient nourishment at other periods of the winter.

In building their nests, each species of ant follows its own peculiar mode of construction, and employs different materials for this purpose. Many form them of clay, and particularly the smaller species; one set building up a regular series of apartments in successive stories, often forty in number, with materials which are furnished to them by another set of workers, who are excavating the ground below. The ceilings are supported throughout by small pillars in some parts, and by vertical walls in others; while broad arches are in other places raised, in order to protect larger spaces, and to admit of lengthened passages of communication throughout a long extent of apartments. These ants can proceed in the building only at such times as the earth has been softened by rain or dew, and the atmosphere is at the same time sufficiently moist to allow of the materials cohering firmly before they dry. Such are probably the ants which Pliny mentions as working by moonlight. On one occasion, when the ants, under the inspection of Mr Huber, had discontinued their labours on account of too great dryness in the atmosphere, he succeeded in getting them to renew their operations by sprinkling water upon them with a wet brush, in imitation of a natural shower. They carefully close the doors of their habitations every night, in order to prevent the intrusion of other insects; and a few remain on the outside during the night as sentinels, to give alarm in case of danger. Some species of ants collect fragments of leaves, of bark, or of straw, with which they construct more permanent and artificially constructed nests than the former. Others employ nothing but the fine powder which they collect from decayed wood. Some, for greater security, establish themselves under a large stone, or in the crevices of decayed buildings. Several tribes, on the other hand, penetrate into the solid substance of wood, which they scoop out into numerous cells, leaving only intermediate partitions of extreme tenuity, just of the strength sufficient to enable the whole fabric to support itself; while it crumbles into powder when pressed between the fingers.

We shall now take a brief review of the principal circumstances relating to the fecundation of the ant, and the evolution and growth of the young. The former is effected very generally during the flight of the females, in which they are accompanied by the males; both appearing to be provided with wings chiefly for this object. A certain number of the females that are impregnated, are also, by the assistance of their wings, enabled to reach distant situations, where they become respectively the founders of new colonies. The males, on the other hand, having fulfilled the office for which nature had destined them, are left to perish on the spot where they descend, being removed from those who formerly administered to them food, and being destitute of the means of procuring subsistence for themselves. Immense swarms of ants are occasionally met with; and some have been recorded of such prodigious density and magnitude as to darken the

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¹ Biblioteca Italiana, tomo xv. p. 217.

Ant. air like a thick cloud, and to cover the ground to a considerable extent where they settled. Mr Gleditsch describes, in the *History of the Berlin Academy* for 1749, shoals of a small black ant which appeared in Germany, and formed high columns in the air, rising to a vast height, and agitated with a curious intestine motion, somewhat resembling the aurora borealis. A similar flight of ants is spoken of by Mr Acolutte, a clergyman of Breslaw, which resembled columns of smoke, and which fell on the churches and the tops of the houses, where the ants could be gathered by handfuls. In the German *Ephemerides*, Dr Charles Rayger gives an account of a large swarm, which passed over the town of Posen, and was directing its course towards the Danube. The whole town was strewn with ants, so that it was impossible to walk without trampling on thirty or forty at every step. And more recently, Mr Dorthes, in the *Journal de Physique* for 1790, relates the appearance of a similar phenomenon at Montpellier. The shoals moved about in different directions, having a singular intestine motion in each column, and also a general motion of rotation. About sunset they all fell to the ground; and, on examining the ants, they were found to belong to the *Formica nigra* of Linnæus.

The swarming of ants does not appear to be at all analogous to that of bees: its object seems to be confined to the propagation of the species, and is not the result of any co-operation of numbers, who associate together in search of a new habitation, in which an already populous assemblage may establish themselves. It would appear that the infant colonies consist of very small numbers, and are perhaps wholly the offspring of a common parent, who has migrated alone, or with but a few companions. The greater number of impregnated females alighting in the neighbourhood of the nest, are laid hold of by the labouring ants, who drag them to the nest, where they keep them prisoners till they are ready to deposit their eggs. It is very generally asserted that they also deprive them of their wings; but the later observations of M. Huber disprove that opinion. The impregnated females cast their wings of their own accord. They twist and contort these organs in various directions, till they finally drop off. Such as are unimpregnated have not been observed to perform this singular action. Each female is at this period attended by a numerous retinue of labourers, who treat her with the greatest deference, and are solicitous to anticipate all her wants. Contrary to what happens among bees, many females inhabit the same nest, and live together in the utmost harmony. The eggs, when first deposited, are very small, but become considerably larger before the larva is excluded, being apparently nourished by absorption; for the ants to whose care they are confided are perpetually licking them with their tongues,—a fact which, however curious, is by no means a solitary one in the history of insects. The larva comes forth at the end of a fortnight, and appears in the form of a transparent maggot, with a head and wings, but without any external organs of motion. They are in this state fed by their nurses with a fluid disgorged from their stomachs; and, in the course of their transformation to the state of nymph, and of perfect insect, are still dependent upon their assistance. These affectionate guardians help them to extricate themselves from the web of the cocoon, to unfold the duplicatures of their wings, and supply them with food, till they are capable of procuring it for themselves. The young ant is an exceedingly tender and delicate animal, easily destroyed by any considerable variation of temperature, or by excessive humidity; and great care and attention appear to be required to bring it to maturity: it appears to be the constant business of the

ants which remain at home to convey them to different parts of the nest, where the temperature is suited to them; and whenever danger threatens they show the utmost solicitude to remove them to situations of security.

Very different degrees of sagacity belong to different tribes of ants. Many traits in the history of the larger kinds, as related by Huber, are of so singular a character as to be scarcely credible if we had received them from a less reputable authority, and if we were not already prepared to admit them, from our knowledge of many equally curious circumstances in the economy of bees, which have been established by the concurrent testimony of the most scrupulous observers. Some tribes of ants, according to this naturalist, who are peculiarly fond of the honey which exudes from the aphids, convey many of these insects into their own nests, lodging them near the vegetables on which they feed, but keeping them prisoners within their habitations, and assigning to them distinct apartments in the subterranean recesses of their dwellings. As if conscious of the future advantages they may derive from these insects, they collect their eggs, and superintend their hatching with the same care which they bestow on the eggs of their own species. The aphid lives in perfect harmony with its keepers, who, so far from molesting it, defend it with courage against ants belonging to other nests, who frequently attempt to get possession of them. Occasionally they are lodged by the ants in fortified buildings, which they construct at a distance from the nest, in situations where they are most secure from invasion. The aphid is not the only genus of insect which furnishes this kind of provision to the ant; the kermes and gall-insect are employed occasionally for the same purpose, and are found domesticated in the nests of ants, at the same time that they contain several species of aphids, and from all of which they collect nutriment.

This picture of domestic harmony is strongly contrasted with the scenes of ferocious contention which are occasionally exhibited between the inhabitants of neighbouring nests; nature appearing to have instilled, together with the love of social order, the same passions of rivalry, of ambition, and of revenge, of which we deplore the operation among beings of a higher order. War, the scourge of the human species, exerts its desolating power among the tribes of gregarious insects, and tends to check their otherwise excessive increase of number. The battles which take place between rival colonies of ants are often on a scale of prodigious magnitude: millions of combatants engage on either side with a fury and pertinacity that is truly astonishing. Their weapons of offence are the jaws, which are capable of inflicting a deep bite, and of instilling into the wound a highly acrid liquor; and also, in many species, a sting resembling in situation and structure that of the bee, and likewise containing a venomous juice. The liquor is well known to possess acid properties, and, though long supposed by chemists to contain a peculiar acid, which was denominated the Formic, has been satisfactorily shown by Foureroy and Vauquelin to consist of the acetic and malic acids, combined with a portion of acid animal matter, to which it owes its peculiar taste and smell. It is extremely volatile and pungent, and is capable of being thrown out by the ant, when irritated, in considerable quantities. Roux, in the *Journal de Médecine* for 1762, reports a number of experiments which were made by exposing animals to its influence. Frogs were killed by the vapour from an ant's nest in less than five minutes; and persons breathing it, when of a certain intensity, were nearly suffocated, or were seized with fever, followed by an extensive cutaneous eruption, which terminated in desquamation of the cuticle.

Ant.

Some of the most daring and courageous species, such as that which M. Huber calls the *Amazon-ant*, make it the business of their lives to attack the nests of the weaker species, and succeed, after a desperate conflict, in plundering them of their eggs and larvæ, which they convey to their own nests. These are hatched and reared by ants of the same species as themselves, who may be considered as auxiliaries to the amazons, and who had themselves, at some former period, been kidnapped from their parent nest by the amazons. Thus, a society is formed among different species of insects, to which no parallel exists but in the human race. The amazons live without labour; they are attended, fed, and cherished by the ants which they have procured by this kind of slave-trade, and who take as much care of their offspring as they do of those of their own species. Perfect order is preserved, and the natural instinct of hostility, which in another condition of the society exists between the two tribes, seems in the auxiliaries completely extinguished, by their being educated with the race of their original oppressors.

Ants have numerous enemies among quadrupeds and birds; and some, as the ant-eater, dasypus, and manis or pangolin, together with the tribe of woodpeckers, devour a very large proportion. The *Formica leonis*, or myrmelion, feeds almost wholly on these insects. The bees at the Cape, according to Mr Campbell, frequently drive out the ants from their nests, of which they take possession themselves. Ants are also infested by lice, which, as may well be imagined, are so minute as to be invisible without the assistance of a very high magnifying power. They are stated by Redi, who discovered them, to resemble in shape those of the fowl and the dove.

Mode of
destroying
ants.

The most effectual mode of destroying ants is to pour boiling water into their nests, which destroys at once both the perfect insects and their eggs and larvæ; so that those who, being from home, had escaped the general catastrophe, finding it impossible to repair the loss, abandon the spot, and disperse. The addition of urine, or of soot, or, still better, of tobacco, which may be infused in

the water, will render it much more efficacious. A decoction of walnut-leaves or lime-water will also generally answer. The night is the best time for applying these remedies, as the ants are then all collected in the nest. Arsenic is exceedingly destructive to ants, and affords another ready mode of getting rid of those that intrude into cupboards or pantries: it may, for this purpose, be mixed with sugar, or kneaded with any kind of provision, and placed in the paths they are observed to frequent. Corrosive sublimate is also highly poisonous to them, and myriads of the sugar-ants at Grenada were destroyed by means of it; and it is stated to have had the effect of rendering the ants so outrageous that they destroyed each other, as could be seen by a magnifying glass, and even, though less distinctly, by the naked eye. It appears also that this effect was produced even when they only came in contact with the poison. The whole island, however, was so overrun with these ants, that the numbers that could be destroyed by these means bore no sensible proportion to the whole; and recourse was had to fire as more applicable to destruction on a larger scale. It was observed that when wood, burnt to the state of charcoal, without flame, and immediately taken from the fire, was laid in their way, they crowded to it in such amazing numbers as soon to extinguish it, though thousands perished by so doing. Holes were therefore dug at proper distances in a cane-piece, and fire made in each of them. Prodigious quantities perished in this way; for those fires, when extinguished, appeared in the shape of mole-hills, from the numbers of dead that were heaped upon them. But as none of the females or young brood were destroyed by this expedient, the ants soon re-appeared in as great numbers as before; and the island would probably have continued subject to this scourge, had it not been for the occurrence of the great hurricane of 1780, which at once cleared all the islands of this dreadful pest, by which the sugar-cane plantations had been threatened with total ruin. (Y.)

For the specific descriptions and systematic arrangement of the different kinds of ants, see ENTOMOLOGY.

Ant.

B E E.

Progress
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this insect.

THE bee, from its singular instincts, its active industry, and the useful products resulting from its labours, has, from the remotest times, attracted the attention, not only of naturalists, but of mankind in general. No nation upon earth has had so many historians as this remarkable tribe of insects. The patience and sagacity of the naturalist have had an ample field for exercise in the study of their structure, physiology, and domestic economy. Their preservation and increase have been objects of assiduous care to the agriculturist; and their reputed perfection of policy and government have long been the theme of admiration, and have afforded copious materials for argument and allusion to the poet and the moralist in every age. It is a subject that has been celebrated and adorned by the muse of Virgil, as well as illustrated by the philosophic genius of Aristotle. Cicero and Pliny report that Aristomachus devoted himself during sixty years to the study of these insects; and Philiscus is said to have retired into a desert wood, that he might pursue his observations on them without interruption. A prodigious number of authors have written express treatises on bees; periodical works have been published relating exclusively to their management and economy; and learned societies have been established for the sole purpose of conducting researches on this subject. The most celebrated association of this kind is the *Société des Abeilles*, founded about fifty years ago in Little Bautzen, a village in Upper Lausatia, under the auspices of the elector of Saxony. Its labours, as we shall presently find, have enriched the science with a number of valuable discoveries.

In so complicated a branch of natural history, the application of the difficult art of observing correctly, and of the cautious processes of induction, cannot be effected without laborious and long-continued efforts. But, on the subject of bees, the inquirer after truth had, besides, many obstacles to encounter, from the very general diffusion of errors, which had been transmitted without due examination from one author to another. The history of the opinions of successive writers will sufficiently prove how gradual and how slow has been the advancement of real knowledge in what concerns these insects, and will teach us to estimate the value of that which we at length possess, as being the result of the labour of ages, and as being extorted from nature by indefatigable and persevering exertions. So great an accumulation of curious and interesting facts, indeed, has accrued to us from the researches of Swammerdam, Maraldi, Reaumur, Schirach, and Huber, as to constitute almost a new science. Many of these have been discovered subsequently to the time of the compilation of the article BEE in the preceding edition of this work. It will therefore be proper, in this place, to give a connected and systematic account of the natural history of this remarkable insect. For the details of the external characters and distinctions of species, we shall refer to the article ENTOMOLOGY. The principal features of their internal conformation will be described when treating of the particular functions to which they are more immediately subservient; and our descriptions will apply, more especially, to the common and best-known species, the *Apis mellifica*, which is the one particularly prized on account of the rich products it affords.

The economy of bees comprehends so wide a field of inquiry, the different parts of which are so connected and dependent upon one another, that it is impossible to treat of them distinctly, without supposing the reader to possess some general acquaintance with the history of these insects. We shall therefore premise a brief account of the different sorts of bees inhabiting the hive, and of the respective offices of each. We shall then proceed to consider their comparative physiology; under which head we shall state the leading particulars relating to their nutrition, secretion, respiration, progressive motion, external senses, and instincts. We shall next follow them in their different labours, from the period when the swarm has settled in a new habitation; we shall detail the complex structure of their hives,—their curious processes of architecture,—the pains they bestow on rearing their progeny, and in sending forth new swarms; and this will lead us to the subject of the fecundation of the queens, and the massacre of the drones. After having thus given an account of their usual condition, we shall, in the last place, describe the result of several experiments and observations which have been made when they were placed in unusual circumstances; experiments which have exhibited many interesting features of their character, and have thrown considerable light on the whole of their history, as well as suggested various practical and economic applications in the management of these insects.

The leading feature in their history, and one which distinguishes them from almost all insects, is their singular distribution into three different kinds, constituting, to all appearance, so many different modifications of sex. The drone, which is characterized by a thicker body, a round head, a more flattened shape, and more obtusely-terminated abdomen, within which are contained the male organs of generation, has been admitted as the male of the species. It is distinguished also by the absence of a sting, and by the humming noise that accompanies its flight. The queen-bee, which is larger than any of the others, has the abdomen of greater length, and is provided with a sting, and with two ovaria of considerable size, is unequivocally recognised as the female. The working bees compose the third class, and are distinguished by the smallness of their size, their lengthened proboscis, the peculiar structure of their legs and thighs, which are adapted to the collection of certain materials obtained from vegetables, and by the apparent absence of every trace of generative organs,—we say apparent absence, because, as will be hereafter stated, rudiments of ovaria have been very lately discovered to exist, which, however, are not perceptible without a very minute and careful dissection. Till within a few years the working bees were regarded as animals deprived of sex, and were accordingly termed *neuters* or *mules*. It is these which perform all the laborious offices for the community,—which construct the interior of their habitation,—which explore the country in search of nourishment and other materials,—which collect and bring them to the hive, and apply them to different purposes; it is this kind that assiduously attend upon the queen, and supply all her wants,—that defend the hive from the attacks of depredators, and carry on hostilities against the various enemies of the tribe. The life of the

Plan of
this article.

Functions
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neuters.

Bee. females is chiefly engrossed with the duties of laying eggs, and conducting the colonies, which, at certain periods, emigrate from the parent state. The drones, producing neither wax nor honey, and depending on the rest for their subsistence, are idle spectators of these labours. They appear to be formed only for the momentary but important duty of impregnation, since they perish when this purpose is accomplished. There is commonly only one perfect queen existing at a time within each hive; and she appears to be treated by all the other bees with every mark of affection and of deference. The number of labourers is very different in different hives; sometimes there are only a few thousands; at other times from twenty to forty, or even fifty thousand. The drones, even in the spring, seldom compose more than one thirtieth or one fortieth of the whole; and, at other seasons, there are none to be found in the hive. In order to form some estimate of the number of bees which can occupy a certain space, Mr Hunter counted what number of drowned bees could be contained in an alehouse pint, and found it to be 2160; so that if a swarm were to fill two quarts, their numbers would be nearly 9000. Reaumur, with the same view of ascertaining their numbers, employed the more accurate method of weighing them; he found that a collection of them, weighing one ounce, consisted of 336 bees; and, therefore, that 16 ounces, or one pound, would consist of 5376 bees.

Real sex
of the
working
bees.

Notwithstanding these differences in conformation, instincts, and offices, between the queen-bee and the workers, it is now established, upon the most incontrovertible evidence, that they both originally proceed from the same kind of larva, and that the queen-bee lays only two kinds of eggs, the one destined to produce the drone, the others capable of being converted, according to circumstances, either into a worker or a queen. It has been proved that the former, although exhibiting no appearance of sexual organs on a superficial examination, are in reality females, and have the rudiments of these organs, which, from their not being developed, are incapable of exercising their proper functions. It may be remarked, that the idea of the working bees being radically females, had been suggested long ago by Dr Warder, in his *Monarchy of Bees*, in which he terms them "True Amazons;" but no attention had been paid to his opinion. The real merit of this great discovery, which affords the key to a multitude of hitherto inexplicable facts, unquestionably belongs to Mr Schirach, vicar of Little Bautzen, the secretary of the Lausatian Society, to which we formerly adverted. When first announced to the world, it was received with suspicion by the greater number of naturalists, and with complete incredulity by others. It was, indeed, at variance with the whole tenor of the observations of Swammerdam, Maraldi, and Reaumur. Wilhelmi, the brother-in-law of Schirach, though an eye-witness of the experiments from which he had deduced this theory, for a long time refused to admit the doctrine, but became at length one of its most strenuous supporters. It is noticed in a vein of sarcastic ridicule by Mr John Hunter, in his otherwise excellent paper on bees in the *Philosophical Transactions*. Needham wrote a memoir for the Imperial Academy of Brussels in 1777, for the express purpose of refuting it; and he then inveighs in strong language against those naturalists who had deigned to give it the least countenance. Mr Key, in the *Bath Society Papers*, declares that he made experiments on this subject for eight years, without obtaining a single result in conformity to Schirach's views. Bonnet, after exercising a laudable scepticism, and making a diligent inquiry, in which he displays a genuine spirit of philosophy, yielded a reluctant assent. But the truth of the doctrine has since been placed beyond the reach of

Bee. controversy by multiplied series of observations and experiments in different parts of Europe; and more especially by the recent investigations of Mr Huber of Geneva. We shall not at present enter into the detail of proofs, because their force will be better appreciated when other particulars belonging to the history of the bee have been explained.

In considering the physiology of the bee, the first function that claims our notice is that of nutrition. The food of bees is principally of two kinds, namely, the fluid secretions of vegetables contained in the nectarea of the flowers, and the dust of the antheræ, which has been termed by botanists the pollen, but which, when collected by the bees, has received a variety of appellations, such as farina, bee-bread, raw wax (*cire brute*), &c. Occasionally, however, we find bees feeding upon other saccharine substances besides honey, such as honey-dew, treacle, syrup, &c. Nutrition.

The organs by which they collect food are extremely complex, for they comprise instruments adapted to the reception of liquid aliment as well as those fitted for the division of solid materials. Reaumur has given the most elaborate description of these organs, in which he has corrected some errors that Swammerdam had fallen into. For the purpose of taking up fluids, they are provided, in common with all hymenopterous insects, with a long and flexible proboscis or trunk, which may be considered as a lengthened tongue, though, strictly speaking, it is formed by a prolongation of the under lip. It is not tubular, as Swammerdam had supposed, but solid throughout; and the minute depression at its extremity is not the aperture of any canal through which liquids can be absorbed. Cuvier, in his *Leçons d'Anatomie Comparée*, has not marked this distinguishing feature in the proboscis of the bee, but speaks of it in common with the tubular trunks of the other hymenoptera, and describes its aperture as being situated in the lower part. But Reaumur has very satisfactorily shown that the trunk of the bee performs strictly the office of a tongue, and not that of a tube for suction; for when it takes up honey or other fluid aliment, the under or the upper surfaces are more immediately applied to it, and rolled from side to side, and the bee thus licks up what adheres to it, while the extremity of the trunk is frequently not applied at all to the substance taken up. The trunk is supported on a pedicle, which admits of being bent back or propelled forwards, and thus can retract or stretch out the trunk to a considerable extent. Protection is given to it by a double sheath; the external, consisting of two scales furnished by the expansion of one of the portions of the labial palpi; and the internal, formed by the prolongation of the two external portions of the jaw. The whole member thus consists of five principal parts, on which account Fabricius termed it *lingua quinquefida*. Organs for collecting food. Proboscis.

For the purpose of mechanically dividing solid materials, the mouth is furnished with two strong mandibles and four palpi; they are but little employed in eating, but are of great use in enabling the insect to seize and break down hard substances for other purposes. In the working bee all these parts are of larger dimensions than in the other kinds. The teeth are two in number, and have the form of concave scales with sharp edges; they are fixed to the ends of the jaws, and play horizontally as in other insects. Reaumur describes and delineates a large aperture above the root of the proboscis, which is so surrounded with fleshy parts as not to be readily seen unless the proboscis be extended and bent downwards. This he considers as the mouth or orifice of the gullet; on the upper side of which, and of course opposite to the root of the proboscis, a small fleshy and pointed organ is seen, which he regards as the tongue, assisting in the deglutition of the Mandibles.

Bee. food. Through this orifice, it is presumed, all the aliment, whether liquid or solid, passes; the former being conveyed to it by the trunk, which, by its contractile power, presses forward the fluids it has collected between itself and the inner sheath, and the latter being received directly after its comminution by the teeth, behind which it is situated. Latreille, however, whose authority is great on a point of this nature, thinks that Reaumur has deceived himself with regard to such an aperture, and disbelieves its existence. He conceives that the food simply passes on by the sides of the tongue, finding its way from thence into the œsophagus, and so on to the stomach.

machs. The bee has two stomachs; the first is a large transparent membranous bag, pointed in front, and swelling out into two pouches behind. It performs an office in some respects analogous to that of the crop in birds; for it receives and retains for a time the fluid of the nectarea, which does not appear to differ in any respect from honey. Mr Hunter observes, that, whatever time the contents of this reservoir may be retained, he never found them altered, so as to give the idea of digestion having taken place. The coats of this reservoir are muscular, by which means it is capable of throwing up the honey into the mouth, so that it is regurgitated into the honey cells, or imparted to other bees. None of it ever passes out from the extremity of the trunk, as Swammerdam had believed. For the purpose of digestion, a second stomach is provided, which takes its origin from the middle of the two posterior lobes of the former, and is of a lengthened cylindrical shape. Its communication with the intestine is not direct, but takes place by a projecting or inverted pylorus, thickest at its most prominent part, with a very small opening in the centre, of a peculiar construction. This inward projecting part is easily seen through the coats of the reservoir, especially if full of honey. A similar kind of structure takes place at the communication of the first with the second stomach, and, having the properties of a valve, must effectually prevent all regurgitation from the latter into the former.

lection pollen. The pollen of flowers, which is the other principal article of food, was shown by Swammerdam to consist of an infinite number of small particles, generally of a globular shape, each of which is found to be a small capsule, inclosing the still finer dust or fecundating principle destined to be shed on the pistils for the purpose of germination. Geoffroy has given a memoir, published in the *Collection Académique des Sciences*, containing a minute description of the shapes of these capsules, taken from different flowers. The working bees, by means of the pencil of hair which grows on the tarsi, first collect a certain quantity of pollen, which they knead together into a ball, and place it in the concave space which is situated at the middle joint of the hinder feet, and has been termed the basket. The surrounding rows of hairs keep the ball from falling off. In order to gather larger quantities at once, the bees are sometimes observed to roll their bodies on the flower, and then, brushing off the pollen which adheres to them with their feet, form it into two masses, which they dispose of as before mentioned; and it is said that, in moist weather, when the particles of pollen cannot be readily made to cohere together, they return to their hive dusted all over with pollen, which they then brush off with their feet. They are often obliged to tear open the capsules which contain the pollen, in order to procure a supply of this substance, when it has not yet been sliced by the flowers.

Pollen is yielded by flowers during the spring in such abundance that the bees of a single hive will often bring back one pound, or even more, in a day. Some agriculturists have accordingly imagined, that the vegetation of

some plants might be endangered from this great consumption of the fecundating principle by insects in general; for other insects besides bees seek it with avidity. But this fear has been proved to be totally without foundation, and the practice of destroying bees in order to prevent this imaginary danger is therefore as useless as it is barbarous. It would appear, indeed, that so far from obstructing the fecundation of plants, the labours of the bee have often tended materially to promote it, by the agitation which they give to the flower, and by transporting the pollen from one flower to another. In this manner may we account for the number of hybrid flowers that are met with near the haunts of bees.

It has been shown very clearly by Huber, in a paper in the *Journal de Physique*, that pollen is peculiarly the food of the young bees, and is collected by the working bees with this intention. Reaumur, however, asserts that he has seen adult bees devour pollen. Swammerdam, who conceived the trunk to be tubular, rejected the idea that pollen could ever be the food of bees, as the globules of which it consists are incapable of entering an orifice so minute as that which appears at the extremity of the trunk, and which, as he was unacquainted with the real mouth, he thought was the only passage to the stomach. Latreille, who does not admit the existence of the large mouth described by Reaumur, states that the mandibles lay hold of the pollen, and carry it to the base of the trunk, from whence it finds its way into the œsophagus by the sides of that organ.

Of honey-dew, which forms part of the food of bees, we shall merely remark that it is an excrementitious matter deposited on the leaves of plants by certain species of aphides.

An abundant supply of water is essential to the healthy condition of bees. They consume a large quantity, and often stop to drink at the edge of stagnant pools, and seem even to prefer putrid and urinous waters to purer streams, as if their saline and pungent qualities were grateful to them.

It has been long the opinion that wax was but a slight Production modification of pollen, which required for this conversion of wax. merely the application of a certain pressure, and a kind of kneading by the feet of the bees. Many naturalists, such as Bernard de Jussieu, had persuaded themselves that the dust of the stamina of flowers contained wax ready formed as one of its ingredients, and quoted the following experiment in proof of this opinion: If the minute grains of pollen be put into water, they gradually swell, till they at length burst, at which moment a small jet of an oily liquor will be perceived, which floats on the water without mixing with it. But Reaumur had attempted in vain to extract any thing like wax from dust of the antheræ; and, indeed, an attention to the chemical properties of these two substances would have sufficiently pointed out their essential differences. From the upper surface of the leaves of many kinds of trees, a substance has indeed been obtained, which possesses all the qualities of bees' wax; but nothing like it can be extracted from pollen. Reaumur was persuaded that the pollen was elaborated in the second stomach of the bee, and thrown up into the mouth in the form of a white foam, which, by exposure to the air, hardened, and became wax; and that the bee took advantage of its soft state to apply it in the building of the combs. So circumstantial an account, given to us by a scrupulous observer of facts, appeared to be perfectly satisfactory, and was acquiesced in by naturalists in general. But it has since been completely proved by the researches of Duchet, of Hunter, and of Huber, but principally by the latter, that wax is a secretion from the abdomen of the bee; and that it depends not at all

Bee.

on the pollen which the insect may consume, but on the quantity of honey or other saccharine substance which it receives into the stomach. The first step in this discovery was made by one of the members of the Lausanian Society, whose name has not been preserved. It was mentioned in a letter of Mr Wilhelmi to Bonnet, in August 1768, in which he says that wax, instead of being rejected by the mouth, exudes from the rings which inclose the posterior part of the body. Of this we may satisfy ourselves by drawing out the bee from the cell in which it is working with wax, by means of the point of a fine needle; and we may perceive, in proportion as the body is elongated, that the wax will make its appearance under the rings, in the form of small scales. Mr Duchet, in his *Culture des Abeilles*, gives a full statement of the principal circumstances attending the production of wax, which he very justly ascribes to the conversion of honey into this substance in the body of the bee. These facts appear to have been entirely overlooked till the subject was again brought forward by Mr John Hunter, in his paper in the *Philosophical Transactions* for 1792. Wildman, however, had cursorily remarked that portions of wax, in the form of scales, and which he conceived must have been moulded on the body of the bee, are sometimes found at the bottom of the hive. Mr Huber was engaged in prosecuting his inquiries on this subject at the same period with Mr Hunter, and discovered, in 1793, the existence of regular receptacles or pouches, from the coats of which the wax is secreted, and within which it accumulates till its edges raise the scales, and become apparent externally. These plates of wax are withdrawn by the bee itself, or some of its fellow-labourers, and are applied in a manner hereafter to be described.

Huber has shown, by a series of well-conducted experiments, that, in a natural state, the quantity of wax secreted is in proportion to the consumption of honey; but that an equal or even greater quantity will be formed if the bee be fed on a solution of sugar in water. Warmth and rest promote this process of secretion; for the bees, after feeding plentifully on saccharine food, hang together in a cluster without moving, for several hours, at the end of which time large plates of wax are found under the abdominal rings. This happened when bees were confined and restricted from any other sort of nourishment; whilst those that were fed on pollen and fruits alone did not produce any wax. It appears also from his researches that the formation of wax is the office of a particular set of bees, which may be distinguished from the rest, and particularly from those that nurse the young larvæ, by the greater size and more cylindrical shape of their abdomen. Dissection also shows that their stomachs are more capacious. In the second volume of Huber's *Nouvelles Observations sur les Abeilles*, he describes minutely the anatomy of the pouches or receptacles for the wax, which are parts peculiar to the working bees, being totally absent in the males and queens. It is a structure that had escaped the keen eyes of Swammerdam, and has not been noticed by any subsequent anatomist. The cavities are lined with a membrane, which presents a number of folds, forming an hexagonal net-work, not unlike the appearance in the second stomach of ruminant quadrupeds, and evidently destined to perform the office of secretion.

Among the secretions peculiar to the bee, the poison which is poured into the wounds made by the sting deserves to be noticed. It is said to owe its mischievous efficacy to certain pungent salts. If a bee is provoked to strike its sting against a plate of glass, a drop of poison will be discharged; and if this is placed under a microscope, the salts may be seen to concrete, as the liquor dries, into clear, oblong, pointed crystals. The sting con-

sists of bearded darts, which are protruded from the end of a sheath; and the venomous juice is likewise injected through the sheath, from a little bag at the root of the sting.

As no organs for the circulation of blood have been yet demonstrated in insects, respiration is supposed to be effected by means totally different from those which are adopted in the higher classes of the animal kingdom. As the blood, or fluid corresponding to the blood, cannot be presented to the air in any separate organ, the air must be conducted to the blood, wherever such a fluid is met with. For this purpose, tracheæ or air-tubes, having several external openings or spiracles, are made to ramify like arteries, and are distributed in an infinite number of branches to every part of the body. The analogy of other insects might perhaps be admitted as sufficient evidence that bees respire atmospheric air, the constant renewal of which is essentially necessary to the continuance of the vital functions. It is, however, not always safe to trust to analogical reasoning in subjects of natural history; and direct evidence is, in all cases, to be preferred when it can be obtained. We must therefore consider as valuable the complete series of experiments on the respiration of bees, that have been lately given to the world by Huber, to whom we already owe so large a portion of the information we possess with regard to these insects. We might indeed have anticipated, with the strongest probability, many of the results to which these experiments have led; but there are others which are quite unexpected, and possess as much of interest as of novelty.

The condition of a hive of bees, in which many thousand individuals, full of animation and activity, are crowded together in the very small space of one or two cubic feet, having no communication with the external air but by means of a small aperture in the lowest part, which entrance is frequently obstructed by a throng of bees that are passing in and out during sultry weather, is of all possible conditions the one least favourable to the renewal of heated air. The most crowded theatres or hospitals are not to be compared with it in point of closeness. Direct experiment, indeed, shows that the combustion of a taper could not be carried on in so limited a space; for Mr Huber found that, in a glass ball of the same dimensions as the hive, and with a similar aperture, the taper went out in a few minutes. So great was the difficulty of explaining the respiration of bees under these circumstances, that Mr Huber was led to examine into the truth of the opinion, that respiration was equally necessary to bees as to other insects. The results were unequivocal. They perish speedily in the vacuum of the air-pump. They are easily drowned by placing them so that the spiracles on the corslet are under water; but revive readily when they are dried. The action of the spiracles is, in this experiment, rendered manifest by the escape of bubbles of air from each of their orifices. When a number of bees are confined in a bottle accurately closed, they exhibit unequivocal symptoms of distress, and fall into complete asphyxia. These changes occur more rapidly when they are placed in any gas which contains no admixture of oxygen, such as carbonic acid, hydrogenous and azotic gases. When they are rendered torpid by cold, and respiration is thereby suspended, these effects do not take place. All these effects are more considerable in adult bees than in the larvæ, though they are also distinctly exhibited in the latter. Suffocation is retarded if the proportion of oxygen be greater than in atmospheric air, and it may be averted altogether by a continual renewal of oxygen. It was ascertained by the eudiometer that the same changes were produced on the air as in the respiration of other animals; namely, the subtraction of

Bee.

Function of respiration.

Its necessity.

Bee. oxygen and the addition of an equal volume of carbonic acid gas.

Yet, on examining the air of the hive itself, it was found scarcely to differ in purity from atmospheric air. It was at one time conjectured that some of the contents of the hive, such as the pollen, the honey, or the wax, might have some power of evolving oxygen, so as to afford the requisite supply of this gas. Experiments, however, proved that they had no such power. Amidst so great an uncertainty, it was thought worth while to ascertain whether bees might not exert some unknown process by which oxygen was generated in the hive itself. If this were true, they could support life although all communication with the external air were intercepted. A hive was selected having glass sides, so as to allow of the observer's seeing what was passing in the interior, and the entrance was completely closed. In a quarter of an hour the bees became sensible of their situation, and showed great uneasiness; all business was suspended; an extraordinary agitation, accompanied by a remarkable noise, prevailed in every quarter. All the bees were seen beating their wings with the same rapidity as in flying. They were thus incessantly occupied during ten minutes. Their motions became then more languid, and, after being utterly exhausted, they fell in succession to the bottom of the hive, till every one of them was in a state of complete asphyxia. It is remarkable that, at this period, the temperature of the hive, which had been previously at 95° of Fahrenheit, suddenly cooled down to that of the external air. On opening the door and the top of the hive, and establishing a current of air through it, the bees were soon restored to animation.

It was proved by this experiment that the air is renewed through the small opening which serves as a door to the hive. By suspending light substances near the entrance, the existence of different currents of air was rendered manifest. After much reflection, it occurred that the violent agitation of the wings might have some influence in procuring this renewal of air. This conjecture was confirmed by an experiment with a glass bell, to the aperture of which an apparatus was fitted, consisting of a small ventilator, which could be moved rapidly round by machinery. When the ventilator was set in motion, the air within could support the combustion of a candle for an unlimited time. Observation further showed that some bees are actually always employed in the office of ventilating the hive; they vibrate their wings with great vigour and constancy, producing so rapid a movement of them, that they cannot be seen except in the two extremities of the arc of vibration, which is at least one of 90°. While thus imitating the actions of flying, they fasten themselves with their feet to the floor of the hive, so that the whole effect of that impulse which, were they at liberty, would carry them forwards with considerable velocity, is exerted on the air, which is therefore driven backwards in a powerful current. Some bees occasionally perform these ventilating motions on the outside of the hive, near the entrance; but a still greater number are employed in this office within doors: sometimes twenty are thus occupied at once, and each bee continues its motions for a certain time, occasionally for nearly half an hour, and is then relieved by another, who takes its place. This is the occasion of that humming sound which is constantly heard from the interior of the hive when the bees are not in a state of torpidity. But it is often heard with even more than usual loudness in the depth of winter. The warmth of the sun's rays, however, always occasions an increased activity among the ventilating bees. The immediate cause of these actions is probably some impression made on their organs by the presence of vitiated air; for a bee

may be made to ventilate itself by placing near it substances which have to them an unpleasant odour, such as spirit of wine or oil of turpentine.

The connection between an active respiration and a high temperature is remarkably exemplified in bees, among which, in consequence of their collecting together in large numbers, the heat is not so easily dissipated, and admits also of being easily ascertained by the thermometer. Mr Hunter found it to vary from 73° to 84° of Fahrenheit; and Mr Huber observed it on some occasions to rise suddenly from about 92° to above 104°.

Bees are well fitted, by their structure, for rapid flight through the air. They possess great muscular strength in proportion to their size, and their indefatigable activity in the different labours of the hive is truly astonishing. Aristotle and Pliny have pretended that, during high winds, they endeavour to steady their flight by holding a small stone with their feet, by way of ballast. This assertion has been shown, both by Swammerdam and Reaumur, to be erroneous in as far as it applied to the common bee; but there are other species which build nests with stones and other hard materials, and which, while transporting them for this purpose, were probably mistaken for the honey-bee.

The physiology of the external senses must necessarily be very imperfectly understood in a class of animals of a nature so remote from our own species. The infinite diversity of characters presented to us by the different tribes of insects, as well as of other animals, naturally suggests the idea that external objects produce on their sentient organs impressions widely different from what they communicate to ourselves. The notions we form of their senses must not only be liable to great inaccuracy, but must often be totally inadequate representations of the truth. A finer organization, and more subtle perceptions, would alone suffice to extend the sphere of their ordinary senses to an inconceivable degree, as the telescope and the microscope have with us extended the powers of vision. But they possess, in all probability, other organs, appropriated to unknown kinds of impressions, and which must open to them avenues to knowledge of various kinds, to which we must ever remain total strangers. Art has with us supplied many elaborate modes of bringing within our cognizance some of the properties of matter which nature has not immediately furnished us with the means of detecting. But who will compare our thermometers, electroscopes, or hygrometers, however elaborately constructed, with those refined instruments with which the lower classes, and particularly insects, appear to be so liberally provided? The antennæ, which are so universally met with in this class of animals, are doubtless organs of the greatest importance in conveying impressions from without. Their continual motion, the constant use which is made of them in examining objects, the total derangement in the instincts of those insects which have been deprived of them, point them out as exquisite organs of more than one sense. To impressions of touch, arising from the immediate contact of bodies, they are highly sensible; but their motions evidently show that they are affected by objects at some distance. They are no doubt alive to all the tremulous motions of the surrounding air, and probably communicate perceptions of some of its other qualities. Composed of a great number of articulations, they are exceedingly flexible in every direction, and can readily embrace the outline of any body that the bee wishes to examine, however small its diameter, and are capable of following all its movements. It is by means of these instruments that the bee is enabled to execute so many works in the interior of the hive, from which the light must be totally excluded.

Bee.

ed. Aided by these, it builds its combs, pours honey into its magazines, feeds the larvæ, and ministers to every want, which it discovers and judges of solely by this species of touch.

The antennæ appear also to be the principal means employed for mutual communication of impressions. The different modes of contact constitute a sort of language, which appears to be susceptible of a great variety of modifications, and to be capable of supplying at once every species of information for which they have occasion. It is in this way alone that they satisfy themselves of the presence of their queen, or communicate to others the alarming intelligence that she has disappeared.

Vision.

The sense residing in the antennæ appears to be, on many occasions, supplementary to that of vision, which in bees, as in other insects, is less perfect than in the larger animals. During the night, therefore, they are chiefly guided in their movements by the former of these senses. This will sufficiently appear from observing by moon-light the mode in which the bees guard the entrance of the hive against the intrusion of moths which flutter in the neighbourhood. They act as vigilant sentinels, performing continual rounds near this important post, extending their antennæ to the utmost, and moving them alternately to the right and to the left. Woe to the unfortunate moth that comes within their reach. Aware of its danger, and of the defective sight of the bees, the moths adroitly avoid the slightest contact, and endeavour to insinuate themselves between the bees, so as to get unperceived into the hive, where they riot upon the honey which they find.

If bees require full day-light for the exercise of vision, it must at the same time be acknowledged, that, when they are so assisted, they appear to enjoy this sense in great perfection. A bee will recognise its habitation from great distances, and distinguish it at once from many others in a numerous apiary. It passes through the air in a straight line towards its object with extreme rapidity. On quitting the hive, it flies towards the field which is most in flower; and as soon as it has determined on its course, it takes as direct a line as a ball issuing from a musket. When it has collected sufficient provision, it rises in the air to discover its hive, and then darts forward with the velocity of an arrow, and with unerring precision in its aim.

Perceptions of temperature.

Their perceptions of heat and cold, which are generally referred to the sense of touch, appear to be extremely delicate. In several experiments of Huber's, the influence of the rays of the sun excited them to a vigorous action of the wings. It is well known that great cold reduces them to a state of torpor, and inferior degrees of cold are evidently unpleasant to them. They show by their conduct that they are sensible of alterations in the state of the weather for some time before we can perceive them. Sometimes, when working with great assiduity, they will suddenly desist from their labours; none will stir out of the hive, while all the working-bees that are abroad hurry home in crowds, and press forward so as to obstruct the entrance of the hive. Often when they are thus warned of the approach of bad weather, we can distinguish no alteration in the state of the atmosphere. Gathering clouds sometimes produce this effect on them; but perhaps they possess some species of hygrometrical sense, unconnected with any impression of vision. It is alleged that no bee is ever caught in a sudden shower, unless from some cause it has wandered very far from the hive, or been disabled by some accident from returning to it. There is reason for thinking, however, that much exaggeration has prevailed in the statements of authors as to the extent of this kind of foresight. Huber supposes that it is the rapid diminution of light that alarms them; for if the sky be uniformly overcast, they proceed on their excursions, and even the

first drops of a soft shower do not make them return with any great precipitation.

Bee.

Their taste is perhaps the most imperfect of their senses. Taste. They exert hardly any discrimination in the collection of honey from different flowers. They are not repelled by the scent or flavour of such as are extremely offensive to our organs, and scruple not to derive supplies from such as are highly poisonous. In some districts in America, it is well known that the honey acquires in this way very deleterious properties. The qualities of honey are, indeed, observed to vary much, according to the particular situation from which it is obtained. The most stagnant and putrid waters, as we have already noticed, are resorted to by bees with the same avidity as the purest. In their selection of flowers they are guided by the quantity of honey they expect to meet with, and in no respect by its quality. When the scythe has cut down all the flowers which before yielded them a plentiful supply, they discontinue their excursions, although the weather be in all respects propitious. Their smell must, therefore, be sufficiently acute to enable them to discover the presence of honey at great distances. Direct experiment has, indeed, proved this to be the case. Mr Huber found that they proceeded immediately towards boxes which contained honey concealed from their view; and such in fact is the situation of the fluid of the nectarea in flowers. Some odours, especially the fumes of tobacco, and indeed all kinds of smoke, are highly obnoxious to them; this is the case, also, with the smell of oil of turpentine, alcohol, ammonia, the nitric and muriatic acids, and several other volatile chemical agents, upon receiving the impressions of which, they immediately set about ventilating themselves in the manner above described. But nothing excites their displeasure in a greater degree than the breath of the spectator; as soon as they feel which, they show signs of anger, and prepare to revenge it as an insult. The odour of the poison of their sting produces similar effects, exciting them to immediate rage and hostility.

Although it is sufficiently clear that many insects possess the power of smell, yet the particular organ of this sense has never been accurately ascertained; and the opinions of naturalists have been much divided on the subject. These opinions have been supported more by arguments drawn from the analogy of what happens in other classes of animals, than by any direct experiments on insects themselves. We know that, in all animals respiring by means of lungs, the organs of smell are placed at the entrance of the passages of the air; and it has often been concluded, that in like manner the stigmata, or the orifices of the air-tubes, were the seat of this sense in insects. By others the antennæ have been assigned as the organs through which these impressions were conveyed to the sensorium. The experiments of Huber have proved that neither of these opinions is correct; and have satisfactorily shown that in the bee this sense resides in the mouth itself, or in its immediate vicinity. Here, indeed, would be its proper station, if this faculty be intended, as we may reasonably suppose it to be, to apprize the individual of the qualities of the food prior to its being eaten. When the mouth of the bee was plugged up with paste, which was allowed to dry before the insect was set at liberty, it remained quite insensible to the same odours to which it had before manifested the strongest repugnance.

It is generally supposed that bees possess the sense of hearing. The common practice of making a loud noise by drums and kettles in order to attract a swarm is founded on this supposition. But the evidence is by no means conclusive; for we find that they are nowise disturbed by a loud clap of thunder, or by the report of a gun, or any

Bee. other noises that may happen to arise around them. It is, however, certain that they are capable of emitting a variety of sounds, which appear expressive of anger, fear, satisfaction, and other passions; and it would seem that they were even capable of communicating certain emotions to one another in this manner. Huber observed that the queens, during their captivity, sent forth a peculiar sound, which he supposes to be a note of lamentation. A certain cry or humming noise from the queen will strike with sudden consternation all the bees in the hive; and they remain for a considerable time motionless and stupefied. Hunter has noticed a number of modulations of sound emitted by bees under different circumstances, and has instituted an inquiry concerning the means employed by them in producing these sounds; for an account of which we shall refer the reader to his paper in the *Philosophical Transactions*.

instincts
bees. If the function of sensation in insects be involved in doubt and obscurity, the knowledge of those more interior faculties which are the springs of voluntary action is hid in still deeper mystery. Buffon refuses to allow bees any portion of intelligence, and contends that the actions we behold, however admirably they are directed to certain ends, are in fact merely the results of their peculiar mechanism. Other philosophers, such as Reaumur, have gone into the opposite extreme, and have considered them as endued with extraordinary wisdom and foresight, as animated by a disinterested patriotism, and as uniting a variety of moral and intellectual qualities of a higher order. The truth, no doubt, lies between these overstrained opinions; but it is nevertheless extremely difficult to decide in what degree these respective principles operate in the production of the effects we witness: We have been too long in the habit of sheltering our ignorance of the causes of this class of phenomena, by referring them indiscriminately to what is called *instinct*, to submit to a cautious and patient investigation of the hidden springs of action. The term *instinct* should properly be regarded, not as denoting a particular and definite principle of action, whose operation we can anticipate in any new or untried combination of circumstances, but as expressive of our inability to refer the phenomena we contemplate to any previously known principle. Thus the actions which an animal performs in obedience to the calls of appetite are not properly said to be instinctive; nor can the term be applied to actions which are the consequence of acquired knowledge, and of which the object is with certainty foreseen by the agent. But when an animal acts apparently under a blind impulse, and produces effects useful to itself or to the species, which effects it could not have previously contemplated as resulting from those actions, it is then customary to say that it is under the guidance of instinct, that is, of some unknown principle of action. It will be proper, therefore, to keep this distinction in view in judging of the voluntary actions of the lower animals.

In no department of natural history is it more necessary to be aware of the proper import of the term instinct, than in studying the phenomena presented by the bee; for nowhere is it more difficult to discriminate between the regular operation of implanted motives, and the result of acquired knowledge and habits. The most striking feature of their history, and the one which apparently lays the foundation for those extraordinary qualities which raise them above the level of other insects, is the disposition to social union. It may in general, indeed, be remarked, that animals which associate together so as to form large communities, display a higher degree of sagacity than those which lead a solitary life. This is especially observable among insects. The spider and *Formica leonis* may exhibit particular talents, or practise particular strata-

gagems in the pursuit and capture of their prey; but their history is limited to a single generation, and embraces none of those interesting relations which obtain between individuals composing the gregarious tribes, such as the ant, the wasp, and the bee. Among these we trace a community of wants and desires, and a mutual intelligence and sympathy, which lead to the constant interchange of good offices, and which, by introducing a systematic division of labour, amidst a unity of design, leads to the execution of public works on a scale of astonishing magnitude. The attachment of bees to their hive, which they defend with a courage and self-devotion truly admirable; their jealousy of intruders; their ready co-operation in all the labours required for the welfare of the community; their tender care of their young; the affection and homage which they bestow on their queen, and which they manifest on all occasions in the most unequivocal manner; imply qualities such as we could hardly persuade ourselves could animate a mere insect, on which we are in the habit of proudly looking down as placed in one of the lowest orders of created beings.

We shall content ourselves at present with these general observations, as the instances which serve to illustrate their moral and intellectual character belong properly to the history of the different processes they follow in the construction of their combs, the hatching and rearing of their progeny, and the mode of conducting their migrations. To these subjects, therefore, we shall now proceed: and in order to present the most connected and complete account of their economy, we shall begin the history from the period when a new swarm has just occupied a hive, and when all the arrangements for their habitation, and the construction of the cells in which their eggs and provisions are to be deposited, are yet to be effected.

The first care of the labouring bees, on their settlement in their new abode, is to clean it out thoroughly. While one set of bees is thus employed, another is distributed about the country, in order to procure the proper materials for blocking up the small holes and chinks of the hive, and for laying a firm foundation for the edifice which is to be constructed within it. The substance which is principally employed in this preliminary stage is *propolis*, a Nature species of glutinous resin of an agreeable aromatic odour, and origin and reddish brown colour, in process of time becoming darker, and acquiring a firmer consistence. According to the analysis of Vauquelin (*Mém. Soc. Agricult. Departem. Seine*), it is composed chiefly of resin, with a small proportion of wax, and of acid and aromatic principles. It is soluble in alcohol, ether, and oils, both fixed and volatile; and tinges the solvent of a beautiful red colour. Cadet has since ascertained in it the presence of benzoic and gallic acids. Reaumur had not been able to discover from what plants the bees collect this substance. Riem asserts that it is chiefly from pines and other trees of the fir kind. The recent observations of Huber have assisted in the solution of this question. On placing branches of the wild poplar tree before the hive, he found that the bees eagerly seized upon the varnish which exudes from the buds; and examining the chemical properties of this varnish, he identified it with the propolis with which the inside of the hive is lined.

The propolis adheres so strongly to the legs and feet of the bee which has collected it, that it cannot be detached without the assistance of its fellow-labourers. For this purpose the bee that is loaded presents its legs to the workers in the hive, which carry off with their jaws this adhesive substance, and immediately apply it, while yet ductile, all round the interior of the hive, and particularly over all the projecting parts; hence its name, of Greek

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Bee. derivation, signifying *before the city*. In like manner all the foreign bodies that are introduced into the common habitation, and are too heavy to be removed, are covered over with this resinous substance. If a snail, for instance, should happen to introduce itself into the hive, after dispatching it with their stings, they encrust it over with propolis. Mr Knight has observed that, besides propolis, bees will occasionally carry home, and employ as cement, other substances, having the same glutinous properties. He frequently covered the decorticated parts of trees, on which he was making experiments, with a cement composed of bees' wax and turpentine; and in the autumn has observed a great number of bees occupied in carrying off this substance. They detached it from the tree with their forceps, and the little portion thus obtained was then transferred by the first to the second leg, by which it was deposited on the thigh of the third, precisely in the same manner as the pollen of flowers is collected and transferred. Whilst the bees were employed in the collection of this substance, Mr Knight had many opportunities of observing their peaceful and patient disposition as individuals, which Mr Hunter had also in some measure noticed. When one bee had collected its load, and was just prepared to take flight, another often came behind it and despoiled it of all it had collected. A second, and even a third load was collected, and lost in the same manner; and still the patient insect pursued its labour, without betraying any symptoms of impatience or resentment. When, however, the hive is approached, the bee appears to be the most irritable of all animals, and is animated with the most vindictive spirit against a public enemy, without displaying any peculiar hostility in the revenge of a private injury.

Construction of the combs.

The next object of their labours is to prepare the combs, which are to be the receptacles for the eggs with which the queen is pregnant, and which are now about to be laid. The material employed for this purpose is not propolis, but wax, the production of which, by secretion from a particular set of bees who feed largely upon honey, was formerly explained. The bees are for this purpose actively employed in collecting honey, and in imparting it to their companions in the hive, who, when they have filled their crops with it, hang together in a thick cluster from the top of the hive, and thus remain in a state of inactivity for a considerable period. During this time the secretion of wax is proceeding, and may be seen collected in laminae under the abdominal scales, whence it is removed by the hind-legs of the bee, and transferred to the fore-legs, and from thence taken up by the jaws. In this operation they are often assisted by their companions, who even directly seize upon the wax from under the abdomen of those who are before them. When a sufficient quantity of materials has thus been collected together, the process of building is commenced. But, in order to understand the subsequent operations, it is necessary to have a correct idea of the form of the cells which compose the combs. We shall, therefore, proceed to give some account of the structure when they have attained their perfect state.

Form of the combs.

The combs of a bee-hive are formed into parallel and vertical strata, each of which is about an inch in thickness, the distances between the surfaces of each being about half an inch, an interval which serves for the passage of the bees over both surfaces. They generally extend the whole breadth of the hive, and often descend the whole length, from the top to the bottom. They consist altogether of thin partitions, which inclose hexagonal cells about half an inch in depth and a quarter of an inch in diameter, opening on both surfaces of the comb, and closed by a partition common to those on both sides, and which

occupies the middle distance between the two surfaces. This partition is not, however, a plane, but is composed of a collection of rhombs. Three, and sometimes four of these rhombs, inclined to one another at a certain angle, form the bottoms of each cell, which thus has the shape of a flattened pyramid, of which the basis is towards the mouth of the cell. The geometrical form of each individual cell is, therefore, an hexagonal prism, terminated by a trihedral pyramid, the three sides of which pyramid are rhombs, which meet at the apex by their obtuse angles, and, forming oblique angles with the sides of the prism, truncate a portion of these, and convert them from rectangles, which they would be in a regular prism, into trapeziums. Of the two angles of these trapeziums adjoining to the base of the pyramid, one must be acute and the other obtuse, the acute angle of one trapezium being next to the acute angle of the adjoining trapezium, and the obtuse angle being in like manner next to another obtuse angle of the preceding trapezium, so that, in going round the base, we meet with pairs of acute and of obtuse angles alternately succeeding each other. The two adjoining acute angles of the trapezia are adjoining to two of the terminal rhombs, which here present their acute angles; so that at these points a solid angle of four planes is formed, all the angles being acute. Each pair of obtuse angles of the trapezia, on the other hand, are adjacent to the obtuse angle of one of the rhombs only, thus composing a solid angle of three planes, of which the angles are all obtuse; and these two kinds of solid angles succeed one another alternately all round the base of the pyramid, there being three of each kind, and six in all. The axis of each cell coincides, not with the axis of the cell on the opposite surface, but with one of its angles, so that each of the three obtuse angles at the base of the terminal pyramid corresponds to the central parts of three of the cells on the opposite side; and each of the sides of the pyramid, which closes a cell on one side, contributes in part to the closing of three of the cells on the opposite side. We may easily satisfy ourselves that this is the case, by piercing the centres of each of the three planes which close the bottom of a cell, with a pin, when, on turning the comb, the three pins will be found to have passed into three different cells on the opposite side.

A structure of this kind is obviously the one of all others calculated to afford the greatest space for each cell, with the same expense of materials. It is easy to perceive, in the first place, that, in a plane surface, when a number of small spaces are to be divided by partitions, the hexagonal form is the one which comprehends the largest space compatible with the extent of the lines which inclose them. For the equilateral triangle, the square, and the regular hexagon, are the only regular forms that admit of being joined together in the same plane, without leaving interstices; and the proportion of the area to the periphery in every polygon increases as the figure consists of a greater number of sides, and is therefore greater in the hexagon than in any of the other two. The truth of this proposition was perceived by Pappus, and even its application to the subject of the honeycomb was made by that ancient geometrician. But the determination of the form and inclination that should be given to the partitions which close the bottoms of the cells, and which may of course belong equally to those on both sides of the comb, is a problem much more complicated and difficult of solution. It has exercised the skill of several modern mathematicians of great eminence, and has generally been resolved by the assistance of the infinitesimal calculus, or the methods of maxima and minima. A mistake has sometimes been committed in supposing that the capacity of the cells would be affected by varying

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Geometric properties of the cells

Bee. the inclination of the partitions, whereas, if abstraction be made of the thickness of these partitions, all the space which is gained on the one side must be obtained at the expense of the space on the other, and the sum total will therefore remain the same. This error has been pointed out by Le Sage of Geneva, and also by others. The whole question, therefore, resolves itself into that of the form producing the greatest saving of materials. Koenig, the pupil of the celebrated Bernoulli, calculated that the angles of the rhombs, which should answer this condition, must be $109^{\circ} 26'$ and $70^{\circ} 34'$. Cramer, professor of mathematics in the university of Geneva, has given a very elegant demonstration of this problem, from which it results that the obtuse angle of the rhomb must be such, that its half has for its tangent the square root of 2. This is the case with the angle $54^{\circ} 44' 8''$; the two angles of the rhomb are therefore $109^{\circ} 28' 16''$ and $70^{\circ} 31' 44''$. It follows also that the two diagonals of this rhomb are to one another in the same proportion as the side and diagonal of a square, that is, as 1 to 1.41421356237, &c. It is also another consequence from the same data, that the angles of the trapezia forming the sides of the hexagonal prism adjacent to the rhombs are precisely equal to those of the rhombs themselves, and that the solid angle formed at the apex of the pyramid, and which is composed of those equal obtuse angles, is precisely equal to each of the three angles at the base, which are also formed of three obtuse angles. It is also true that these are the only angles which will give this perfect equality. Maraldi had already made the same remark; and, assuming the principle of the equality of the angles as the basis of his reasoning, had calculated them on this hypothesis, making them $109^{\circ} 28'$ and $70^{\circ} 32'$, which is nearly accurate. To the same author we are indebted for the comparison of the results of theory with fact, by the admeasurement of the actual angles of the honeycomb; these he states to be about 110° and 70° , which is as near an agreement with theory as could well be expected.

Boscovich, who has also given a solution of the same problem, conceives that the equality of inclination of the planes gives greater facility to the construction of the comb, and might, therefore, be a motive of preference, independently of the greater economy of wax. Maclaurin has exercised his abilities in resolving this problem, and has demonstrated by simple geometry, that the most advantageous form is that which results from the supposed equality of the three plane angles forming the solid angles at the base. He estimates the saving of wax by partitions so constructed, above what would be required for a flat partition, at one fourth of the wax which would be wanted to complete the truncated sides of the cells, so as to form them into rectangles. L'Huilier, in the *Memoirs of the Berlin Academy*, has given a demonstration which is remarkable for its simplicity, and for its involving none but elementary propositions; he values the economy of wax at $\frac{1}{5}$ of the whole wax employed. Le Sage, as appears from the life of that philosopher by Professor Prevost, has shown that this celebrated problem reduces itself to the finding of the angle at which two planes with a given inclination (such as 120°) can be cut by a third plane, so as to make all the angles resulting from the section equal to one another.

But a more essential advantage than even the economy of wax results from this structure, namely, that the whole fabric has much greater strength than if it were composed of planes at right angles to one another; and when we consider the weight they have to support when stored with honey, pollen, and the young brood, besides that of the bees themselves, it is evident that strength is a material requisite in the work.

It has often been a subject of wonder how such diminutive insects could have adopted and adhered to so regular a plan of architecture, and what principles can actuate so great a multitude to co-operate by the most effectual and systematic mode in its completion. Buffon has endeavoured to explain the hexagonal form by the uniform pressure of a great number of bees all working at the same time, exerted equally in all directions in a limited space; and illustrates his theory by supposing a number of similar cylinders compressed together, and taking the form of hexagonal prisms by the uniform expansion of each. The analogy of the forms produced by the law of crystallization,—of the figures assumed by various parts in the animal and vegetable world, such as the skin of the bat, and the inner coat of the second stomach of ruminant quadrupeds,—is also adduced by this captivating but superficial writer in support of his argument. But however plausible this theory may at first sight appear, it will not stand the test of a more serious examination. The explanation he has attempted applies no further than to the inclination of the sides of the cells; but he did not take into account, perhaps from not having studied the subject mathematically, the inclinations and forms of the planes which close each cell, and so curiously conspire on both sides to serve a similar office, while they at the same time accurately fulfil a refined geometrical condition. But it is sufficient confutation of the whole theory to show, that it is directly at variance with the actual process employed by the insects in the construction of their combs.

It might be supposed that bees had been provided by nature with instruments for building of a form somewhat analogous to the angles of the cells; but in no part, either of the teeth, antennæ, or feet, can any such correspondence be traced. Their shape in no respect answers to that of the rhombs, which are constructed by their means, any more than the chisel of the sculptor resembles the statue which it has carved. The shape of the head is indeed triangular, but its three angles are acute, and different from that of the planes of the cells. The form of the plates of wax, as they are moulded in the pouches into which this substance is secreted, is an irregular pentagon, in no respect affording a model for any of the parts which compose the honeycomb. Hunter, observing that the thickness of the partition was nearly equal to that of the scale of wax, thought that the bees apply these scales immediately to the formation of the partition, by merely cementing them together. Reaumur, notwithstanding the use of glass hives, had not been able to discover the mystery of their process of architecture; but inferred, from what he saw, that the wax was rejected from the stomach in the form of a white frothy liquor. No naturalist, indeed, prior to Huber, had been able to follow these insects in their labours, on account of their crowding together in a thick mass while they are building; but the expedients resorted to by that ingenious philosopher have unfolded the whole process, which he has given with great detail in the second volume of his *Observations sur les Abeilles*. Huber witnessed the whole of their actions, and saw that each bee drew out, with its hind feet, one of the plates of wax from under the scales where it was lodged, and, carrying it to the mouth in a vertical position, turned it round, so that every part of its edge was made to pass in succession under the cutting edge of the jaws; it was thus soon divided into very small fragments, while at the same time a frothy liquor was poured upon it from the tongue, so as to form it into a perfectly plastic mass. This liquor gave the wax a whiteness and opacity which it did not possess originally, and rendered it at the same time tenacious and ductile. A quantity of wax thus prepared for use is accumulated,

Bee.
Buffon's theory of the formation of the combs.

Mode of their construction.

Bee.

and applied to further the work in the manner we are presently to describe.

But, in considering the process by which the comb is formed, a circumstance should be pointed out, which seems not to have been particularly noticed by any author except Huber; and yet it is one of essential importance in studying their process of architecture;—namely, that the first row of cells on either side are of a form very different from that of the subsequent rows. As they take their origin from a plane surface, two of the sides necessary to complete the hexagon are cut off by this plane, so that the general form of the orifice is pentagonal; and the bottom of the cells on one side is composed of two equal rhombs only, and on the other side of two trapezoidal planes, with one rhomb. Such a modification of shape was necessary, in order to prepare the way for the regularly-formed cells which were to follow.

The foundations of the combs are laid by the bees raising a solid block or plate of wax of a semicircular form. In this they scoop out a small vertical channel, of the size of an ordinary cell. The sides of this channel are then strengthened by additions of wax. On the opposite side two other channels are formed, one on each side of the plane opposite to the former channel. The extremities of these channels, which at first present a curved outline, are then fashioned into straight walls, forming an angle at each vertex. The bottom of each cell being thus sketched out, the design is completed by raising walls round the sides. Different bees generally work on the opposite sides at the same time, and appear to have some perception of the thickness of the partitions, and of the situation of the opposite walls, in which they are perhaps guided by slight prominences, occasioned by the depressions which correspond to them on the other side; and they scrape off the wax in those places where its thickness is greatest; that is, where the bees on the other side had accumulated materials. In this way, then, in constructing the successive rows, the axis of each cell will be found to occupy the most retiring parts of the partition, and will be opposite to the junction of three of the opposite cells.

Soon after the bees have completed the foundations, and constructed a few of the cells of the central comb, they begin two others, one on each side, at the proper distance, and in this manner continue to form others in succession, in proportion as the former are advanced. Their object at first seems to be to extend the surface of the work, so as to admit of the greatest possible number of workers being employed at one and the same time. In this way, then, the work proceeds from all points at once, new cells being begun before the former are completed, so that the whole comb, while it is in progress of construction, has a semi-lenticular shape, broader at the top, and tapering below and towards the sides. It extends downwards, however, more rapidly than in any other direction, and its surfaces do not become parallel to each other till the last stage of the building process. When this is completed, the whole is further strengthened by an additional coating of propolis round the margin of all the cells; and the junctions of every plane, both of the sides and bottoms of the cells, are also soldered together by a lining of the same substance. The edges of the combs are also secured in their situations by being glued to the side of the hive, and supported by fresh abutments of propolis. Sometimes a mixture of wax and propolis, manufactured by the bees themselves, is employed as the cementing material. The first coating of this compound substance is denominated *Commosis* by Pliny, and described as having a bitter taste; the second, or the *Pissoceros* of the same author, is stated to be of a thinner con-

sistence, and more adhesive than the former; while the third substance or propolis is completely solid.

The cells recently constructed are perfectly white, but in a short time they are found of a yellow tint, which becomes gradually deeper, and, when very ancient, gives them a dark brown cast. It is therefore easy to distinguish in a hive the successive periods of formation of different portions of the combs. From the researches of Huber, it appears that these variations of colour are not owing to any changes in the wax itself, but to additional coatings of a peculiar varnish, consisting of propolis and a colouring matter. The latter differs materially from propolis, being wholly insoluble in alcohol. It loses its colour by the action of nitric acid or the light of the sun. Its origin has not yet been discovered; nor has the mode in which it is applied been clearly made out; although Huber presumes, from his observations, that they spread it by means of their mandibles, which he has seen them rub against the sides of the cells, while they acquired a yellow colour from the operation.

Such is the general outline of the architectural labours of the bee. A number of modifications are however met with, adapting them to various purposes and to new circumstances. The cells are required to be of different sizes for the reception of different sorts of eggs and larvæ. The smallest, which are also the most numerous, are appropriated to the eggs of the working bees; a larger sort receive those of the males; and a small number of very large cells are destined for the education of the young queens, and are therefore called royal cells. The first set are generally five and one third lines in depth, and two and a half in diameter; the second are from seven to seven and a half lines in depth, and three and three fourths in diameter; while the royal cells are above one inch deep, one third of an inch wide, and their walls are about one eighth of an inch in thickness. Other cells, again, are set apart as magazines of honey or of pollen; they are made twice as deep as the common cells, and their axes are inclined to the horizon, so that their mouths are in the highest part, and their liquid contents may be more easily retained. When these are filled, they are closed up by the bees with a wall of wax, and opened only when necessity requires.

The regularity of the cells is often disturbed in consequence of the admixture of rows of larger cells with those of smaller dimensions; but the pyramidal partitions are adapted by successive gradations to these changes; so that in many rows of what may be called cells of transition, the bottom presents four planes instead of three, two being trapeziums, and the other two irregular hexagons. These irregularities are met with chiefly in the combs most distant from the central one. When an abundant supply of honey induces them to lay up a large quantity in store, they build up for this purpose the walls of common cells, so as to give them a greater depth. The royal cells are often raised from the ruins of a number of other cells, which are destroyed to make room for them; they are usually built on the edge of some of the shorter combs, and often in the very centre of the hive. Sometimes there are but three or four of them; at other times eleven, or even fourteen, have been counted in the same hive. They are formed of a mixture of propolis and wax; their form is oblong, resembling that of a pear; their position is always vertical, so that when they arise from amidst other cells, they are placed against the mouths of those cells, and project beyond the common surface of the comb. They are perfectly smooth on the inner surface; while their outer side is covered with a kind of hexagonal fret-work, as if they were intended for the foundation of regular cells.

As soon as a sufficient number of cells have been con-

Bee.

Bee.

Process of rearing the queen-bee.

But the queen-bee, although perfectly formed, is not always at liberty to come out of her prison; for if the queen-mother be still in the hive, waiting a favourable state of the weather to conduct another swarm, the bees do not suffer the young queens to stir out; they even strengthen the covering of the cell by an additional coating of wax, perforating it with a small hole, through which the prisoner can thrust out its trunk in order to be fed by those who guard it. The royal prisoners continually utter a kind of plaintive song, the modulations of which are said to vary. One consequence of their detention is, that they are capable of flying as soon as they are set at liberty. But the motive of this proceeding on the part of the bees who guard them, is to be found in the implacable hatred which the old queen bears against all those of her own sex, and which impels her to destroy without mercy all the young queens that come within her reach. The working bees are, on this account, very solicitous to prevent her even approaching the royal cells while there is any prospect of a swarm being about to take place. They establish themselves as a guard around these cells, and, forgetting their allegiance on this occasion, actually beat her off as often as she endeavours to come near them. If, on the other hand, the swarming season is over, or circumstances prevent any further swarms from being sent off, the bees do not interpose any obstacle to the fury of the old queen, who immediately begins the work of destruction, transfixing with her sting, one after the other, the whole of the royal brood while they are yet confined

Bee.

in their cells. It is observed by Huber, that the royal larvæ construct only imperfect cocoons, open behind, and enveloping only the head, thorax, and first ring of the abdomen; and he conceives that the intention of nature in this apparent imperfection is, that they may be exposed to the mortal sting of the queen, to whom they may be given up as a sacrifice.

When the old queen has taken her departure along with the first swarm, the young queens are liberated in succession, at intervals of a few days, in order to prevent their attacking and destroying one another, which would be the infallible consequence of their meeting. This exterminating warfare is prevented by the vigilance of the bees who guard them, so long as new swarms are expected to take place. When a young queen is liberated, she is, like others of her sex, anxious to get rid of her rivals, and even at that early age seeks to destroy her sisters, who are still confined in the other royal cells; but as often as she approaches them she is bit, pulled, and chased without ceremony by the sentinels. But when the season is too far advanced for swarming, or when the hive is too much exhausted in its population by the swarms that have already been sent off, they no longer interfere in preserving peace, and the first that acquires her liberty proceeds to massacre all her rivals. If two or more queens should happen to issue out at the same moment, they mutually seek each other, and fight till one is killed, and the survivor is immediately received as the sovereign of the hive. The bees, far from seeking to prevent these battles, appear to excite the combatants against each other, surrounding and bringing them back to the charge when they are disposed to recede from each other; but when either of the queens shows a disposition to approach her antagonist, all the bees forming the clusters instantly give way to allow her full liberty for the attack. The first use which the conquering queen makes of her victory is to secure herself against fresh dangers by destroying all her future rivals in the royal cells; while the other bees, who are spectators of the carnage, share in the spoil, greedily devouring any food which may be found at the bottom of the cells, and even sucking the fluid from the abdomen of the pupæ before they toss out the carcasses.

Impreg-
nation.

The impregnation of the queen-bee was formerly involved in the deepest obscurity, and has given rise to a multitude of very fanciful opinions. Some have denied that any intercourse with the male was necessary for the fecundation of the eggs. Swammerdam supposed that the mere effluvia proceeding from the males, where they were collected in clusters, was sufficiently active to produce this effect, by penetrating the body of the female. Huber proved, by a decisive experiment, that no such consequence resulted from these effluvia. Maraldi imagined that the eggs were fecundated by the drones, after being deposited in the cells, in the same way that the spawn of fishes is rendered prolific by the milters. Mr Debrau of Cambridge, in a paper published in the *Philosophical Transactions*, fancied that he had seen the milt-like fluid in the cells. But this appearance has been shown by Huber to be a mere optical illusion, arising from the reflection of light at the bottom of the cell. When the males are excluded from the hive, the queen is as fertile, and the eggs as prolific, as when they are present. Hattorff supposed that the queen is capable of impregnating herself; an opinion which was supported by Schirach and Wilhelmi, and was even favourably received by Bonnet, as it in some measure accorded with his discoveries respecting the aphids, of which our readers will find an account in the article APHIS. (See ENTOMOLOGY, *Index*.) Linnæus was of opinion that an actual union between the sexes took place, and Reaumur fancied that he had seen

this happen within the hive. There is, however, great reason to think that he was mistaken. Huber has clearly proved that the queen is never impregnated as long as she remains in the interior of the hive; and, if confined within it, continues barren, though surrounded by males. It is only during her flight, at a considerable height in the air, that the male has complete access to her so as to effect the impregnation. In half an hour the queen-bee returns to the hive with unequivocal proofs of the intercourse that has taken place, for she has in fact robbed the drone of the organs concerned in this operation; and the drone, thus mutilated, is left to perish on the ground. From its being necessary that the queen should fly to a distance in order to be impregnated, Huber infers the necessity of a great number of drones being attached to the hive, that there may be a sufficient chance of her meeting one of them during her aerial excursion.

We are now to direct our attention to the migrations of bees, by which new colonies, similar to that which had originally peopled the parent hive, are founded. The final causes of this phenomenon are sufficiently obvious; but it does not so clearly appear to what circumstances it is immediately owing. The increasing population of a hive probably occasions inconvenience from the want of room, the increase of heat, and the greater vitiation of the air; inconveniences which become still more serious as the summer advances. The spring is accordingly the commencement of the swarming season; no swarm, indeed, will ever take place while the weather is cold, nor until the hive is well stocked with eggs of every kind. The queen-bee, in consequence of the great number of eggs she has been laying, is now reduced to a more slender shape, and is well fitted for flight. Her aversion for the royal brood, which she seems to foresee will in no long time become able to dispute the throne with her, and the vain attempts she makes to destroy them in the cradle, in which she is invariably repelled by the bees who guard them, produce in her a constant restlessness and agitation, which, as Huber represents it, rises to a degree of delirium. This frenzy, from whatever cause it may originate, is communicated to the workers; they may be seen hurrying to and fro in the combs, with evident marks of impatience; the heat of the hive is increased by their tumultuous movements; it sometimes rises suddenly, on these occasions, from 92° to above 104°. A general buzz is heard throughout the hive. This state recurs from time to time, for some days before the swarm is actually on the wing; and the interval is occupied in making preparations for the approaching expedition. Provisions are collected in greater quantity by the working bees. Mr Hunter killed several of those that came away, and found their crops full, while those that remained in the hive had their crops not near so full. Scouts are sent out to look for a proper habitation. Mr Knight, in the *Philosophical Transactions*, gives us a curious account of his observations on their manœuvres in this respect. In the cavity of a hollow tree, which, by the application of a board, had been fitted up for the reception of the swarms, he constantly observed, "that, about fourteen days previous to their arrival, a small number of bees, varying from twenty to fifty, were every day employed in examining, and apparently in keeping possession of, the cavity; for if molested, they showed evident signs of displeasure, though they never employed their stings in defending their proposed habitation. Their examination was not confined to the cavity, but extended to the external parts of the tree above; every dead knot particularly arrested their attention, as if they had been apprehensive of being injured by moisture, which this might admit into the cavity below; and they apparently did not leave any part of the bark near the ca-

Bee.

Prepara-
tion for
swarmin.

Bee. vity unexamined. A part of the colony which purposed to emigrate appeared in this case to have been delegated to search for a proper habitation; and the individual who succeeded must have apparently had some means of conveying information of his success to others; for it cannot be supposed that fifty bees should each accidentally meet at and fix upon the same cavity, at a mile distant from their hive, which Mr Knight has frequently observed them to do, in a wood where several trees were adapted for their reception; and indeed he observed that they almost uniformly selected that cavity which he himself thought was the best adapted to their use. It not unfrequently happened that swarms of his own bees took possession of these cavities, and such swarms were in several instances followed from his garden to the trees; and they were observed to deviate very little from the direct line between the one point and the other, which seems to indicate that those bees who had formerly acted as purveyors now became guides."

departure
of the
swarm.

On the day on which the swarm quits the hive, few of the workers roam to any distance, but several are seen performing circles in the air round the hive. The noise is on a sudden hushed, and all the bees enter the hive; this silence announces their immediate departure. A few workers appear at the door, turn towards the hive, and striking with their wings, give, as it were, the signal for flight. All those who are to accompany the expedition rush towards the door, and issue forth with wonderful rapidity, rising in the air and hovering for some time, as if in order to wait for the assemblage of the whole troop; then, following the motions of the queen, they settle wherever she alights, forming a dense cluster around her. Sometimes, from weakness, or some other cause, she returns back to the hive, and is immediately attended thither by the rest. But if the weather be fine, the expedition is only deferred for one or two days, and they again take their departure. If their return be owing to the loss of their queen, they remain a fortnight or longer before the attempt to migrate is renewed, and then the swarm is much larger than before, which renders it probable that they have waited for the queen that was to go off with the next swarm. Sometimes, when every thing indicates an approaching emigration, the passage of a cloud across the sun will suspend all their operations, and the previous bustle gives place to a state of perfect calm. But, if the day be not far advanced, the breaking out of sunshine will renew the commotion, and determine the moment of actual flight.

recession
of the
swarms.

The swarm having rested for some time on the first landing-place, and collected the whole of its numbers, soars again in the air, keeping in a close phalanx, and directing its course with great velocity to the spot which their guides had selected; giving out, at the same time, a loud and acute-toned hum by the action of their wings.

The parent hive, thus deserted by its queen and a large proportion of its inhabitants, is busily occupied in repairing its loss. The bees which remain quietly pursue their labours; the young brood, soon arriving at maturity, quickly fill up every deficiency; and young queens, being allowed their liberty, one after the other, conduct in their turns new swarms, in the same manner as the first. The second swarm is not sent off till after the space of from five to ten days after the first. The following swarms succeed quicker to each other, but consist of smaller numbers than the earlier ones. If it happen that two queens are found in a swarm, either the swarm divides itself into two, and have separate destinations, or a single combat between the queens decides on which of them the empire is to devolve. Sometimes, indeed, they appear not to perceive each other, and the parties belonging to each construct separate combs

within the same hive; but no sooner do these combs come in contact, and thus give occasion to the queens meeting each other, than the contest begins, and it does not terminate but by the death of one of the rival queens. Successive swarms are sent off as long as the increase of population admits of it, and the number thus produced in a season depends on a variety of circumstances, such as the abundance of flowers, and the warmth of the climate, and the capacity of the hive. Bosc, while he was French consul in Carolina, found a hive in the woods which had been robbed of its wax and honey by the negroes: he contrived to convey the bees in his hat to a hive in his garden; he obtained from this hive eleven swarms before the end of autumn; and these again afforded him the same number of secondary swarms, so that, by the end of the year, he had twenty-two hives stocked from the one he had thus saved from destruction. In this country a hive commonly sends off only two, and sometimes three swarms in the course of the summer.

Bee.

Very few drones accompany the new colonies, so that almost all those produced in the spring remain in the hive. But when the queens are impregnated, and no new swarms are about to take place, the workers, who had till then suffered them to live unmolested in the hive, are on a sudden seized with a deadly fury towards them, and a scene of carnage ensues. This usually happens in July or August. They chase their unhappy victims in every quarter, till they seek a refuge at the bottom of the hive, where they collect in crowds, and are indiscriminately, and without a single exception, massacred by the working bees, who, with implacable fury, transfix them with their stings, and throw the dead bodies out of the hive. So great is their antipathy to all the race of drones, that they destroy, at the same time, the male eggs and larvæ, and tear open the cocoons of their pupæ, in order to devote them to one common destruction. This sacrifice of the males is not, however, the effect of a blind and indiscriminating instinct; for if a hive be deprived of its queen, the massacre does not take place, while the hottest persecution rages in all the surrounding hives. In this case the males are allowed to survive one winter.

Massacre
of the
drones.

Having thus got rid of the useless mouths, which consumed, without any advantage to the public, a large portion of their provisions, the bees spend the remainder of the summer in collecting stores of honey and of pollen for the ensuing winter. Their gleanings are now less abundant than in the spring, and require more labour in the search and collection. But at this season the leaves of many kinds of trees, which are covered in the morning with a saccharine fluid that transudes through them, furnish them with a species of nourishment, which, though of very inferior quality to the fluid of the nectaræa, still contributes to their support. Fruit is also attacked by bees, after the cuticular covering has been broken through by birds or snails. They also find nutriment in the *honey-dew*, which, as already stated, is an excrementitious fluid from the aphids. Often, however, these resources fail, and the hive is threatened with famine. On these occasions the distressed bees frequently betake themselves to plunder. Spies are sent out to examine the neighbouring hives; allured by the smell of honey, they examine the appearance and strength of its possessors; and, selecting the weakest hive as the object of attack, they begin a furious onset, which costs great numbers their lives. If the invaders should fail in their attempt to force the entrance, they retreat, and are not pursued by those whom they have assailed; but if they succeed in making good the assault, the war continues to rage in the interior of the hive, till one party is utterly exterminated; reinforcements are sent for by the invading army, and the bees

Provision
for the
winter.

Mutual
depredations.

Bee.

from the neighbouring hives often join the assailants and share in the plunder. In a short time the whole of the enemy's magazines are completely emptied. If, on the other hand, the invaders should be defeated, the successful party is by no means safe from the attacks of the bees from other hives, if any of them should chance to have mingled in the fray, and especially if they have once penetrated as far as the magazines, for in that case they are sure to return, accompanied with a large reinforcement, and the unfortunate hive that has once been attacked ultimately falls a sacrifice to these repeated invasions.

The close of autumn puts a period to their labours abroad. They then live on the provisions they have amassed, till the cold of winter reduces them to a torpid state; from which they awake on the return of vernal warmth, and renew the same circle of labours. Sometimes the strong light reflected from the snow during a clear sunshine deceives them with the appearance of warmth, and some bees are tempted to issue forth in order to collect provisions. All who thus venture out perish by the cold in a few minutes.

Duration of life.

Bees seldom die a natural death. They are at all times exposed to a variety of accidents, which thin their numbers; so that the average duration of their lives does not exceed one year. We may conclude that the whole generation is renewed in that space of time, from the results of experiments which have been tried of marking all the individuals of a hive in the spring, when it was found that none were in existence the next season. They are the natural prey of a number of quadrupeds, birds, and insects; many are overtaken by stormy weather, or fly to too great a distance, and never find their way back again to the hive; others are benumbed by cold; and numbers perish in battle with others of their own species, or lose their lives by being unable to withdraw the stings which they have employed against their enemies. The fecundity of the queen-bee is, however, adequate not only to repair these losses, but to multiply the population in a very high progression. It is computed that in France a single queen will lay from 30,000 to 60,000 eggs. This however varies according to the climate; for in Carolina and the West Indies they are known to produce at least three times this number. A single intercourse with the male is sufficient for the fecundation of all the eggs which the queen lays for at least two years, as has been proved by Huber; but its influence probably extends to all the eggs which the queen may lay during the rest of her life. The same queen has been observed to conduct swarms for two successive years; but the natural period of their lives is not known with any certainty. The ancients supposed it to be seven years; but Féburier suspects that, like the males, they are destroyed by the labourers when they have fulfilled their destination; for he was witness to an attack made by six labourers on a queen, whom he rescued with difficulty. Mr Hunter observes, that, judging from analogy, a bee's natural life is limited to a certain number of seasons; for he conceives that no individual insect of any species lives one month longer than the others of the same species. In the bee, one might suppose the period of life to be equal to the time that a hive can last; but this is not a necessary consequence, since they keep up a succession of generations. The comb of the hive may be said to be the furniture and storehouse of the bees, which by use must wear out; but, independently of this, it will in time become unfit for use, by the accumulation of cocoons, together with the excrements of the maggots, which are never removed. The former, indeed, lines the whole cell, top, sides, and bottom; and may be distinguished from the cocoons of former maggots that have been hatched in the same cell, by a portion of dried

Durability of the combs.

excrement, which is interposed between them at the bottom of the cell. Mr Hunter counted above twenty different linings in one cell, and found the cell about one quarter or one third filled up. A piece of comb so circumstanced, when boiled for the wax, will keep its form, and the small quantity of wax is squeezed out at different parts, as if squeezed out of a sponge, and runs together in the crevices; while a piece of comb that never has been bred in, even of the same hive, melts almost wholly down. Hence the combs can only last a certain number of years. However, to make them last longer, the bees often add a little to the mouth of the cell, which is seldom done with wax alone, but with some sort of mixture; and they sometimes cover the silk lining of the last chrysalis; but all this, observes Mr Hunter, makes such cells clumsy, in comparison of the original ones.

We have thus given an account of the principal facts in the history of bees, as far as they relate to the usual or natural condition of these insects. We shall conclude with the relation of several curious phenomena which they exhibit under particular and unusual circumstances, in which accident, or the designs of the experimenter, may have placed them.

The loss of the queen is an event which has the most marked influence on their conduct. Although the queen is constantly an object of attention and of strong affection to the whole community, they are not immediately sensible of her absence when she is removed from the hive. The ordinary labours are continued without interruption, and it is not till a whole hour has elapsed that symptoms of uneasiness are manifested, and it is even then only partially displayed. The inquietude begins in one part of the hive, the workers become restless, abandon the young which they were feeding, run to and fro, and, by striking each other with their antennæ, communicate the alarming intelligence very quickly to their companions. The ferment soon extends to the whole community; the bees rush precipitately out of the hive, and seek for their lost queen in every direction. This state of confusion continues for two or three, and sometimes for five hours, but never longer. Tranquillity is again re-established; they return to their labours; and selecting one of the larvæ that is not more than three days old, they break down two of the contiguous cells, sacrificing the larvæ contained in them, and proceed to build up one royal cell from their ruins. They then supply the worm with the food necessary to promote its quick growth, and, leaving untouched the rhomboidal bottom, they raise around it a cylindrical inclosure. In three days the larva has grown to such a size as to require an extension of its lodging, and must inhabit a cell nearly of a pyramidal figure, and hanging perpendicularly. A new pyramidal tube is therefore constructed with the wax of the surrounding cells, which is soldered at right angles to the first, and the bees, working downwards, gradually contract its diameter from the base, which is very wide, to the point. In proportion as the worm grows the bees labour in extending the cell, and bring food, which they place before its mouth and round its body, forming a kind of coiled zone around it. The worm, which can move only in a spiral direction, turns incessantly to take its food before its head; it insensibly descends, and at length arrives at the orifice of the cell. It then transforms itself into a pupa, is inclosed with a covering of wax, as before described, and, in the space of ten days, the original loss is thus repaired by the birth of a new queen. Schirach found, that if a number of bees be confined with even a single larva, which, in the natural course would have become a working bee, they immediately set about giving it the royal education above related, and thus raise it to the dignity of queen.

Bee.

What happens when they lose their queen.

Bee.

This discovery, which has since been amply confirmed by recent experiment and observation, was at first chiefly admired for its singularity in a physiological point of view. But it is evidently capable of being very advantageously applied towards the formation of artificial swarms, or new colonies of bees, by which the produce in honey and wax may be proportionally augmented. In the early months of spring, and even during the succeeding months, so late as November, M. Schirach cut off from an old hive a piece of that part of the comb which contained the eggs of the working bees, taking care, however, that it likewise included some worms hatched within the three preceding days. He fixed this in an empty hive, or box, together with a portion of honey-comb, &c.; or, in other words, with a sufficiency of food and building materials, or wax, for the use of the intended colony. He then put into, and confined within the box, a sufficient number of common working bees, taken from the same or any other hive. As soon as the members of this small community found themselves deprived of their liberty, and without a queen, a dreadful uproar ensued, which continued generally, with some short intervals of silence, for the space of about 24 hours; during which time it is to be supposed they were alternately meditating and holding counsel on the future support of the new republic. On the final cessation of this tumult, the general and almost constant result was, that they betook themselves to work, first proceeding to the construction of royal cells, and then taking the proper measures for hatching and feeding such of the brood as were placed within them. Sometimes even on the second day the foundations of one or more royal cells were perceptible. This operation has been hitherto conducted within doors. The new colony may now be safely trusted in the garden, if the weather be warm, and have the liberty allowed them of passing out of the box; of which they instantly avail themselves, and are seen in a short time almost totally to desert their new habitation. In about two hours, however, they begin to re-enter it. We should not neglect to observe, that if they should be placed near the old hive from which they were taken, they will very often attempt to enter it, but are as constantly repulsed by their former companions and brethren. It is prudent, therefore, to place them at a distance from the mother state, in order to avoid the inconveniences of a civil war. The final result of the experiment is, that the colony of working bees thus shut up, with a morsel of common brood, not only hatch it, but are found, at the end of eighteen or twenty days, to have produced from thence one or two queens, which have apparently proceeded from worms of the common sort, pitched upon by them for that purpose; and which, under other circumstances, that is, if they had remained in the old hive, would, in the course of their metamorphosis, have attained only to the condition of working bees. In the present instance, the common worm appears to be converted by them into a queen-bee merely because the hive was in want of one. Hence we may justly infer that the kingdom of the bees is not, if the expression may be used, a *jure divino*, or hereditary monarchy, but an elective kingdom; in which the choice of their future ruler is made by the body of the people.

While the hive remains without a queen, swarming can never take place, however crowded the hive may be. The young queens are suffered to come out of their cells without impediment, and, after a number of deadly combats, the empire remains with the survivor. Huber has made the singular observation, that two queens, however inveterate may be their mutual hostility, never actually both destroy each other; and that when, in the course of their contest, they are placed in such a relative position as that each has it in her power to strike a mortal blow on the

other with its sting, they suddenly separate, and fly from each other with every appearance of being panic-struck. The final cause of the instinct that prompts this conduct is sufficiently obvious, as, without it, the hive would be altogether deprived of a queen.

The bees recognise the individual person of their own queen. If another be palmed upon them, they seize and surround her, so that she is either suffocated or perishes with hunger; for it is very remarkable that the workers are never seen to attack a queen-bee with their stings. If, however, more than eighteen hours have elapsed before the stranger queen be introduced, she has some chance of escape. The bees do, indeed, at first seize and confine her, but less rigidly; and they soon begin to disperse, and at length leave her to reign over a hive, in which she was at first treated as a prisoner. If twenty-four hours have elapsed, the stranger will be well received from the first, and at once admitted to the sovereignty of the hive. If a supernumerary queen be introduced into the hive, she is laid hold of by the bees, and presented to the reigning queen, while a ring is formed by the bees, who continue to be spectators, and even promoters of the combat, in which one or other of the queens is destined to perish. Schirach and Reims had imagined that, in these circumstances, the stranger met her death from the hands of the working bees; but this mistake has been rectified by Huber, who gives the account above stated.

If the impregnation of the queen be delayed beyond the twenty-first day of her life, she begins soon after to lay the eggs of drones, and produces no other kind of eggs during the remainder of her life. This very curious and unexpected fact was discovered by Huber, and has been satisfactorily established by his very numerous and varied experiments, although its explanation is perhaps attended with insuperable difficulties. The body of a queen whose impregnation has thus been retarded is shorter than common, and the extremities remain slender, while the first two rings of the abdomen, or those next the thorax, are uncommonly swollen. On dissecting the double ovary, both branches were found to be equally expanded and equally sound, but the eggs were apparently not placed so closely together as in common queens. It was not correctly ascertained whether the queens whose impregnation was retarded laid a number of drone eggs corresponding to the whole number of eggs, both of workers and drones, which they ought to have deposited; but it is certain that they laid a greater number of drone eggs than they ought naturally to have done. On these occasions the instinct of the queen-bee appears to suffer, for she then lays her eggs indiscriminately in large and in small cells, those laid in large cells producing large drones, those in small cells small drones; and she has been known to lay the eggs of drones even in royal cells, some of which are always constructed when the queen begins to lay male eggs. It is curious that the workers were, on these last occasions, deceived, and treated the embryo drones as if they had been truly of the royal brood.

One of the most remarkable facts concerning the generation of bees, is the existence occasionally of prolific workers, the discovery of which we owe to Reims. Although it was doubted by Bonnet, its reality has been fully confirmed by the researches of Huber; and it explains what was before unaccountable, the production of eggs in hives absolutely destitute of a queen. It is also remarkable, that the eggs thus produced are always those of drones. The origin of these supplementary queens is accounted for from their having passed the vermicular state in cells contiguous to the royal ones, and from their having, at an early period, devoured some portion of the

Bee.

Retarded
fecundation.Prolific
working
bees.

Bee.

stimulating jelly which was destined for the nourishment of the royal brood; and from their ovaria thus receiving a partial development, which renders them susceptible of being impregnated. It is curious that these imperfect queens are still objects of jealousy and animosity to the queen-bee. How they become impregnated has not been ascertained; but the fact of their being productive was a strong confirmation of the truth of Schirach's theory concerning the sexes of bees. Needham, to whom the fact was known, had eluded the force of the argument by pretending that these bees did not belong to the working class, but were real queens of an unusually small size. The supposed absence of ovaria in the working bee was still, indeed, a difficulty which tended to throw some degree of doubt on the correctness of Schirach's doctrine. No person, as Bonnet repeatedly alleges, could suppose that these organs, however minute they might be, had escaped the penetration of Swammerdam, who was unrivalled in his anatomical skill in all that related to insects, and who had bestowed great labour in the examination of the structure of the bee. What had eluded his scalpel and microscope was reserved for the still finer hand and more dexterous dissection of a lady. Miss Jurine, the daughter of the celebrated naturalist of Geneva, has discovered, by adopting a particular method of preparing the object to be viewed, the rudiments of ovaria in the common working bee; she examined a great number, and never failed to find them. Cuvier, in his *Leçons d'Anatomie Comparée*, mentions a suspicion that he had seen some very small oviducts in the working bees, a suspicion which we now find to be completely verified.

Effects of mutilations.

We have next to relate the results of experiments of a more cruel kind, but which illustrate several points in the physiology of these insects. The amputation of the four wings of the queen did not interfere with her laying of the eggs, and the workers did not show her the less attention on account of her being thus mutilated. Of course, if the operation be performed before she is impregnated, she remains barren, since it is necessary for the sexual congress that she should fly out of the hive. The amputation of a single antenna appeared to be productive of no bad consequence of any kind; but the removal of both the antennæ was followed by singular effects. The queen who had suffered this operation ran about in apparent disorder, dropping her eggs at random, and was incapable of directing her trunk with precision to the food that was offered her. At times she appeared desirous of escaping from the hive, and when this was prevented, she returned in a state of delirium, was indifferent to the caresses of the workers, and received another similarly mutilated queen, that was presented to her, without the least symptom of dislike. The workers, on the other hand, received the stranger queen with great respect, although the first still remained in the hive. A third queen, not mutilated, was next introduced; she was very ill received, and immediately detained and kept close prisoner. When the queen, deprived of her antennæ, was allowed to quit the hive, she was followed by none of the workers, and was abandoned to her fate.

Variations in their mode of building.

Bees naturally build from above downwards, but may, by a particular artifice, devised by Huber, be induced to reverse this process. For this purpose a glass hive, with slender laths fixed at the bottom of it, must be provided, and the bees confined in it. They are unable to fasten themselves to the smooth surfaces, and, therefore, esta-

Bee.

lish the foundations of the combs on the wood, and are forced to proceed in a direction opposite to the usual one; in this way Huber was enabled to observe their proceedings. But the readiest mode of inducing them to build in any particular direction is to supply them with portions of ready-made combs, which should be fixed with wires in the proper position; and they will always continue to complete them upon the model presented to them. The hive which Huber recommends is constructed on this principle, consisting of upright frames of a square form, fitted to each other, and of such a size as just to contain each of them a single comb; by separating these, every part of the hive can be laid open and examined with the utmost ease. Féburier has improved upon this construction by changing the shape of the frames from a square to a trapezium, having an acute angle at the summit; a form which allows the moisture that collects at the top to run down the sides more easily than it would do from a flat roof. In this way, any portion of the honey or wax may be removed at pleasure, without hurting or incommoding any one of the bees; and artificial swarms may, at the proper season, be readily procured, by dividing the hive into two portions, and adapting empty frames to each portion.

The wasp and the hornet have long been known as the Enemies determined enemies of the bee, committing great ravages of bees. among these weaker insects: they attack them individually, but oftener commit their aggressions in large armies, on which occasions numbers perish on both sides. In some parts of America, wasps have multiplied to so great a degree, as to render it impossible to rear bees. Among quadrupeds, the ant-eater occasionally devours them. The bear and the badger overturn the hives, and plunder their contents. Rats and mice are very formidable enemies, as they invade them at all seasons, and especially during their torpid state, when they are incapable of revenging the aggression. The woodpecker may succeed in breaking through the hive, and then speedily destroys all its inhabitants; the swallow, the sparrow, the titmouse, the cuckoo, and the *Merops apiaster*, or bee-eater, and poultry of every kind, prey upon them separately. According to Bosc, they are also food for the shrikes, and for the *Falco apivorus*. Lizards watch for them, and seize them as they alight near the hive. Toads occasionally devour them. They are in some danger from the larger kinds of spiders, and of *Libellulæ*, as also from the *Philanthus apivorus* of Fabricius. But the most insidious and destructive enemy of these insects is the moth; various species of which, particularly the *Phalena mellolena*, insinuate themselves into the hive, and deposit their eggs unperceived between the cells in such numbers, that the hive is soon overrun with the larvæ, where they are hatched, and the bees are forced to abandon the hive. A new enemy of the same tribe has been lately discovered by Huber, in the *Sphinx atropos*, well known by the name of death's head. Towards the end of autumn, when the bees have filled their magazines, a loud hum is sometimes heard near their habitation, and a multitude of bees come out during the night, and fly about in the utmost confusion. The tumult continues for several hours, and the next morning a number of dead bees are strewed before the hive. On examining the hive, it is found to have been robbed of all its honey, and the bees do not return to it.¹ These effects result from the incursions of the sphinx, which watches its opportunity to introduce itself into the hive during the night, when the bees are depriv-

¹ There appears to be some exaggeration or misconception in this statement of the Genevese observer. The death's head moth is one of the largest of the lepidopterous insects of Europe, and could not possibly effect an entrance into any hive constructed with ordinary care. Nor is it probable that it could consume more than a very small portion of honey, even if it were to obtain admission.

Bee. ed of the advantages of vision, which the sphinx enjoys in greater perfection at this period. By rendering the door-way extremely narrow, so as only to admit a single bee at a time, this accident may be prevented; and it is curious that the bees themselves frequently anticipate this danger, and provide against it by employing, of their own accord, the very same mode of defence. They construct a thick wall, which barricades the entrance, and resembles a regular fortification, with bastions, casemates, and massive gateways. They often, indeed, have recourse to a similar contrivance for protection against the pillaging bees, enabling them to repel the assault with greater effect. At other times, when the danger is less pressing, the inconveniences of so narrow a gateway being strongly felt, they enlarge it by removing the fortification they had built, and do not again construct it unless the appearance of the enemy in the ensuing season should inspire them with fresh alarms. If, on the other hand, the precaution of narrowing the gateway should already have been taken by the cultivator, the bees, feeling themselves secure, spare themselves the unnecessary labour of erecting these walls. This single trait in their history is a sufficient refutation of those theories which ascribe all their actions to the operation of a blind indiscriminating instinct, and would exclude every species of foresight and reflection. (v.)

In the article *APIARY* of this work we have already described the leaf and book hives of M. Huber, with the proposed improvements of several other apiarians. The chief objection to some of these is the expense and difficulty of their construction, and the greater degree of attention which they exact on the part of the cultivator. Those made of straw are generally preferred, as being less liable to be overheated by the rays of the sun: they are likewise of easy purchase, from their cheapness; and in winter they exclude the cold better than hives made of other materials. The following is Mr Wildman's account of the structure and general management of his hives:—"My hives are seven inches in height and ten in width. The sides are upright, so that the top and bottom are of the same diameter. A hive holds nearly a peck. In the upper row of straw there is a hoop of about half an inch in breadth, to which are nailed five bars of deal, full a quarter of an inch in thickness and an inch and quarter wide, and half an inch asunder from one another; a narrow short bar is nailed at each side, half an inch distant from the bars next them, in order to fill up the remaining parts of the circle; so that there are in all seven bars of deal, to which the bees fix their combs. The space of half an inch between the bars allows a sufficient and easy passage for the bees from one comb to another. In order to give great steadiness to the combs, so that, upon moving the hive, the combs may not fall off, or incline out of their direction, a stick should be run through the middle of the hive, in a direction directly across the bars, or at right angles with them. When the hives are made, a piece of wood should be worked into the lower row of straw, long enough to allow a door for the bees, of four inches in length, and half an inch in height.

"The proprietor of the bees should provide himself with several flat covers of straw, worked of the same thickness as the hives, and a foot in diameter, that so it may be of the same width as the outside of the hives. Before the cover is applied to the hive, a piece of clean paper, of the size of the top of the hive, should be laid over it; and a coat of cow-dung, which is the least apt to crack of any cement easily to be obtained, should be laid all round the circumference of the hive. Let the cover be laid upon this, and made fast to the hive with a packing-needle and pack-thread, so that neither cold nor vermin may enter.

Bee. "Each hive should stand single on a piece of deal or other wood, somewhat larger than the bottom of the hive. That part of the stand which is at the mouth of the hive should project some inches for the bees to rest on when they return from the field. This stand should be supported upon a single post, two and a half feet high, to which it should be screwed very securely, that high winds or other accidents may not blow down both stand and hive. A quantity of soot mixed with barley chaff should be strewed on the ground round the post, which will effectually prevent ants, slugs, and other vermin, from rising up to the hive. The soot and chaff should from time to time be renewed as it is blown or washed away, though, as it is sheltered by the stand, it remains a considerable time, especially if care be taken that no weeds rise through it. Weeds, indeed, should not be permitted to rise near the hive, for they may give shelter to vermin which may be hurtful to the bees.

"The stands for bees should be four yards asunder, or, if the apiary will not admit of so much, as far asunder as may be, that the bees of one hive may not interfere with those of another hive, as is sometimes the case when the hives are near one another, or on the same stand; for the bees, mistaking their own hives, light sometimes at the wrong door, and a fray ensues, in which one or more may lose their lives."

He further directs, that whoever intends to construct an apiary should purchase a proper number of hives at the latter part of the year, when they are cheapest. These should be full of combs, and well stored with bees. The purchaser should also examine the combs, with a view to ascertain the age of the hives. The combs of the season are white; those of the former year are of a darkish yellow; and where the combs are black, the hive should be rejected, because when old they are more subject to the attacks of vermin and other accidents. If the requisite number of hives have not been purchased in the autumn, it will be necessary to remedy this neglect as soon as the severity of the cold has passed in spring. At this season, according to Mr Wildman, bees which are in good condition will go into the fields early in the morning, return well laden, enter boldly, and will seldom leave their home in bad weather. They are alert on the least disturbance; and we may judge of their strength by the loudness of their humming. The summer is not an advisable season for purchasing bees, because the heat of the weather softens the wax, and renders the combs liable to break and give way, if they are not well secured in the interior. The honey, too, being thinner than at other times, is more apt to run from the cells, which not only occasions a loss of the material, but daubs, and possibly destroys, the bees.

Mr Wildman's feats in the handling of these irritable and pugnacious creatures have been the frequent subject of surprise. As it is often of consequence to be able to regulate the settling of a swarm, we shall here subjoin his method in his own words. "Long experience has taught me, that as soon as I turn up a hive, and give it some taps on the sides and bottom, the queen immediately appears to know the cause of this alarm, but soon retires again among her people. Being accustomed to see her so often, I readily perceive her at first glance; and long practice has enabled me to seize her instantly with a tenderness that does not in the least endanger her person. This is of the utmost importance, for the least injury done to her brings immediate destruction to the hive, if you have not a spare queen to put in her place, as I have too often experienced in my first attempts. When possessed of her, I can without injury to her, or exciting that degree of resentment that may tempt her to sting me, slip her into my other

Bee. hand, and, returning the live to its place, hold her there, till the bees, missing her, are all on wing, and in the utmost confusion. When the bees are thus distressed, I place the queen wherever I would have the bees to settle. The moment a few of them discover her, they give notice to those near them, and those to the rest, the knowledge of which soon becomes so general, that in a few minutes they all collect themselves round her, and are so happy in having recovered this sole support of their state, that they will long remain quiet in their situation. Nay, the scent of her body is so attractive of them, that the slightest touch of her along any place or substance will attach the bees to it, and induce them to pursue any path she takes." This was the only witchcraft used by Mr Wildman, and is that alone which is practised by others who have since made similar exhibitions.

In the management of bees a great deal must of course depend on supplying them with an abundant pasture. A rich corn country is well known to be to them as a barren desert during a great portion of the year. Hence the judicious practice of shifting them from place to place according to the circumstances of the season. It was the advice of Celsus, that after the vernal pastures were consumed, bees should be transported to places abounding with autumnal flowers; and it was in accordance with such advice that they were annually carried in ancient times from Achaia to Attica, and from Eubœa and the islands of the Cyclades to Scyrus. In Sicily, also, they were brought to Hybla from other parts of the island. So also in our own country the people of the lowlands, as soon as the "bright consummate flowers" of summer are on the wane, dispatch their hives in cart loads to the blooming heather of the mountain pastures, where a never-ending wilderness of sweets is spread before them. It is indeed to be regretted that our moorlands, in this respect, are so much more neglected than they ought to be. The very air of the highland hills is often redolent with the rich perfume, while here and there a solitary bee is seen or heard labouring with wearied wing among the inexhaustible stores of nature, and scarcely able to regain its lonely shelter in the distant vale. When we consider the poverty of our mountaineers, and their frequent want of occupation, it is the more to be lamented that so easy a source of emolument should lie open to them in vain. It has been calculated that the pastures of Scotland could maintain as many bees as would produce 4,000,000 pints of honey and 1,000,000 pounds of wax; and were these quantities tripled for England and Ireland, the produce of the British empire would be 12,000,000 pints of honey, and 3,000,000 pounds of wax per annum. If we allow five shillings per pint for the honey and one shilling and sixpence per pound for the wax, we have an annual produce in money of L.3,225,000. But, in consequence of the present neglect of this branch of rural economy, we pay every year a large sum to foreign nations for articles which we could raise ourselves, with scarcely any outlay either of capital or time.

We learn from Pliny that the practice of removing bees from place to place was frequent in the Roman territories. "As soon," says he, "as the spring food for bees has failed in the valleys near our towns, the hives of bees are put into boats, and carried up against the stream of the river in the night, in search of better pasture. The bees go out in the morning in quest of provisions, and return regularly to their hives in the boats, with the stores they have collected. This method is continued till the sinking of the boats to a certain depth in the water shows that the hives are sufficiently full; and they are then carried back to their former homes, where their honey is taken out of them." And this is still the practice of the Italians who

live near the banks of the Po, the river which Pliny instanced particularly in the passage above quoted.

M. Maillet relates, in his description of Egypt, that, in "spite of the ignorance and rusticity which have got possession of that country, there yet remain in it several footsteps of the industry and skill of the ancient Egyptians. One of their most admirable contrivances is, their sending their bees annually into distant countries, in order to procure them sustenance there, at a time when they could not find any at home; and their afterwards bringing them back, like shepherds who should travel with their flock, and make them feed as they go. It was observed by the ancient inhabitants of Lower Egypt, that all plants blossomed, and the fruits of the earth ripened, above six weeks earlier in Upper Egypt than with them. They applied this remark to their bees; and the means then made use of by them to enable these usefully industrious insects to reap advantage from the more forward state of nature there, were exactly the same as are now practised for the like purpose in that country. About the end of October, all such inhabitants of Lower Egypt as have hives of bees, embark them on the Nile, and convey them up that river quite into Upper Egypt; observing to time it so that they arrive there just when the inundation is withdrawn, the lands have been sown, and the flowers begin to bud. The hives thus sent are marked and numbered by their respective owners, and placed pyramidically in boats prepared for the purpose. After they have remained some days at their farthest station, and are supposed to have gathered all the wax and honey they could find in the fields within two or three leagues around, their conductors convey them in the same boats two or three leagues lower down, and there leave the laborious insects as long time as is necessary for them to collect all the riches of this spot. Thus the nearer they come to the place of their more permanent abode, they find the productions of the earth, and the plants which afford them food, forward in proportion. In fine, about the beginning of February, after having travelled through the whole length of Egypt, gathering all the rich produce of the delightful banks of the Nile, they arrive at the mouth of that river, towards the ocean, from whence they set out, and from whence they are now returned to their several homes; for care is taken to keep an exact register of every district from whence the hives were sent in the beginning of the season, of their numbers, of the names of the persons who sent them, and likewise of the mark or number of the boat in which they were placed."

In many parts of France floating bee-houses are very common. They have on board one barge three score or a hundred bee-hives, well defended from the inclemency of an accidental storm. With these the owners suffer themselves to float gently down the river, the bees continually choosing their flowery pasture along the banks of the stream; and thus a single floating bee-house yields the proprietor a considerable income.

They have also a method of transporting their bees by land, well worth our imitation in many parts of this kingdom. Their first care is to examine those hives, some of whose honeycombs might be broken or separated by the jolting of the vehicle; they are then made fast one to the other, and against the sides of the hive, by means of small sticks, which may be disposed differently as occasion points out. This being done, every hive is set upon a packing-cloth, or something like it, the threads of which are very wide; the sides of this cloth are then turned up and laid on the outside of each hive, in which state they are tied together with a piece of small pack-thread wound several times round the hive. As many hives as a cart built for the purpose will hold are after-

wards placed in the vehicle. The hives are set two and two, the whole length of the cart. Over these are placed others, which make as it were a second story or bed of hives. Care is taken in this stowage not to let one hive stop up another, it being essentially necessary for the bees to have air; and it is for this reason they are wrapped up in a coarse cloth, the threads of which have been wove very wide, in order that the air may have a free passage, and lessen the heat which these insects raise in their hives, especially when they move about very tumultuously, as often happens in these carts. Those used for this purpose in Yevre hold from thirty to forty-eight hives. As soon as all are thus stowed, the caravan sets out. If the season is sultry, they travel only in the night; but a proper advantage is taken of cool days. These caravans do not travel fast. The horses must not be permitted even to trot: they are led slowly, and along the smoothest roads. When there are not combs in the hives sufficient to support the bees during their journey, the owner takes the earliest opportunity of resting them wherever they can collect the materials for wax. The hives are taken out of the cart, then set upon the ground, and after removing the cloth from over them, the bees go forth in search of food. The first field they come to serves them as an inn. In the evening, as soon as they are all returned, the hives are shut up; and being placed again in the cart, they proceed on their journey. When the caravan has arrived at the journey's end, the hives are distributed in the gardens, or in the fields adjacent to the houses of different peasants, who, for a very small reward, undertake to look after them. Thus it is that, in such spots as do not abound in flowers at all seasons, means are found to supply the bees with food during the whole year.

These instances of the great advantages which attend the shifting of bees in search of pasture afford an excellent lesson to many places in this kingdom: they direct particularly the inhabitants of the rich vales, where the harvest for bees ends early, to remove their stocks to places which abound in heath; this plant continuing in bloom during a considerable part of autumn, and yielding great abundance of food to bees. Persons in the neighbourhood of hills and mountains will save the bees a great deal of labour, by also taking the advantage of shifting their places of abode.

The degree of cold which bees can endure has not been ascertained, though it is no doubt considerable. They survive the winter in many cold parts of Russia, in hollow trees, without any attention being paid to them; and their hives are frequently made of the bark of trees, which does not afford a very complete protection from the effects of frost. Many hives which are thought to die of cold in winter die in reality of famine, when a rainy summer and cold autumn have prevented their laying in a sufficient store of provisions. The hives should therefore be carefully examined in the after-part of the season, and the amount of food ascertained. Mr White judiciously ob-

serves, that bees which stand on the north side of a building whose height intercepts the sun's beams all the winter will waste less of their provisions than others which stand in the sun; for, coming forth seldom, they eat little, and yet are as forward in the spring to work and swarm as those which had twice as much honey left with them the preceding autumn. The owner ought, however, to examine their condition in the course of the winter, and if he finds that, instead of being clustered between the combs, numbers have fallen to the bottom of the hive, it should immediately be shifted to a warmer place.

In regard to the destruction of bees, it has been observed that no true lover of these industrious insects ever lighted the fatal match without concern. One of the easiest and most simple methods of obtaining possession of a portion of their store is the following: Uncover the hole in the upper centre of a flat-topped straw hive or box, and place a glass vessel over it in such a way that no bee can get either in or out except by the ordinary opening of the lower hive. The glass hive must be covered with an empty hive or with a cloth, that too much light may not prevent the bees from working. As soon as they have filled the straw hive or box, they will begin to work up into the glass hive. Mr Thorley, junior, informs us, that he himself has had one of these glass hives filled by the bees in thirty days in a fine season; and that it contained 38 pounds of fine honey. When the glass is completely filled, slide a tin plate between it and the hive or box, so as to cover the passage, and in half an hour the glass may be taken off with safety. What few bees remain in it will readily go to their companions. He has added a glass window to his straw hives, in order to see what progress bees make; which is of some importance, especially if one hive is to be taken away whilst the season still continues favourable for their collecting honey; for when the combs are filled with honey, the cells are sealed up, and the bees forsake them and reside mostly in the hive in which their works are chiefly carried on. Observing also that the bees were apt to extend their combs through the passage of communication in the upper hive, whether glass or other, which rendered it necessary to divide the comb when the upper hive was taken away, he now puts in that passage a wire screen or netting, the meshes of which are large enough for a loaded bee to go easily through them. This prevents the joining of the combs from one box to the other, and consequently obviates the necessity of cutting them, and of spilling some of the honey, which running down among a crowd of bees, used before to incommodate them much, it being difficult for them to disencumber their wings.

We shall conclude by observing, that the honey-bee (*apis mellifica*) is supposed to be of Asiatic origin. They were imported from Europe to America, where they are now found wild in great numbers, and at a vast distance from human habitations. (T.)

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Manticora Marillosa.

Cicindela sylvatica.

Anthia 4. guttata.

Enicodius nigus.

Cicindela tenuipes.

Brachinus Jurinei.

Graphipterus multiquittatus.

Mouth of
Anthia 10. guttata.

Diptis ruficollis.

Scarites subterraneus.

Hapalus tricolor.

Mormolyce phyllodes.

Mouth of *M.*

Head of
Lor. pilicornis.

Panagaeus fulvipennis.

Dilemus violaceus.

Acanthocelis ruficornis.

Omophron suturalis.

Sphaeroderus nitidicollis.

Carabus ruficornis.

Procerus lauricus.

Cychrus italicus.

Pamborus alternans.

Calasoma sylvatica.

Dytiscus Hermieri.

Dytiscus Roselli.

Larva of Dytiscus.

Pupa of Dytiscus.

Fore leg of Colymbetes.

Micropeplus Muller.

Hygrobia Hermann.

Gyrinus sulcatus.

Antenna of Gyrinus.

Pederus riparius.

Oxyporus rufus.

Staphylinus erythropterus.

Head of 10.

Larva of Gyrinus magdalenae.

Buprestis bicolor.

Larva of Buprestis quercus.

Stenus biguttatus.

Lesteva dichroa.

Lathrobium elongatum.

Tachinus atricapillus.

Palpus of 23.

Palpus of 28.

Trichus cruentata.

Elater plagiatas.

Tachiporus marginatus.

Adelocera Chabani.

Ceraphytum clateroides.

Head of Hemirhipis flabellicornis.

Callirhipis Gerni.

Head of Cal. Dejeani.

Rhipiceri cyanea. *Dictyoptera sanguinea.* *Lycus latissimus.* *Omaliscus suturalis.* *Lampyris noctiluca.*
Male.

Female of 5.

Larva of 5.

Drilus flavescens.
Female.

Male.

Lampyris Savignii. *Telephorus fuscus.* *Drilus flavescens.*
Male magd. *Malachius bipustulatus.* *Malthinus biguttatus.* *Dasytes ater.*
Male. *Melyris viridis.* *Clerus apiarius.* *Pinus elegans.* *Necrobia violacea.* *Ptilinus pectinatus.* *Necrophorus vespillo.* *Hister reniformis.* *Necrodes littoralis.* *Silpha quadripunctata.* *Nitidula ferruginea.* *Heterocerus marginatus.* *Dermestes lardarius.* *Hydrous piceus.* *Helophorus aquaticus.* *Sphaeridium 4-maculatum.*

Ateuchus Egyptianum. *Ateuchus suar.* *Onthophagus rarus.* *Phaneus Imperator.* *Copris bellator.* *Aphodius bipunctatus.* *Head of Chiron grandis.* *Ateuchus Imolus, Fem?
of Fischer.* *Geotrupes Blackburni.* *Head of Geotrupes.* *Chiron grandis.* *Bulbocerus fulvus.* *Head of Bulbocerus.* *Antenna of D9* *Oryctes Chevrolatii.* *Maxilla of 23.* *Scarabaeus menter.* *Antenna of 19.* *Mandible of 23.* *Antenna of Mel. vulgaris,
Male.* *Chrysophora chrysochlora.* *Labium of 23.* *Antenna of Mel. vulgaris,
Female.* *Herodotus reticulatus.* *Rutela nitidissima.* *Macraspis splendida.* *Serica
flavimana.* *Antenna of Serica.* *Melolontha fullo.* *Areoda Kirbyi*

Lophonocerus barbicornis.

Cerambyx lurtipes.

Xecydalis major.

Lumia aurocincta.

Stenopterus elegans.

Rhagium bifasciatum.

Sagra cyanea.

Donacia linnea.

Megascelis prasina.

Aburnus corallinus.

Hispa Fabricii.

Cassida longicornis.

Chlamys cuprea.

Lamprosoma corrusca.

Doryphora multipunctata.

Paropsis 8. lineata.

Timarchus balearica.

Chrysomela humeralis.

Erotylus gibbosus.

Prasocuris hanoveriana.

Eumorphus Sumatrensis.

Endomychus coecineus.

Coccinella ocellata.

Pselaphus hamatus.

Chentium bituberculatum.

Claviger longicornis.

Antenna of 26.

Empusa lobipes.

*Labium of
Forficula auricularia.*

Phyllium siccifolia.

*Maxilla of
Forf. auricularia.*

Phasma annulata.

Forficula croceipennis.

Blatta picta.

Gryllo-talpa vulgaris.

Gryllus domesticus.

Truxalis nasutus.

Locusta viridissima.

Head of 12.

Acrydium migratorium.

Pneumonia papillosa.

Tettix bipunctata.

Scutellerus Divus.

Tessentema Sonneratii.

Phloea cassideoides.

Coreus parulosus.

Noides tipularia.

Lygaeus equestris.

Cimex lectularius.

Hydrometra linearis.

Gerris lacustris.

Nepa cinerea.

Notonecta glauca.

Fulgora candelaria.

Cicada trivittata.

Membracis foliata.

Centrotus cornutus.

Livia junconum.

Thrips.

Aphis roseae.

Larva of 19.

Coccus cacti.
Male.

Coccus cacti.
Female.

Under view of 21.

Nymph of 2.

Libellula depressa.

Nymph of *Agrion pudica.*

Libellula Indica.

Ephemera bioculata.

Head of 7.

Ephemera limbata.

Agrion Chinensis.

Ephemera vulgata.

Nymph of 9.

Nemoptera halterata.

Larva of 12.

Myriarchon torquicarinum.

Panorpa communis.

Nymph of 12.

Head of 13.

Tail of 13.

Eggs of *Hemerobius.*

Termites fatale, Larva or Worker.

Termites fatale, Male.

Case Worm, or Larva of *Phryganea.*

Ascalaphus Braziliensis.

Raphidia ophiopsis.

Phryganea.

Termites fatale, or White Ant, Gravid Female.

Case Worm, or Larva of *Phryganea.*

Cimbex axillaris. *Hylotoma rosæ.* *Tenthredo zonata.* *Lophyrus pini.* *Antenna of 4.* *Female of 4.* *Urophysia camelus.* *Sirex gigas.* *Oryssus coronatus.* *Evania cubæ.* *Head of 15.* *Pelecinus polycerator.* *Outline of 10.* *Picus capensis.* *Stephanus fuscatus.* *Head & neck of 15.* *Ichneumon grossorius.* *Peltastes suarius.* *Pimpla manifestator.* *Cynips rosæ.* *Toppa picta.* *Excrescences produced by Cynips rosæ.* *22 laid open.*

26.

27.

28.

Larvæ of Cynips rosæ magnified. *Leucospis dorsigera.* *Chalcis minuta.*

STREPSIPTERA.

Pupa of Stylops Albitus. *Stenox Picta* *Larva of 30.*

Parnassius Apollo.

Papilio Machaon

Pieris thiria.

Thais Medesiusae.

Colias Iphyle.

Danaida eunice.

Heliconius Lamproctorii.

Vanessa Io.

Larva and Chrysalis of Vanessa Io.

Vanessa cultus.

Argynnis moneta.

*Larva of
Argynnis paphia.*

*Larva of
Nymphalis ilia.*

*Chrysalis of
Nymphalis ilia.*

Nymphalis ethea.

Nymphalis lasius.

Morpho actorion.

Nymphalis lasius.

Pavonia acadina.

Erycina virginiensis. *Brassolis astyn.* *Erycina virginiensis.* *Eumenia tacea.* *Satyrus Balder.* *Zephyrius amor.* *Larva of Morpho phidippus.* *Urania Boisduvalii.* *Eurybia carolina.* *Myrina Jaffra.* *Polyommatus Thoe.* *Urania Boisduvalii.* *Hesperia sabulius.* *Chrysalis and larva of
Hesperia tages.*

Agarista Pales. *Coronis Leachii.* *Castnia Acrooides.* *Zygana filipendule.* *Sphinx jasminearum.**Chrysalis of 12.* *Larva of Sphinx jas.* *Agiocera rectilinea.* *Zygana pulchella.* *Smerinthus io.* *Thyris sepulchralis.* *Sesia asilipennis.* *Larva of 12.* *Cossus Macmurtrei.* *Aglaope Americana.* *Atychia pumila.* *Procris nebulosa.* *Glanopsis Follettii.* *Larva of Cossus ligniperda.* *Sericaria ruficeps.* *Zenzeru scalaris.* *Bombyx digramma.* *Saturnia Bauchini.* *Lasiocampa proboscidea.* *Larva of Saturnia Luna.* *Stygia australis.* *Larva of Hepialus knuli.*

Notodonta ziczar.

Orygia detrita.

Female of 2.

Larva of *Orygia gonostigma.*

Chelonia evidens.

Callimorpha lecontei.

Dicranoura borealis.

Larva of 7.

Noctua (Ophideres) Imperator.

Larva of *Erebos (Choptera) putrescens.*

Botys dilucidalis.

Hydrocampe aquatilis.

Phalena machaonaria.

Erebos limacina.

Phalena guttaria.

Pyrallis sajana.

Herminia sidonia.

Euplocampus anthracinus.

Aglossa dilucidalis.

Crambus retusalis.

Tinea tapezana.

Yponomeuta pusilla.

Mithya carnea.

Adela Degeerella.

Pterophorus ptilodactylus.

Alucita asperella.

Ornoides hexadactylus.