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IX. *Descriptions of some New and Rare Cephalopoda.*

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AMONGST other contributions to natural history which have resulted from the labours of our zealous Corresponding Member Mr. George Bennett, during his late voyage to Australia, are several new or little known marine invertebrate animals, most of which were taken by means of the towing-net in the open sea, or among the gulf-weed. The value of these specimens, in a scientific point of view, is much increased, by the care with which the circumstances attending the capture of each are registered; and I now commence the fulfilment of a promise to my friend, by bringing a portion of these specimens before the notice of the Members of the Society, with such observations as seem to be worthy their attention.

The subjects at present under consideration belong to the class *Cephalopoda*: they are,

- 1st. A specimen of the *Cranchia scabra*, Leach.
- 2nd. Four specimens of a very small nondescript species of *Loligo*.
- 3rd. The head and principal viscera of a *Decapodous Dibranchiate Cephalopod*, from Port Jackson.
- 4th. Three specimens of a small nondescript species of *Octopus*.
- 5th. A very small specimen of the shell of *Argonauta hians*, Solander, with its inhabitant (*Ocythoe Cranchii*, Leach) and a large cluster of ova.

With respect to the first of these specimens, Mr. Bennett, in his Journal, remarks, "On the 1st of March, fine weather, with light and moderate trade breezes from the south-east, thermometer Fahr. 77° to 80°, latitude 12° 15' S., longitude 10° 15' W., at 8 p.m., captured, with the towing-net, several fine specimens of *Hyalæa dentata*, and two species of the *Medusa* genus; the latter are preserved in spirits (bottle No. 4, D.). One was very prettily marked with dark red spots." The specimen thus distinguished is the *Cranchia scabra*, now on the table¹; and from the uncommon form which this very remarkable *Cephalopod* presents, one cannot feel surprised that it should have been referred by its captor to a *Radiate* family, with which the *Cephalopods* bear, in more than one respect, an analogical relation.

The *Cranchia scabra* is the species on which the genus dedicated to the enterprising naturalist by whom it was first taken, was founded: it belongs to that tribe of *Dibran-*

¹ Pl. XXI. figg. 1—5.

chiate Cephalopods which have a pair of long peduncles superadded to the ordinary eight arms, and to that family of *Decapoda* in which the rudimental shell is degraded to the condition of a single horny style, lodged in the substance of the mantle in the middle of its dorsal aspect.

The principal external character which entitles *Cranchia* to rank as a genus distinct from *Loligo* and *Onychoteuthis*, is the continuation of the mantle with the dorsal parietes of the head, and a consequent interruption of its free anterior margin at that part: from *Sepioteuthis*, *Sepiola* and *Rossia*, it differs generically (according to the circumstances which modern zoologists have agreed to regard as of generic importance,) not only in the proportions and position of the pallial fins, but in the structure and connexions of the funnel; and in some points of its anatomy, as will be afterwards described. With respect to the first-named character I would however observe, that species in which the pallial fins are short and terminal in position, and which present the same condition of the internal rudimental shell, the same connections of the mantle, and armature of the suckers, should not be broken up into genera in consequence of differences in the form only of the fins, especially when unsupported by corresponding internal differences of structure; for when we compare together the different species of the uncinated *Calamaries*, which form the well-marked genus *Onychoteuthis* of Lichtenstein, we find that scarcely two species agree in the precise contour of the fins; and if we examine, with the same view, the numerous members of the group *Loligo*, as it is now restricted, we shall find several, as the *Lol. piscatorum*, Lapilaye; *Lol. Duvaucellii*, D'Orbigny; *Lol. brevipinna*, Lesueur; and especially the *Lol. brevis* of De Blainville, which closely approximate the *Cranchia scabra* in the rounded contour and dorsal position of the terminal fins; so that were it not for the difference in the connections of the anterior margin of the mantle, the latter *Cephalopod*, notwithstanding its singular form, could not be separated generically from the *Loligines* on external characters alone.

This condition of the mantle, however, has scarcely been sufficiently attended to in the subsequent location of species in the genus *Cranchia*. In M. Férussac's description of one of the most remarkable of these recent additions, *e. g.* the *Cranchia Bonelliana*¹, it is to be regretted that no mention is made of the adhesion or otherwise of the mantle to the posterior part of the head. The same doubts apply to the claims of the *Cranchia cardiptera* of Péron, and the *Cranchia minima* of Férussac, to rank in the genus in which they have been placed: in the figures given of them by Férussac, the anterior margin of the mantle appears to be free on the dorsal aspect, as in *Loligo*. In justice, however, to the lamented zoologist who first described the *Cranchia Bonelliana*, and to whom the scientific world is indebted for a most splendid monograph on *Cephalopoda*, now in progress of publication, it must be observed, that the limited nature of the observations on the characters of *Cranchia*, and the imperfection of the specimen upon which Dr. Leach

¹ *Annales des Sciences Naturelles*, tom. iii. (1835) p. 339.

founded the genus, render it a matter of difficulty and doubt to refer subsequently discovered species satisfactorily to it. The desire expressed by M. de Férussac, that additional observations should be made on the typical species, I shall therefore endeavour to fulfil to the best of my ability, from the specimen which Mr. Bennett has transmitted to me¹.

This specimen is smaller than the one described by Dr. Leach, but presents the same enlarged, expanded, flaccid bag-like form of the mantle, terminated at one extremity by a disproportionately minute pair of fins, and at the other by a head and arms of almost equally diminutive size; so that when the tentacles are retracted, as was the case in Mr. Bennett's specimen, very little of the ordinary *facies* of a *Cephalopod* is presented to the observer.

The dimensions of this specimen are as follows:

	Inches.	Lines.
From the posterior end of the body to the end of the tentacle out-stretched	1	8
_____ root of the tentacle	0	11
Length of the longest arm	0	3
_____ shortest ditto	0	1½
_____ fins	0	2
Breadth of the two united fins	0	3
Circumference of the thickest part of the body	3	0
Breadth of the head	0	3½

The body or mantle is wrinkled and flaccid, in consequence of the very small space occupied by the *viscera*; and these are situated at its anterior part, and not at the bottom of the sac, as in *Loligopsis*. It is probable that at the reproductive season the enlarged *ovarium* may fill more or less of the pallial cavity; but in the ordinary state of *Cranchia scabra* the disproportion of the mantle to the contained parts is very remarkable, and unique in the class *Cephalopoda*; but a similar disproportion between the *viscera* and *pallium* is found in some of the *Pteropoda*.

The surface of the mantle in *Cranchia scabra* is uniformly beset with small round spots,

¹ The following are the observations which M. Férussac makes on the distinguishing characters of the genus *Cranchia*:—"Pour fixer toutes les incertitudes à l'égard du genre *Cranchie*, et pour lui rapporter sans hésitation l'espèce que nous faisons connaître, il faudrait que celles qui ont été décrites par le Dr. Leach fussent retrouvées et mieux connues. Le caractère principal qui leur a été assigné consiste dans la forme et position terminales des nageoires. Sous ce rapport, ce genre se confond presque avec les *Calmarets*, mais ceux-ci en sont bien distingués par la forme de leurs bras tentaculaires. Il n'est séparé des *Calmars* que par la forme de ces mêmes nageoires, qui sont réunies à leur extrémité et semblent dépasser celle du sac. Dans les espèces que nous y rapportons et que nous avons pu observer, le port et l'ensemble des formes les distinguent bien plus encore des *Calmars*; mais nous ne pouvons faire la même observation au sujet des espèces signalées par le Docteur Leach, parcequ'il a négligé de nous donner une description complète et détaillée, reproche qu'on peut faire quelquefois à cet habile observateur sans porter atteinte à sa réputation bien acquise."—*Ibid.*, p. 346.

the dark red colour of which had changed in the spirit to a dingy brown; these spots occur also, but of more minute size, on the fins, and on the exterior of the arms and tentacles. A narrow line extends down the middle of the back of the mantle, through the whole length; this line, when viewed by transmitted light, is transparent, the parietes of the mantle being at that part extremely thin, and containing a colourless pellucid style of gelatinous consistency, pointed at both extremities, but of almost uniform breadth through the whole length, being very slightly contracted in the middle. The diameter of this representative of the *gladius* is $\frac{1}{30}$ th of an inch; its length is equal to that of the mantle.

The surface of the mantle, from which the trivial name of the present species is derived, next claimed attention; on viewing this part under the microscope, it was seen to give off innumerable small flattened processes, varying from a thirtieth to a fiftieth of an inch in breadth, and about a fiftieth of an inch in length, and terminating in two, three, or four sharp-pointed processes; these give to the outline of the mantle, under the microscope, an irregularly denticulated appearance. The surface of the skin, though generally smooth, presents several remarkable irregularities in other species of *Cephalopods*; thus it is beset with branched *papillæ* in the *Sepia papillata*, with more simple obtuse eminences in *Sepia mammillata*, with tubercles in *Sepia tuberculata*, with sharp-pointed tubercles in *Octopus aculeatus*, &c., to which the aculeated *lamellæ* of our subject make a near approach; it is highly probable that these different cutaneous processes serve to indicate to the *Cephalopods* possessing them the nature of the surfaces with which they may come in contact, and augment their sense of touch.

The terminal fins, which appear to have been lacerated in Cranch's specimen, were entire in ours; they are of a regularly rounded form, approximated on the dorsal aspect, and united at their bases, the united part extending about a line beyond the end of the mantle; they are not supported by cartilages, as in *Loligo*, but appear to be mere reduplications of the integument.

The head is principally composed of the large lateral prominent eyes; the circumference of the *cornea* is marked with a circle of closely approximated large dark spots.

The arms have the usual conical form; the first or dorsal pair is the shortest, as in most *Decapods*; the second and fourth nearly equal, and rather longer than the first; the third pair is double the length of the first.

The first, second, and third pair of arms are united at their bases by an intervening web of greater proportional extent than is usually met with in the *Decapodous Cephalopods*, and which is entirely wanting in the *Loligines*. In the *Cranchia Bonelliana* a similar web extends between the corresponding arms for full two thirds of their extent. Between the third and fourth pair of arms there is no connecting web, the interspace being occupied by the thick round stems of the elongated peduncles. All the arms are connected together by the external membranous lip, which gives off eight pointed processes; but these, instead of projecting freely, as in most of the *Loligines*, the *Sepioteu-*

this, and *Sepia*, are tied down or inserted at the internal surface of the base of each arm; the intermediate portions of the lip form an internal and smaller uniting web, of which the portions between the third and fourth pair of arms are the widest. With respect to the outer web, we may, I think, justly infer, that since in the *Octopodous* tribe of *Cephalopods* it forms, in the total absence of the mantle-fins, the sole organ of swimming, so here it is developed, though in an inferior degree, to compensate in some measure for the feeble condition of the terminal fins; and we may consequently conclude that the locomotion of the *Cranchiæ* in the watery element is principally in the retrograde direction.

The brachial suckers are pedunculate, and arranged in a double alternate series along the margin of each arm; the interspace is wider than usual, and from the semitransparency of the part in this small *Cephalopod*, the gangliated nerve which supplies the part was beautifully distinct, as seen by transmitted light under the lens, running along the centre of this part. The tentacles are relatively thicker than in any other *Decapodous Cephalopod*, forming a remarkable contrast to the extremely slender and elongated ones in the genus *Loligopsis*. The suckers, which are irregularly clustered at the slightly expanded extremities, are much smaller than those of the arms, but are also pedunculated; the extremities of the tentacles are fringed on both sides with a thin entire narrow membrane: the nerve which runs along the middle of these parts is a simple opaque chord where it is lodged in the stem, but becomes enlarged and knotty at the acetabuliferous extremity.

The mandibles were protruded in our specimen to an extent which seemed to have been produced by accidental compression. They were composed of a thin horny substance, of a brown colour, at the sharp-pointed extremities, and along the smooth trenchant margins, but elsewhere colourless. The jaws were surrounded by a thick, plicated, but not papillose, internal lip, and by the outer thin membranous fold above mentioned. The *infundibulum* was of small size, and projected in the usual situation from the mantle; it differed from the same part in the genus *Loligo*, in being obliquely truncate at the extremity, in such a direction that the dorsal parietes were folded down at this part, and overlapped the ventral, as shown in the magnified figure. On laying open the ventral parietes of the mantle, we found that the base of the funnel was not articulated by lateral moveable ball and socket joints to the internal surface of the ventro-lateral parts of the mantle, but that its ventral parietes became expanded, thin, and transparent, and were inserted into, and became continuous with, the corresponding parts of the mantle. According to Rathké, the funnel is attached in a similar manner by the adhesion of the ventro-lateral parts of its bases to the corresponding parts of the mantle in the genus *Loligopsis*. In all the other genera of *Decapodous Cephalopods* the funnel is articulated to the mantle at the exterior part of its base by two enarthrodial joints, the projection being on the mantle, and the socket on the funnel; both parts of the joint are composed of cartilage, covered by a fine smooth synovial membrane; but here we have a

singular exception to all other enarthrodial joints, for the synovial membrane does not form a shut sac, but is continuous with the mucous membrane lining the interior of the mantle. The convex cartilage is of an oval form in the *Cuttle-fish*; in the *Calamaries* (*Loligo*) it forms an elongated ridge; in the genus *Onychoteuthis* the articular ridges commence at the anterior margin of the mantle, and extend one third of the way down the sac, being formed by two thin lateral cartilaginous *laminae*, placed rather towards the ventral aspect of the mantle; an elevated groove in the corresponding side of the funnel plays upon each of these ridges; but in the genus *Loligopsis* the sides of the funnel adhere to the corresponding cartilaginous *laminae*; these which have been supposed to be anomalous and peculiar to that genus differ from the lateral cartilages of other *Decapodous Cephalopods* only in their greater length and tuberculated form. In the *Cranchia* these cartilages are entirely wanting, as in the *Octopodous Dibranchiata*.

With respect to the anatomy of the *Cranchia*, I can only state that it possesses two gills, which are provided with branchial ventricles, but that these are without fleshy appendages; and that it has two large inferior salivary glands. The decomposed state of the digestive and generative *viscera* in the present specimen prevented any satisfactory observations being made upon them.

From the preceding description it will be evident that the genus *Cranchia* differs from *Loligo* in particulars of sufficient importance to justify a generic separation, and that in the attachment of the funnel to the mantle, and in the absence of appendages to the branchial ventricles, it is allied to the genus *Loligopsis*, which it also resembles in the rounded form and terminal position of the fins. From this genus, however, it is distinguished by the adhesion of the mantle to the head, by the presence of the infundibular valve, by the comparative strength and shortness of the tentacles, and by the webs extended between the first, second, and third arms.

The four specimens of the small species of *Loligo*, which is the second on the list of Mr. Bennett's *Cephalopods*, belong to a species hitherto undescribed, and which, from the peculiar breadth of the head, I propose to call *laticeps*¹. The diminutive size of these specimens, the largest of which measures only $1\frac{1}{2}$ inch from the extremity of the mantle to the end of the outstretched tentacle, suggested at first a denomination indicative of that particular; but when we reflect that in other genera, as *Octopus*, there have been found species of still smaller dimensions than the one now described, it may ultimately be discovered, even if adult, to be not the smallest of its genus. Mr. Bennett gives the following note relative to the capture of these small *Calamaries*:—"April 5th, fine weather; wind east by north; light and moderate breezes; thermometer 68° to 72° , lat. $29^{\circ} 17'$ north; longitude $46^{\circ} 57'$ west: at noon, among a mass of 'Sargasso weed,' took, in my towing net, small *Sepiæ* of a fine purple colour with dark red spots."

¹ Pl. XXI. figg. 6—11.

The specimens now present numerous spots of a deep purplish brown colour ; according to the number and aggregation of which, the skin is darker or lighter. They occur in greatest number on the back part of the head and trunk ; are wanting on the fins, and on the under surface of the third and fourth pair of arms ; and are very sparingly distributed on the under part of the head and mantle, which are consequently of a light colour : the most remarkable disposition of the dark pigment is that which the inner surface of the 1st, 2nd, and 3rd pair of arms presents in the interspace of the suckers, where it is disposed in broad, irregularly shaped, transverse stripes, corresponding to each pair of suckers.

As the dimensions of the arms, tentacles, head, body and fins, are accurately represented in the figures (Pl. XXI. figg. 6 & 7.) subjoined, which is taken from the largest of the four specimens, they need not here be detailed.

The head is slightly compressed, but broad ; supporting anteriorly, arms which are relatively longer than in the *Calamaries* generally, the second and third pair being nearly equal to the trunk in length. Laterally the head supports a pair of large and well-developed eyes. The orifice in the integument leading to the capsule of the eye is spherical, proportionally large, as in *Loligo vulgaris*, and in the axis of vision : the *sclerotica* is perforated by a smaller aperture immediately behind the preceding, so that the capsule of the lens is immediately exposed to the external surrounding medium ; the lens is proportionally small, but attached to the ciliary body as in the *Sepia* : the *pigmentum* appeared to be disposed in thick detached portions ; it was lined anteriorly by an opaque white substance, which I conceive to be the true *retina*, although the principal expansion of the optic filaments is posterior to the pigment. The hyaloid membrane was, as usual in this class, a strong and very distinct transparent coat.

The body of the *Lol. laticeps* is subcylindrical and conical, gradually diminishing in circumference till it terminates in a point at the posterior margin of the fins, which do not extend conjoined together beyond this part, as in the *Cranchia*. The anterior margin of the mantle is free in the whole of its circumference, as in the rest of the genus *Loligo*. The muscles which connect the head to it posteriorly have their origins extended along a pair of approximate cartilaginous styles placed at the back of the neck : the anterior part of the mantle is secured by the two strong pillars of the funnel.

On the inner surface of the mantle at its ventro-lateral aspects, are situated the two elongated cartilaginous ridges, which are articulated, as in other *Loligines*, to cavities of a corresponding form at the sides of the base of the funnel. The interior of the funnel is provided with the usual valve, attached at the dorsal aspect of the canal. Two thin membranes extend from the head to the back part of the funnel. The terminal orifice of the funnel is oblique, but not to the same extent as in *Cranchia scabra* : in all the specimens I found four large spots of pigment arranged transversely below this orifice. The fins are terminal and dorsal ; a space of about $\frac{1}{3}$ a line intervenes between their origin anteriorly, whence their bases converge and are united at the apex of the trunk ;

their breadth and length are the same ; their superior contour is an obtuse angle. Their inferior margin is rounded in the *Cranchia cardioptera* of Péron, to which the species under consideration has a superficial resemblance ; the terminal fins have a semicircular contour, and their origins are widely separated anteriorly ; they also extend beyond the termination of the trunk : the trunk is broader in proportion to the head, and does not diminish gradually to a point, but is rounded off at the posterior extremity. The *Cranchia minima* of Férussac may be at once distinguished from *Loligo laticeps* by the extension of the trunk beyond the small rounded fins, which gives a trilobate contour to the termination of the body.

The *gladius* is proportionally as well developed in this small species as in the larger *Calamaries* : it commences by a firm blunt anterior extremity, about one third from which the sides begin to dilate until within the same distance from the posterior end, towards which they converge to a point : the expanded part of the *gladius* is very concave towards the *viscera*.

The mandibles have the usual form, the lower one overlapping the upper ; the dark-coloured exposed part is of greater extent than in the *Cranchia*. They are surrounded by a tumid inner circular lip, minutely plicated transversely ; the external membranous lip presents a free and slightly indented internal margin ; its external margin is produced into eight pointed processes, which, as in *Loligo todarus* and *Lol. Piscatorum*, are tied down to the inner surface of the arms, and are without rudimental suckers.

Of the arms, the 3rd pair are the longest ; the 2nd, 4th, and 1st pair successively diminish in length, but in a very slight degree. The suckers are arranged at the margins of the inner surface in a double alternate series, attached by moderately long and slender peduncles, having a lateral insertion ; the diameter of the suckers is half that of the part of the arm which supports them. In the tentacles the suckers are confined to the dilated extremities, as in *Loligo vulgaris* : they are here arranged in three or four irregular series, and present the following peculiarity :—the peduncles, which are at first filiform, dilate at their commencement, before they are attached to the sucker, like the *calyx* of a flower ; and the cavity of the sucker is continued in this dilated part (Pl. XXI. figg. 8, 10.)

With respect to the anatomy of this minute species, we cannot be surprised that it is in every respect as complex as that of the largest of the genus of which it presents all the external character : just as in the highest class of animals, the harvest-mouse exemplifies as perfectly the mammiferous type of organization as the elephant. The gills in *Loligo laticeps* are attached through their entire length by a membrane to the sides of the mantle ; the branchial hearts, to which the above connecting membranes have a relation of coexistence, are provided with small fleshy appendages, as in other *Calamaries*, and indeed as in all the *Dibranchiata* which have the funnel articulated with the mantle.

The divisions of the *vena cava*, and the extremities of the visceral veins, have thickened spongy coats, with a tolerably smooth and equal external surface : the systemic

ventricle is lozenge-shaped, and elongated in the direction of the axis of the body, but the two lateral angles which receive the branchial veins are not on the same plane, the right being most anterior. The digestive organs presented no deviation worthy of notice ; the *anus* was provided with the two small aliform valves or appendages.

The small species of *Octopus*¹ which next comes under consideration, is, like the small *Loligo* above described, an inhabitant of the Sargasso or Gulf-weed. Two specimens of this *Cephalopod* were taken on the 5th of April, and the third on the following day, in latitude 30° 31' north, longitude 44° 7' west. Mr. Bennett mentions them as "small *Sepiæ*" of a purplish colour.

The *Cephalopods* of the genus *Octopus* are generally found near the coast, where they seek their prey among the rocks, creeping on their eight legs with the body carried above or behind the head ; they are less calculated for living in the open sea than the *Decapods*, which are provided with an additional pair of fins. That singular oceanic phenomenon, the Sargasso or Gulf-weed, serves however, in place of a shore, as a resting-place to the small species now under consideration, and affords food and shelter to innumerable other curious *Invertebrata* : indeed an accurate *fauna* of this floating mass of marine vegetables would be a most interesting addition to Zoology.

The largest of the three specimens of *Octopus* collected by Mr. Bennett measured from the extremity of the sac to the end of the longest arm exactly an inch and a half, the length of the sac or body being barely half an inch. The first peculiarity which may be noticed is in the position and attachment of the eyes, which, instead of being contained in a capsule as in the common *Poulp*, project uncovered from the sides of the head in the form of large dark-coloured spherical bodies : in this structure we are reminded of the *Nautilus*, in which the organs of vision not only project from the sides of the head, but are supported on peduncles : the prominence of the eye-balls in the *Argonauta*, and still more in the *Octopus hyalinus*, is an approximation to the structure just described in the present species. Those alone, who have witnessed the persevering activity, power, and velocity of motion exercised by the *Octopus* when engaged in its destructive practices amongst a shoal of fishes, and who have seen it with its beak buried deep in the flesh of a victim held fast in the irresistible embrace of its numerous arms, in an instant simultaneously dissolve the attachment of its thousand suckers, and, disengaging itself from its prey, dart like an arrow from the net that has been cautiously moved towards it for its capture, can form an adequate idea of the acuteness of visual perception and powers of action with which this singular and unshapely *Cephalopod* is endowed.

In the present species the form of the body is ventricose, but slightly tapering to its extremity ; the mantle is connected by a broad continuation of the integument to the back

¹ Pl. XXI. figg. 12, 13.

of the head; the greatest breadth of the body is 4 lines; the breadth of the head, including the eyes, is half an inch. Of the eight arms which radiate from the anterior part of the head, the first or dorsal pair is the longest, as is the case in many species of *Octopus*; the second pair is nearly the same length as the first; the third pair, which is commonly the longest in the *Decapods*, is here scarcely half the length of the first; the fourth pair is nearly two thirds the length of the first.

The musculo-membranous web which is usually extended between the bases of all the arms in the *Octopi*, is in this species developed to the ordinary extent between the four dorsal arms only: the webs between the second and third, and the third and fourth arms are very short; that between the fourth pair is wanting. From this peculiarity I propose to name the species *Octopus semipalmatus*. The suckers are sessile, and are arranged in a double close-set alternate series on the margins of the internal surface of the arms, with a broader interspace than is usually observed (figg. 12, 13. Pl. XXI.)

The eyes are of proportionally large size, and present a dark colour, in consequence of the pigment shining through the sclerotic coat. The sclerotic is perforated by a circular aperture in the usual situation; and as the dermal *cornea*, which covers the anterior part of the *sclerotica* in the common *Poulp*, is absent in this species, the capsule of the crystalline lens is exposed, as in the *Nautilus*, to the sea-water. The funnel has the usual exterior form: it is without a valve; but at the sides of its base there is a structure approaching to the articulation by which it is united to the mantle in the *Decapodous* tribe of *Cephalopods*. Immediately above the insertion of each lateral pillar there is a small transverse crescentic ridge which rests upon a similar ridge projecting from the side of the mantle (see *a, b*, fig. 13. Pl. XXI.); neither of these prominences however is supported by cartilage, as in the *Decapoda*. In the *Octopus catenulatus* there is a similar structure, but the projection on the mantle is shorter and more prominent; in the *Argonauta* the articulation of the sides of the funnel is still more complete, and is constant in all the known species of that genus¹.

With respect to the anatomy of this small *Cephalopod* it may be observed, that in the presence of a crop, in the lateral insertion of the gullet into that receptacle, in the muscular stomach, the spiral laminated bag, and the folded intestine, it accords with the generic type of structure presented in the common *Poulp* (*Octopus vulgaris*, Cuv.). The ink-bag is similarly buried in the anterior part of an undivided large liver: the biliary ducts are without glandular appendages: the follicles appended to the branchial divisions of the *vena cava*, are elongated, and hang from the exterior of the vessels; the branchial hearts are without fleshy appendages; the *branchiæ* are connected by membranous bands to the sides of the mantle; the branchial *laminæ* present a zig-zag folding, as in

¹ The preceding examples of the infundibular joints in the genus *Octopus* diminish the value of that character as distinguishing *Ocythoe* from *Octopus*. See Dr. Leach's account of *Ocythoe Cranchii*,—Phil. Trans. 1817, p. 295.

the *Argonaut*; there are fifteen pairs in each gill. The *peritoneum*, or external membrane of the *viscera*, was remarkably mottled with large purple-red spots: I have observed the same disposition of a brown pigment on the *peritoneum* in the *Argonautæ*¹.

The pigment which gave the purplish tint to the skin when the animal was alive, appeared to have been driven from the surface; for on removing the cuticle, which was remarkably thick and elastic in this small *Cephalopod*, only some small brown spots were perceptible in the vesicular *rete mucosum*: these were aggregated chiefly on the dorsal aspect of the body and head.

As the generative organs were scarcely developed in either of the specimens, it is probable that they may not have arrived at maturity, and the species consequently may be assumed to attain a greater size than that of the largest individual in the collection, which measures only $1\frac{1}{2}$ inch from the bottom of the sac to the extremity of the longest arm. The prominence of the eyes, the structure of the funnel, the proportions of the arms, and the partial development of the interbrachial web, will however afford the means of distinguishing this species when it is again met with.

The very interesting specimen of the *Paper Nautilus*, or *Argonaut*, which forms part of Mr. Bennett's collection of *Cephalopoda*, is thus noted in his journal:—

“March 7th. Fine weather; light and moderate south-east trade breezes; therm. from 81 to 84; lat. $4^{\circ} 43'$ south, long. $17^{\circ} 37'$ west. I did not capture a single specimen with the net during the day; but at 8 p. m. I procured some small specimens of *Exocætus*, and also an excellent specimen of an *Argonauta*: on placing it in sea-water it expanded its *tentacula*, but did not attach itself to the glass, or move about. Early on the following morning I found the animal dead in the glass of sea-water in which I had placed it on the previous night, and on moving the shell to take it out, the soft parts fell out. After the animal was out of the shell, a cluster of *ova* was seen attached to the involuted part of the shell; somewhat resembling, but in the recent state more beautifully shown than in, the engraving of apparently a similar specimen in the Appendix to ‘Tuckey's Narrative of the Congo Expedition.’ On placing the shell in spirits, the cluster of *ova* floated out like a diminutive plant of a pure white colour, presenting a very elegant appearance. After being preserved a day in spirits, much of this beautiful appearance was lost. The body of the animal was of a dark reddish colour, which colour was also given to the upper part of the shell, either naturally or imparted to it by the animal; the remainder of the animal was of a dirty white with minute purplish dots; and the arms were also speckled underneath of a similar colour: the suckers were white. These *cephalopodous* animals are not (and I consider correctly) regarded as the true inhabitants of the shell, but merely parasitical inhabitants; and the animal not having

¹ A development of pigment on the serous membrane of the abdomen is observable in many fishes, and in some reptiles, as *Anguis fragilis*, *Ophisarus ventralis*, and some species of *Lacerta*, Cuv., and in *Agama atra*, where the peritoneal pigment is almost black.

the power of either producing or reproducing the shell, must be sufficient to decide that the one usually found in it, is not the original inhabitant of the shell."

With respect to the remark with which my friend concludes his observations on the present specimens, I need scarcely observe that there is no doubt that the determination of the power possessed by the *Ocythoë* of reproducing, or otherwise, the *Argonaut* shell, would be an *experimentum crucis*, and settle the long-agitated question. I do not find, however, among the notes left by Mr. Bennett in my charge, any other observations respecting the *Argonaut* than those above transcribed; and the experiments hitherto recorded touching the reproduction of the shell by the *Cephalopod* inhabiting it, have been deemed by the experimenters as proving that the shell is the veritable production of the *Cephalopod*.

The shell of the specimen under consideration belongs to the species *Argonauta hians* of Solander, and the animal is the *Ocythoë Cranchii* of Dr. Leach, so called on the supposition of its being a parasitic inhabitant. It is worthy of remark, that in the present, as in every other instance of which I have cognizance, where the *Argonauta hians* has been taken with its inhabitant, the latter has invariably presented characters as specifically distinct from those of the *Cephalopods* inhabiting the *Argonauta Argo* and *Argonauta tuberculata* as are those of the latter from each other: and the same circumstance holds good with respect to a nondescript species of *Argonaut*¹, taken by Capt. P. P. King in the South Pacific ocean; in which both the shell and its inhabitant differ specifically from the three recent species hitherto described. I am aware that it has been urged by the advocates of the parasitic nature of the *Ocythoë*, that the *Argonaut* shells taken possession of by different species of *Ocythoë* in different parts of the ocean would be most likely to be also of distinct species: but the constancy of the correspondence between the *Cephalopod* and the shell, both as to specific peculiarities and size, affords strong presumptive evidence of their relation to each other being something more than mere accidental adaptation².

¹ This species I have called, from the colour of the animal and its shell, *Argonauta rufa*.

² Since the preceding observations were written, the following facts have been added to the natural history of the *Argonaut*. M. D'Orbigny states that he has observed specimens of the *Ocythoë* in *Argonaut* shells, of which the margin of the aperture was entire, and in a membranous or soft state; whence he concludes that the shell had recently received an addition at that part, and that this addition was due to the *Cephalopod* inhabiting it. It is difficult to assent to the explanation of this fact offered by M. De Blainville*, viz. that the true constructor had been very recently expelled by the *Ocythoë*, for in that case the very delicate margins of the shell would surely have been injured by the *Cephalopod* whilst violently expelling the rightful owner, and usurping possession of the fragile shell.

Two experimenters (Madame Power and M. Rang), at different periods, and in different places, have broken and removed portions of the *Argonaut* shell while inhabited by the living *Cephalopod*, and have observed that the latter repaired the breaches by a secreted substance, not indeed similar to the originally formed shell, but which one of the experimenters, M. Rang, compares in this respect with the shelly matter secreted by the

* *Annales d'Anatomic et de Physiologie*, Mai, 1837.

The most interesting circumstance to be noted in Mr. Bennett's *Argonaut*, is its diminutive size, in connection with the large mass of *ova* which it has formed, excluded

Limaces to repair accidental breaches in their shell, and which also differs from the originally formed shell. When, however, fractures occur near the margin of the shell, they are repaired by a substance identical with the rest of the shell, as has been shown by Mr. Charlesworth*; but whether these reparations are due to the Cephalopod, or to some yet unknown *Mollusk*, can of course only be determined when the question is decided respecting the real constructor of the *Argonaut*.

The true use and disposition of the palmated arms of the *Ocythoë* have been determined and described by M. Sander Rang. The base of each of these arms passes out of the shell at the angle between the summit and auricular process of the free margin, and the membrane expands upon the outside of the shell, and meets its fellow at the flattened keel. These expansions are transparent in the living *Argonaut*, and are compared by M. Rang to the thin lobes of the mantle which the living *Cowry* spreads over its shell. Thus, when the *Argonaut* creeps at the bottom of the sea, it carries the shell above it, supporting it by means of the palmated arms, and moves along, its head being downwards, by means of the other three pairs of arms. M. Rang, who has long devoted himself to the study of *Malacologie*, and who is allowed by M. De Blainville to be 'parfaitement au courant de l'état de la question,' derives from the preceding observations a conviction that the *Ocythoë* is the true constructor of the *Argonaut*. M. De Blainville, however, sees in the palmated arms only the analogous organs of the claspers at the extremity of the tail of the parasitic *Paguri*.

I have frequently, however, seen *Paguri*, and especially young ones, in shells very disproportionate to their own size; but I have never observed an analogous disproportion between the *Argonaut* shell and its occupant. In a series of six small *Argonauts*, *Cephalopods* and shells, captured at the same time in the South Pacific Ocean, all individuals of the same species (*Arg. rufa*, O.), but all differing by slight gradations in size, and of which five are young, and without *ova*, and totally fill the shell, there is an exact accordance between the size of the shell and the size of the inhabitant; a corresponding gradation of size is maintained in both. In a series of several small and very young specimens of the *Argonauta Argo*, which I examined whilst they were temporarily deposited by Madame Power in the hands of Mr. Charlesworth, and which, from the slight difference of size, must have exhibited stages of growth differing at most by a few days only, there was the same exact correspondence between the size of the *Cephalopod* and that of its shell. Now to explain this accordance between the *Cephalopod* and shell on the parasitic theory, we must have recourse to the supposition that the *Argonauts* change their shell at very brief intervals: indeed the chief business of their lives would be in that case to hunt out, seize, and dispossess the (assumed, but yet unseen) true constructor of the shell, in order to present so constant a harmony in the relative proportion of the *Cephalopod* and shell which my observations on two series of two different species of *Argonaut* have shown to exist.

On the same occasion that I compared together the interesting series of the young specimens of *Argonauta Argo*, I examined the small vermicular bodies supposed by Madame Power to be the newly-excluded young of the *A. Argo*; these were, however, young specimens of the parasite of the *Argonaut* described by Cuvier under the name of *Hectocotylus*, which in the disposition of its numerous suckers, offers a remarkable resemblance to the arm of an *acetabuliferous Cephalopod*.

I cannot help further observing that the apparent strength of the main argument for the parasitic nature of the *Ocythoë*, is its real weakness, since it arises from a view of analogy contracted within the artificial limits of the systematist. The argument runs thus: Because the *Ocythoë* has no muscular attachment to its shell, and because it is said to leave it and return to it at will, and to have no fixed relative position (?) to the shell, and because there is no other *testaceous Mollusk* in the same predicament, therefore the occupant of the *Argonaut* shell is a parasite. But surely we are justified in extending our views of analogy in such a question beyond the limits of an artificial group, and we have not to look very far into the animal series before we find, in the *Ser-*

* Magazine of Natural History (New Series), 1837, p. 526.

from its oviducts, and attached to the shell. When first captured, the *ova* were pressed down into the back part of the shell; but upon the removal of the superincumbent weight of the animal, it would appear that their own elasticity, combined perhaps with the absorption of fluid, and the coagulation of the albumen by the alcohol, had tended to occasion their protrusion forwards.

The longest diameter of the shell is nine lines; the transverse diameter six lines: the length of the animal, from the *fundus* of the sac to the end of the longest arm (the second), one inch four lines; the length of the sac, from its *fundus* to the free margin at the base of the funnel, five lines. The funnel extends beyond the base or uniting membrane of the ventral pair of arms; it is, as in the other genera of *Octocera*, unprovided with an internal valve; but is articulated at its base by two lateral joints to the mantle. The account of this structure in the Philosophical Transactions does not convey an adequate or correct idea of what the present specimen of *Ocythoë Cranchii* presents; there appears indeed to be a typographical error in Dr. Leach's description. I find on each side of the base of the funnel, immediately above the insertion of the lateral muscular pillars, a small firm fleshy tubercle, above which there is a small depression; on the inside of the mantle immediately opposite, there is a corresponding tubercle and cavity, but their positions are reversed, the tubercle being above the cavity; thus the prominences in the funnel and mantle are reciprocally received into the opposite depressions, and the funnel and mantle are locked together by a double ball and socket joint, in the degree of apposition necessary for the complete fulfilment of the vigorous alternating muscular actions on which the respiratory function depends (*a, b*, fig. 14. Pl. XXI.)

The arms in Mr. Bennett's *Argonauta hians* were not rigidly contracted, as happens generally with those specimens which are immersed alive in spirits; but were flaccid and flexible, and well adapted for determining their exact proportions and form. The length of the first pair was nine lines; the number of suckers on each of these was thirty-six; they extend, as in *Argonauta Argo*, along the circumference of the terminal membrane, but not to the same distance. I could not trace them with the microscope further than about one third of the way down from the anterior margin of the membrane; while in *Arg. tuberculata* they may be traced along more than half the circumference of the *velum*;

pula, e. g., instances of soft-bodied invertebrates secreting as true a shell as the *calcareous Argonaut*, yet having as little of a muscular attachment or uniform position to the shell, and as much freedom of quitting their shell and returning to it, as the *Argonaut*.

With respect to another argument*, in favour of the parasitism of the *Cephalopod* of the *Argonaut*, which, from an imperfect knowledge of the circumstances attending the development of the *ova* of the *Mollusca*, was supposed to be afforded by a difference in the size of the *ova* of the *Ocythoë*, and of that which Mr. Gray regards as the *nucleus* of the *Argonaut* shell; I refer to it only because it has been adopted by M. De Blainville in his *résumé* of the *Argonaut* question as valid in favour of the parasitism of the *Ocythoë*: it has, however, since been abandoned by its promulgator, being founded on erroneous premises. (See the Magazine of Natural History, 1837, New Series, p. 247.)

* See Proceedings of the Zoological Society for September, 1834.

and in *Arg. Argo* they are visible to the naked eye, and extend round the whole of the circumference of the same part. From this disposition of the suckers it would appear as if the characteristic structure of the first pair of arms arose from their extremities being bent back upon themselves and united to the stem by means of a thin membrane. These membranes are most developed in the Mediterranean species, the *Argonauta Argo*, and have been described by naturalists and poets from Aristotle and Callimachus down to Cuvier and Byron, as serving the office of sails; the animal being supposed to have the power of rigidly extending the soft fleshy arms which support the membranes, and of maintaining the latter tensely outstretched to meet the breeze. It is scarcely necessary to observe, that the structure of the parts in question is incompatible with this hypothesis of the use of the *vela* in navigating the frail boat of the *Argonaut*¹.

In the present species the terminal membranes of the first pair of arms are relatively smaller than in *Arg. Argo* or in *Arg. tuberculata*: in the latter they are broader than they are long: in the *Argonauta hians* they present contrary proportions. In the present specimen in which the *vela* are beautifully entire, they measure from the commencement of the reflected portion of the arm, (or what would be considered as the end of the arm) to the lower margin of the web, four lines, their breadth is three lines. The length of the second pair of arms is ten lines, the number of suckers, fifty-six; the length of the third pair eight lines, number of suckers fifty-two; the length of the fourth pair seven lines, the number of suckers twenty-eight.

Dr. Leach observes, in his description of *Ocythoe Cranchii*, that "all the internal organs are essentially the same as in the *Polypus*." (*Octopus* of Cuvier, loc. cit., p. 294.) We found, however, that the *Argonauta hians*, like the *Argonauta Argo*, receded from the naked *Octopods*, *Octopus* and *Eledone*, and approached the *Decapods* in the structure of the branchial hearts, which are provided with a fleshy appendage; and in the form of the appendages to the *vena cava* which are shorter and thicker; and in the relative position of the lozenge-shaped *ink-bag*, which is not buried in the substance of the liver, but lies in its anterior concavity. The inferior salivary glands are also relatively smaller.

The following differences, as compared with the *Octopus*, occur in other internal organs which adhere to the type of structure which characterizes the *Octopodous* tribe of *Dibranchiata*. The crop increases in width as it approaches the stomach. The laminated pancreatic bag is of a triangular form, and not spirally disposed; the two simple biliary ducts enter at its apex. The two oviducts are devoid of the circular laminated glands which surround them about the middle of their course in the *Octopus*; they are also disposed in four or five convolutions as they pass behind the roots of the *branchiæ*, and they terminate at a greater relative distance from the base of the funnel.

¹ Since the above was written, it has been ascertained by direct observation, that these *vela*, or rather *velamenta*, have not only a relation of coexistence, but one of direct physiological import, to the development of the shell in the *Argonauts*, serving as the organs both of secreting and of retaining this part. See the observations of M. Rang, *Comptes Rendus de l'Acad. des Sciences*, Avril 24, 1837.

The affinity of the *Argonauta* to the *Decapodous Cephalopods* is further indicated by the inferior development of the mediastinal *septum* which divides longitudinally the branchial chamber. This *septum* in *Eledone* is complete and muscular throughout, excepting a very small proportion of its inferior part. In the *Octopus*, in which this *septum* is well described and figured by Cuvier, as the "*bride antérieure qui lie la bourse à la masse viscérale*," a greater proportion of the lower part is membranous than in *Eledone*. In the *Argonauta* the muscular part of the *septum* is reduced to two narrow and delicate strips, which arise from the posterior part of the cranial cartilage, descend obliquely forwards, intercept the termination of the *rectum* and ink-passage, to which they serve as a sphincter, and then expand in the vertical direction, to be inserted along the middle line of the internal surface of the anterior part of the mantle: a membrane is continued from their upper part to within a short distance of the margin of the mantle; and another from their lower part extends downwards, and terminates opposite the base of the gills; the branchial chambers intercommunicate both above and below this *septum*. In *Sepiolo* the muscles corresponding to the *bride antérieure* of the *Octopus* are developed in the same degree as in the *Argonauta*; but the membranous part of the *septum* above them is wanting, while that which is continued from their inferior margins is more complete. In the *Calamaries* both these muscles and the *septum* of the branchial chamber are wanting.

With respect to the nervous system of the *Argonauta*, I find in a large specimen of the *Argo*, that the brain, when viewed from the superior or dorsal aspect, presents, as in *Octopus*, an anterior, white, flattened, transversely oblong band, and a posterior raised convex semilunar mass, which terminates by a semicircular border *posteriorly*, the extremities of which are directly continued, to form or join the posterior nervous collar of the *œsophagus*. The great lateral nerves of the mantle come off from the posterior subœsophageal mass, precisely as in *Octopus*; and instead of extending down in a parallel direction as low as the roots of the gills, as represented in the splendid figure by Delle Chiaie¹, they diverge, penetrate the short muscles, analogous to the *brides latérales* in the *Poult*, and terminate in the stellated ganglions opposite the upper extremities of the gills, and immediately below the base of the funnel: by some unaccountable error, these nerves, in Delle Chiaie's figure, which some of our compilers have copied, are made to come off from the optic ganglions. The lateral muscles above mentioned are the analogues of the great shell-muscles of the *Nautilus Pompilius*; they are more strongly developed in *Loligo* and *Sepia* than in *Octopus*, but have the same origin in each, the same attachment to the capsule containing the rudimental shell, and are always perforated by the great lateral nerves of the mantle: they are perforated by the corresponding divided and ungangliated nerves in the *Nautilus*, in which these muscles acquire the *maximum* of development. In the *Argonauta*, which has no muscular attachment to its shell, and has no internal *testaceous* rudiment, the corresponding

¹ Poli, *Testacea Utriusque Sicilia*, vol. iii. pars 1^{ma}, posthuma, 1826.

muscles have the smallest development, and the mantle-nerves which perforate them are, prior to the formation of the ganglion, relatively the shortest that are met with in the *Dibranchiate* order.

I carefully examined the *ova* of Mr. Bennett's small specimen, but obtained no results bearing upon the interesting question before alluded to, the development of the *embryo* not having proceeded to the degree necessary for the appearance of the shell, supposing it to be formed *in ovo*. The observations recorded in the 'Philosophical Transactions,' by Mr. Bauer (1817), and in the 'Zoological Journal,' by Mr. Broderip, (vol. iv. p. 57.) are, for the same reason, inconclusive as to this point.

The *ova* of the *Argonauta hians* were nearly of the same size as those of the *Arg. Argo* at a similar stage of development, viz. $\frac{1}{25}$ th inch in length, and $\frac{1}{35}$ th in diameter; but they are of a more regular oval form, not tapering to the end opposite the attachment of the peduncle. Examined with transmitted light, they are composed of an exterior, smooth, colourless, transparent, tough, elastic, cortical tunic; next of a more delicate membrane (the *chorion*), containing a straw-coloured transparent *albuminous* fluid: in this fluid there was an irregular mass of semi-opaque granules, in which was imbedded an opaque dark vitelline body, surrounded by a membrane and pellucid fluid. The form and proportion of the opaque vitelline body and its transparent investing membrane varied in size and shape in different *ova*: I have carefully figured one of the most remarkable in this respect (fig. 15), in which for a moment I entertained the exhilarating idea, that the *nucleus* of the real shell was contained within it: on tearing open the external tunic, however, the contained substance turned out to be nothing more than the yolk, separated by an intervening stratum of clear fluid from the transparent *membrana vitelli*, and the whole substance of the opaque mass separated into the flakes, granules, and globules of oil, of which the *vitellus* is usually composed: there was not a trace of any consistent parts of an *embryo*, nor the slightest particle of calcareous matter.

The mutilated *Decapodous Cephalopod*, obtained at Port Jackson, New South Wales, and transmitted to me by Mr. Bennett, consisted only of the head and principal *viscera*, and was consequently too imperfect to allow of its being satisfactorily determined, even as to its genus. But as the suckers were arranged in a double alternate row on each of the short arms, it was evidently not a *Sepia* of Cuvier, while the denticulated margins of the horny rims of the suckers show that it may have belonged either to the genus *Sepioteuthis*, Fér., or *Loligo*, Cuv. As in some species, both of *Sepioteuthis* and *Loligo*, the outer lip gave off eight short processes, on the inner surface of which, near their extremity, were three or four small suckers, attached by peduncles, and having precisely the same structure as those of the eight large exterior arms. In this repetition of the ordinary series of cephalic prehensile processes, we may perceive an evident analogy to the internal series of processes (labial tentacles) which exist in the *Nautilus*. In some species of *Calamary*, indeed, as in the *Loligo Pealii*, Le Sueur, the acetabuliferous labial

processes are more developed than in the present specimen from Port Jackson. In *Loligo corollifera*, Tiles, these labial processes have been compared by Bojanus to the internal shorter series of tubercles of a *Medusa*. But this structure illustrates only in a very remote degree the relation of analogy subsisting between the *Cephalopods* and *Radiaries*.

The structure of the tongue, *pharynx*, and glandular appendages, presented nothing remarkable. The *œsophagus* was slender, and continued of uniform breadth, as in the *Decapods* generally, to the stomach, which presented the usual gizzard-like structure. In the *Octopods*, as in the *Nautilus*, the *œsophagus* dilates into a crop¹.

The *rectum* in this *Cephalopod* was furnished with two lateral processes (fig. 16. pl. XXI.), of a flattened triangular form, and evidently adapted to constitute a valvular apparatus for the protection of the anal aperture. They are attached at opposite sides of this transversely extended orifice by their acute angles, from which a ridge is extended to the middle of the opposite base, so that when the valves are folded down upon the vent (as in the figure above the number of reference,) the ridges fit into the aperture, and accurately close it. In the *Cuttle-fish* (*Sepia officinalis*, Linn.) the corresponding processes are of a rhomboidal form, with a thicker ridge on the side next the anal aperture, which they are thus adapted to defend against any foreign substances which may obtain entry into the pallial cavity. In *Onychoteuthis* and in *Loligopsis* the anal appendages are long and slender: in the latter genus Rathké² compares them to *antennæ*; and since in these *Cephalopods* they cannot act the part of mechanical guards, it may be inferred that they perform the function of instruments of sensation, and convey the stimulus to contract, to the muscular sphincter which closes the outlet of the alimentary canal. It is interesting to notice the relation of coexistence which these appendages bear to the lateral fins; for they are only present in those *Cephalopods* which have the power of propelling themselves forward, and in which their use is therefore obvious, as the orifices of the branchial cavity, in which the intestine terminates, are directed forwards. In the *Octopods* the *anus* is not provided with these appendages.

Of the remaining *viscera* of the *Decapod* in question I have only to notice the reproductive organs: these were of the female sex, and exhibited the *ova* both in the ovary, where they were inclosed in reticulate *calyces*, as in most *Cephalopods*, and in their passage through the oviduct, where the *ova* show the true character of their external surface, which is perfectly smooth and polished³.

¹ It is evident from this difference of structure in the two groups of *Dibranchiata*, that Aristotle took his excellent description of the digestive organs of the *Malakia* either from a *Sepia* or *Teuthis*: he says, "Μερὰ δὲ τὸ στόμα ἔχουσιν οἰσφάγον μακρὸν καὶ στενόν, ἐχόμενον δὲ τούτου πρόλοβον μέγαν καὶ περιφερῆ ὀρνιθώδη."—*Hist. de Anim.*, lib. iv. c. 19.

² *Mémoires de l'Acad. Imp. de Petersburg*, tom. ii. (1833), p. 169. 'Ueber *Perothis*,' &c.

³ I am not aware of any modern account of the mode in which the *ova* of the *Cephalopoda* are impregnated, taken from actual observation. Aristotle, whose *History of Animals* is still the richest in details of the habits

The female organs of generation in the *Cephalopodous* class present five principal modifications of structure. The *ovarium* is single in all, but sometimes, as in the *Cuttle-fish*, it is divided by a *septum*.

1. In the *Nautilus* there is one oviduct, which traverses an elongated gland at its extremity: there is also a superadded nidamental gland, which has no connection with the oviduct, but is attached, as in the *Pectinibranchiate Gastropods*, to the parietes of the branchial chamber.

2. In *Sepia*, *Sepiola*, *Rossia*, *Sepioteuthis*, and some species of *Loligo*, there is also one oviduct with a glandular termination; but the nidamental glands are two separate bodies, detached from the mantle, and having no communication with the oviduct.

3. In *Onychoteuthis*, *Loligo sagittata* and some other *Calamaries* there are two distinct oviducts, each terminated by a glandular organ, and also two separate nidamental glands.

4. In the *Octopi* and *Eledonæ* there are two oviducts, each of which traverses a glandular organ, situated about the middle of its course: there are no detached nidamental glands.

5. In the *Argonaut* the two oviducts are convoluted, and have glandular coats throughout their extent, but without partial enlargements: there are no separate nidamental glands.

and æconomy of the *Cephalopods*, gives two descriptions of the act of impregnation. In the fifth book of the *Historia Animalium* it is stated that the *Polypus* (*Octopus* or *Poulp*), the *Sepia* (*Cuttle-fish*), and the *Teuthis* (*Calamary*), all copulate in the same manner; the male and female having their heads turned towards one another, and their cephalic arms being so coadapted as to adhere by the mutual apposition of the suckers. In this act the *Poulps* are described as seeking the bottom, while the *Cuttles* and *Calamaries* are said to swim freely about in the water, the individual of one sex moving forwards, the other backwards. Aristotle also observes, that the *ova* are expelled by the funnel, which the Greeks call *φυστηῖρα*; and some, he adds, assert that the *coitus* takes place through this part. From the position of the terminal orifice of the oviduct at the base of the funnel, and the inclination of the *penis* towards the same part, the latter supposition derives some probability, especially with respect to the *Sepia* and *Sepioteuthis*, in which the male organ is well developed; but in these, as in all other *Cephalopods*, true intromission is physically impossible. From the dense nature of the external covering which the *ova* derive in their course along the efferent passages, it is very improbable that they can be impregnated otherwise than internally, and before the nidamental covering is laid upon the thin smooth chorion which invests the *ovum* externally, prior to its escape from the oviduct: the descriptions of Aristotle may therefore relate to some such imperfect connexion as takes place in the *Salamanders*, &c. It is worthy of remark, indeed, that the differences in the situation in which the *coitus* is said to take place in Aristotle's description corresponds with the modifications of the locomotive powers in the three genera treated of. It is only, for example, in the *Sepia* and *Loligo* that posterior fins exist, enabling the individuals to swim forwards. The second account of the impregnation of the Malakian *ova* occurs in the 12th Chapter of the 8th Book of the *Historia Animalium*, where the generation of fishes is treated of. "When they (fishes) bring forth, the male, following the female, sprinkles the *ova* with his *semen*. The same thing happens to the *Malakia*, for in the genus *Sepia*, wherever the female deposits the *ova* the male follows and impregnates them: this possibly happens in like manner to other *Malakia*, but hitherto it has been observed in the *Sepia* alone." The *ova* of the *Sepia*, however, are precisely those which, of all *Cephalopods*, from the density and thickness of their coats, are the least likely to receive the impregnating influence after having been excluded.

The *Decapod* here described presented the second type of the generative organs. The *ovarium* was of an elongated form, and of great extent; it was filled with reticulate ovisacs, containing *ova* in all stages of development, and must have occupied nearly the whole of the posterior half of the abdominal cavity. The single oviduct came off from the middle of the left side of the ovary, and descended obliquely to the bottom of the ovary, where it was dilated by a cluster of smooth and polished *ova*; it was then bent suddenly upon itself, and near the anterior extremity of the ovary entered the terminal gland, which was expanded at its commencement, and after suddenly contracting, gradually tapered to its free extremity. The *ova* presented an oval form, and were three lines in length. The first or membranous portion of the oviduct had thin, semitransparent, and very dilatable coats. The two detached nidamental glands were of a longer and narrower form than in the *Sepia*, but thicker, and of greater relative size, than in the *Loligines*. They presented the usual transversely laminated structure and anterior longitudinal fissure, in which the glutinous secretion is moulded into the thread-like form, adapted to connect the *ova* together as they escape from the true oviduct, with which these glands have often been confounded. But besides the above parts, which are evidently subservient to the generative function, I found two small, round, flat, fleshy bodies attached to the anterior extremity of each of the two nidamental glands. They had no cavity, and were destitute of any duct or outlet, and had no other connection with the nidamental glands than by the cellular tissue. Their texture was compact, with a few minute cellular cavities about the centre: they were of an orange colour. In the *Cuttle-fish* there is a corresponding body, similarly situated, but single and trilobate, consisting of two lateral slightly compressed conical portions, united by a middle oval lobe (see fig. 19. pl. XXI.). The dorsal surface of the lateral lobes is flattened; the opposite side excavated to receive the superincumbent extremities of the ovarian glands: to these glands the trilobed body is attached by a tough connecting membrane. On making a section of a lobe of the body in question (as in fig. 20.), its texture appears to be dense, and somewhat granular, with minute cells at the centre, which contain a caseous substance. In *Sepiola* the corresponding body is single, as in the *Sepia*, and is similarly attached to the anterior extremities of the nidamental glands. In the *Loligines*, and in the *Cephalopod* taken by Captain Ross on the shore of Boothia, and which, being the type of a new genus, I have described under the name of *Rossia*¹, there are two fleshy bodies, as in Mr. Geo. Bennett's *Cephalopod*. Each body in *Rossia* (see fig. 18. *h h* pl. XXI.) is attached by cellular tissue to the anterior part of the corresponding nidamental gland (*g g*), and is excavated by a deep groove, situated close to the aperture of the gland. From this structure, and the position of the glands, we might infer that they assisted in moulding the nidamental secretion, or in applying it to the *ova*.

If we take into consideration the texture of these enigmatical and hitherto undescribed

¹ Zoological Appendix to Capt. Sir John Ross's Voyage.

bodies¹, their bright colours, and their relative position to the generative apparatus, we may perceive an evident analogy between them, and the *corpora succenturiata*, or suprarrenal bodies of the vertebrate animals.

The preceding dissections, combined with those which I have made from time to time on other *Cephalopods*, belonging to the genera *Sepiola*, *Rossia*, *Loligo*, *Onychoteuthis*, *Sepia*, *Octopus*, *Eledone*, *Argonauta*, and *Nautilus*, have, in connection with physiological views, suggested ideas of the natural affinities and formation of the different groups of *Cephalopods*, which differ in some respects from those expressed in the previous classifications of these highly organized invertebrate animals; and I am induced to offer them to the consideration of zoologists, as they appear to me to be more in accordance with the best principles now recognised in the subdivision of other *molluscan* classes.

The systems of classification of the *Cephalopods* existing in the best works of the present day differ from each other in some material points. In one, e. g., no characters of ordinal importance are recognised; but the class is immediately subdivided into several minor groups, of the value of tribes or families: in other classifications, where a primary division of the class into two or three orders is adopted, the characters are derived sometimes from modifications of the locomotive organs, but more frequently from different conditions of the shell: and one can scarcely suppress a feeling of surprise that the modifications of the tegumentary system, the low relations of which are so generally recognized in the subdivision of other classes of *Mollusca*, should be adopted for the classification of the *Cephalopods* by so many systematic writers of authority on *Malacology*.

Lamarck (*Philosophie Zoologique*, 1809,) divides the *Cephalopods* into three orders; first, into those which have a multilocular shell; second, those which have a unilocular shell; and third, those which are without either.

It is obvious also that the modifications of the dermal system mainly govern the distributions of the *Cephalopoda* in both editions of the *Règne Animal* of Cuvier. In the edition of 1817 the *Naked Cephalopods* or *Seiches* constitute the first family, to which the *Nautili*, *Belemnites*, *Hippurites*, *Ammonites*, *Camerines*, and even the *Argonauts*, are severally regarded as equivalent groups. In the edition of 1829 considerations of the affinities indicated by internal organization prevail so far as to lead to the suppression of the group of *Argonauts*, and its union with the *Seiches*. The other modifications consist of the additions of families, including the later discovered chambered shells presenting new modifications of structure, such as the *Actinocamax* of Miller, and the *Camarines*, or microscopic chambered shells.

In 1821 Mr. Gray² proposed a classification of the *Cephalopods* in which a primary division into three orders was distinctly recognised, and names applied to them indi-

¹ Cuvier makes no mention of them, and they appear by subsequent anatomists to have been confounded with the nidamental glands.

² London Medical Repository, 1821.

cative of modifications of the shell, which he terms 'Protector'. The *Seiches*, or *Naked Cephalopods* of Cuvier, are subdivided into two orders, of which the first, under the name of *Anosteophora*, corresponds with the *Poulpes* of Cuvier, and with the *Octopoda* of Dr. Leach's arrangement of 1817, presently to be noticed; while the second order, *Sepiophora*, is equivalent to the *Decapoda* of Leach, or to the remaining *Seiches* of Cuvier's system. All the *Cephalopods* with chambered shells are collected together into a third order, under the name of *Nautilophora*.

The reformed classification of the *Cephalopoda* contained in the *Malacologie* of M. De Blainville (1825)¹, though much more truly expressive of the natural affinities of its objects than that proposed by Mr. Gray, still reposes on the insecure basis of tegumentary modifications. The whole of the *Seiches* of Cuvier are here raised to the rank of an Order, under the name of *Cryptodibranchiata*; and the author, guided by the knowledge of their internal organization, rightly uses the characters derivable from the modifications of their internal shell, as indicative merely of the subdivisions of this order. M. de Blainville made also another important step in advance, by separating the *Cephalopods* with microscopic chambered shells, under the name of *Cellulacea*, from those with *siphonated* shells, which he terms *Polythalamacea*. Subsequent researches have since proved that the *Cellulacea* of M. De Blainville ought to be removed altogether from the class *Cephalopoda*. The classification of the *Cephalopods* adopted by M. Férussac in the great work still in progress of publication is essentially the same as regards its primary divisions as that of M. de Blainville, but the nomenclature of M. D'Orbigny is preferred. All the *Cephalopods*, e. g., without chambered shells, form the first order, under the name of *Acetabulifères*; all those having *siphonated* chambered shells form a second order, termed *Siphonifères*; and the *non-siphonated* microscopic chambered shells constitute a third order, under the name of *Foraminifères*.

Now in consequence of the subordinate character on which all the preceding classifications are founded, there is a violation of natural affinities in the formation of the primary groups. The genus *Spirula*, e. g., as well as the *Belemnites*, and other congeneric extinct *Cephalopods* with internal chambered shells, are united, solely on account of the polythalamous structure of their shell, with *Cephalopods* of an inferior grade of organization, as the *Nautilites*, while they are separated from those which possess the *dibranchiate* or higher type of structure,—a type of structure which the laws of coexistence all but demonstrate to have been exemplified in the *Cephalopods* with internal chambered shells, first quoted, viz. *Spirula* and *Belemnites*.

The natural affinities of the *Cephalopods* seem to have been still less regarded in that distribution of the species in which the *Dibranchiate Decapoda* are joined with all those *Cephalopods* possessing chambered shells in one primary division of the class, which M. de Haan² terms *Adherentia*; and in which the *Dibranchiate Octopoda* are raised to

¹ In 1815 this author proposed a binary division of the *Cephalopods*, which he preferred to term *Cryptodibranches*, into *Cryptodibranches nus* and *Cryptodibranches testacées*.—*Journal de Physique*, t. lxxxiii. p. 244.

² *Monographia Ammoniteorum*, &c., 8vo, 1825.

the rank of an equivalent section, under the name *Libera*. The primary division of *Cephalopods*, proposed by M. Deshayes¹, into the two orders *Octopodes* and *Decapodes*, is essentially the same as that of M. De Haan, as the latter group combines the naked or *dibranchiate* species with the *Nautilacea* of De Blainville.

Thus it will be seen that most of the preceding schemes are based on the modifications of the shell or its analogue, and some of them, as that proposed by M. Férussac, have been published since the modifications of structure in those *Cephalopods* which inhabit an *external* chambered shell have been pointed out. It is this circumstance which has chiefly induced me to state here my views of the distribution of the *Cephalopods*, founded in part on the dissection of the *Nautilus Pompilius*, and on a comparison of its organization with that of the *Cephalopods* with *internal* shells, so far as indications of their structure can be obtained from the hitherto imperfect descriptions of the recent *Spirula*, and from the remains of the *Belemnites*. But before I proceed to detail these views I shall briefly adduce the few examples of the classification of the *Cephalopods*, in which an attempt is made to distribute these highly organized *Mollusks* into groups founded on considerations of structure of higher importance than tegumentary or testaceous characters.

The first classification of this nature is due, as might have been expected, to a highly accomplished classical Naturalist, well versed in the zoological writings of Aristotle. This Naturalist, Schneider, to whom we owe the best translation of the 'Historia Animalium,' is the first of the moderns who attempted to revive the philosophical views which guided the Father of Natural History in his distribution of the *Malakia* or *Cephalopods*. For this group of *Cephalopods* Schneider proposed the name of *Octopodia*, comprehending therein the species in which two superadded elongated slender arms are present, but which were distinguished by Aristotle from the ordinary eight arms, under the name of 'Proboscides.' Schneider² divides the class into two groups, which are characterized as follows:—

1. *Pedes octoni breves, promuscides binæ, venter pinnatus, ossiculum dorsi.* Ex. *Sepia, Loligo, Teuthis*, &c.

2. *Pedes octoni longi basi palmati, absque promuscidibus, pinnis et osse dorsali.* Ex. *Polypus, Moschites, Nautilus* (or *Argonauta*); and indicates a third, founded on Rumphius's description of the *Nautilus Pompilius*, with the following character: *Pedibus lobatis, seu digitatis absque acetabulis.*

The classification proposed by Dr. Leach³, which in one respect is inferior to Schneider's, is also essentially based on the modifications of the organs of locomotion. In this scheme Dr. Leach leaves entirely out of consideration the *chambered* shells, and apparently restricts the class *Cephalopoda* to the *naked* species. These he divides into two

¹ *Encyclopédie Méthod.* 1830.

² *Sammlung Vermischter Abhandlungen der Zoologie*, &c., 8vo. 1784.

³ *Zoological Miscellany*, vol. iii. 1817.

orders, according to the number of cephalic appendages, the presence or absence of palial fins, and the connexions of the mantle to the neck.

The same principles are adopted in the present classification of the *Cephalopods* in our National Museum; a third order being added to the *Octopoda* and *Decapoda* of Leach, corresponding with the *Polythalamacea* of M. De Blainville, and characterised, according to the structure of the *Nautilus Pompilius*, by many short arms destitute of suckers. Weigman, also, in his *Handbuch der Zoologie*, (1832,) makes each of the two divisions of Leach's *Cephalopods* equivalent to the *Polythalamacea* of De Blainville, which he terms *Nautilacea*.

But the general organization of the *Octopodous* and *Decapodous Cephalopods*, and especially their respiratory and circulating systems, correspond so closely, and both at the same time deviate so widely from the condition of the corresponding systems in the genus *Nautilus*, that the inequality of the value of the three *primary* divisions of the *Cephalopods* adopted in the synopsis of the British Museum must be obvious: characters, moreover, taken from modifications of the locomotive and prehensile organs alone, or associated with such minor particulars of organic structure as are applied by Dr. Leach in his subdivision of the *Naked Cephalopods*, can only be viewed as indicative of secondary subdivisions of the class.

A mature consideration of the relations subsisting between the modifications of the *Cephalopodic* type of structure presented by the *Pearly Nautilus*, and the *siphonated* chambered shell, has led me to perceive that the presence of a *siphonated* chambered shell of itself is not a character of ordinal importance: the organic conditions which may justly be regarded as indicating ordinal distinctions relate rather to the amount of development of the chambered shell, and to its relative position, either as protecting, or protected by, the soft parts of its fabricator. Where the chambered shell is limited to its hydrostatical functions, and is buried, like an air-bladder, in the interior of the *Cephalopod*, and is no longer subservient to its defence, we may infer that an ink-bag will be superadded to compensate for the absence of a large defensive case; and, at the same time, that the relief from the incumbrance of a shell so developed will be accompanied by an increase of locomotive powers, demanding those modifications of the respiratory and circulating functions which are undoubtedly of ordinal importance.

Now as the *Nautilus Pompilius* presents an inferior or subdivided type of the respiratory organs, and as the function of respiration in this species has not the advantage of those superadded hearts for accelerating the course of the venous blood through the gills which the naked and more active *Cephalopods* possess, and as these most interesting physiological modifications are related to the size and external position of the shell, I feel myself justified in grouping with the family represented by this existing *Siphoniferous* species, the extinct *Orthoceratites*, *Ammonites*, and all other *Siphonifera* of which the soft parts were, in like manner, contained in and protected by a chambered shell. To the group thus characterised I have applied the term *Tetrabranchiata*, derived

from the number of the gills in the *Nautilus*¹. The *Cephalopods* with internal chambered shells, heretofore classed with the *Siphoniferous Cephalopods* which constitute the preceding order, I would join with all the other *Naked Cephalopods*, to form a second order, under the term *Dibranchiata*², having reference to the number of gills, viz. two. This number is constant in all the '*Seiches*' of Cuvier, and is associated with the presence of two-branchial hearts, besides the single systemic heart, and with an ink-bag: there can be little doubt that the same type of structure is exemplified in the *Spirula*, from what has been determined respecting its external characters³.

The subdivision of the *Tetrabranchiata* must necessarily be determined by the modifications of the shell and calcareous parts of the beak, since, excepting in one genus, no other parts of the animals now remain for the study of the naturalist. With reference to the higher or *Dibranchiate* order, as extended by the admission of the *Spirula* and *Belemnites*, we may with propriety adopt the character afforded by the number of cephalic arms as indicative of a *primary* subdivision, and include the *Dibranchiates* having internal chambered shells, with the *Calamaries* and *Cuttle-fishes* in a tribe called *Decapoda*, or those which have two long peduncles superadded to the eight ordinary arms. The character afforded by the internal chambered shell seems hardly of sufficient value to separate the *Cephalopods* having that part, as a third tribe distinct from the ordinary *Decapods*; for the difference is at least as great between the minute horny style of the *Sepioida* and the *sepium* of the *Cuttle-fish*, as between this latter and the internal calcareous apparatus of the *Belemnite*. Moreover, Lamarck's figure and the descriptions of the *Spirula* demonstrate so close a resemblance between its locomotive organs and those of the *Cuttles* and *Calamaries*, as to afford additional reasons for not placing them further apart than as families in the same tribe.

The tribe *DECAPODA* of the *Dibranchiate* order of *Cephalopods* may be subdivided into four families. Of these the *Spirulidæ*, represented by the *Spirula australis*, Lam., must be regarded as next in the order of affinity to the *Tetrabranchiate* group. The *Belem-*

¹ Memoir on the *Pearly Nautilus*, 1832, p. 56.

² The introduction of these new words for the primary divisions of the *Cephalopods* into a science already overloaded with Greek compounds, requires perhaps some apology or explanation.

The groups which the terms *Dibranchiata* and *Tetrabranchiata* respectively indicate are not equivalent to the orders or primary divisions in any previous classification of the *Cephalopods*, and I could not, therefore, have adopted the ordinal names of my predecessors without the hazard of ambiguity or error.

The order *Dibranchiata*, e. g. differs from the *Cryptodibranchiata* of M. De Blainville, and from the *Acetabulifera* of M. D'Orbigny, in the addition of the families *Spirulidæ* and *Belemnitidæ*; and my *Tetrabranchiata* differs from the *Polythalamacea* and the *Siphonifera* of the same authors, in the absence of those genera in which the chambered and *siphonated* shells are internal. Under these circumstances, therefore, where a presumed deeper insight into the organization and affinities of a class of animals leads to an actual modification of its subdivisions, new terms for such modified groups seem preferable to the risk of confusion which would arise from applying the same name to two different collections of objects.

³ The discovery by Dr. Buckland, of the remains of the ink-bag in the extinct *Belemnites*, justifies the conclusion from the laws of coexistence, that these *Cephalopods* also possessed two gills and two branchial hearts.

nitida, including the genera *Belemnites*, *Actinocamax*, *Pseudobelus*, &c., offer the transition from the *Spirulida* to the *Cephalopods* in which the internal shell is still calcareous, but in which the traces of the camerated structure become very obscure. Such is the condition of the shell in the *Sepiada*, or third family, represented by the common *Cuttle-fish* (*Sepia officinalis*, Linn.). Besides the character derivable from the modifications of the shell, the species hitherto observed of this family present lateral fins, extending the whole length of the mantle; and the marginal horny lining of the suckers is entire, or only minutely denticulated; but this latter is a character rather of generic than of family importance.

The fourth family of *Decapodous Dibranchiata*, I propose to term *Teuthida*, from the name *τευθω*, applied by Aristotle to the *Calamaries* or typical genus of the family. The principal character of this family reposes on the horny condition of the shell, the rudiment of which exists as a single *lamina*, more or less developed, and encysted in the substance of the dorsal aspect of the mantle: the form of the body in this family is mostly elongated and cylindrical, and the pallial fins are generally broad, shorter than the body, and terminal. The genera included in this family may be arranged in two groups, according to the structure of the funnel. In section A, or those in which the funnel is articulated at its base to two internal ventro-lateral cartilaginous prominences of the mantle, may be ranked the genera *Sepioteuthis*, Bl.; *Loligo*, Cuv.; *Onychoteuthis*, Lichtenstein; *Rossia*, Owen; *Sepiola*, Leach. In all these genera, moreover, the funnel is provided with an internal valve. In section B, or those in which the funnel is adherent at the ventro-lateral parts of its base to the mantle, may be ranked the genera *Cranchia*, Leach, and *Loligopsis*, Lam. The latter genus, besides the common absence or loss of its superadded tentacles, manifests an affinity with the *Octopodous Dibranchiates*, in the absence of the valve of the funnel; and in both genera the transition to the same group is indicated by the absence of the fleshy appendages to the branchial hearts.

The uninterrupted continuation of the mantle with the posterior part of the head or neck, and the confluence of the pallial fins at their posterior extremities, which Dr. Leach uses as family characters, are indicative of generic distinctions only: the proportional length of the arms is even of still less importance.

The tribe OCTOPODA, besides the absence of the long peduncles, is characterised by the absence of the pallial fins, and infundibular valve. I subdivide this tribe into the families *Testacea* and *Nuda*. Of these the first is represented by the genus *Argonauta*, and its affinity to the *Decapodous* group is manifested by the presence of appendages to the branchial hearts, and by the ball and socket articulations of the funnel. The first or dorsal pair of arms support membranous expansions for secreting, repairing, and retaining the shell.

The naked *Octopods* have all or part of the arms connected at their bases by a broad web; the first pair being elongated, and gradually diminishing to a point. The funnel

is generally attached to the sides of the mantle; the branchial hearts are without fleshy appendages; the biliary ducts without follicular appendages; the shell is represented by two short, brittle, horny or gelatinous styles, encysted in the dorso-lateral parts of the mantle. This family includes the genera *Octopus*, Leach, and *Eledona*, Leach. The following is a tabular view of my classification of the *Cephalopods* :—

Classis.	Ordines.	Tribus.	Familia.	Genera.
CEPHALOPODA.	DIBRANCHIATA	OCTOPODA	<i>Nuda</i>	{ <i>Eledona</i> .
			<i>Testacea</i>	{ <i>Octopus</i> .
	DECAPODA	TEUTHIDA	a. <i>Teuthida</i>	{ <i>Argonauta</i> .
				{ <i>Bellerophon</i> , &c.
				{ <i>Loligopsis</i> .
				{ <i>Cranchia</i> .
CEPHALOPODA.	TETRABRANCHIATA ¹	DECAPODA	b. <i>Teuthida</i>	{ <i>Sepiola</i> .
				{ <i>Rossia</i> .
	TETRABRANCHIATA ¹	DECAPODA	<i>Sepiadae</i>	{ <i>Onychoteuthis</i> .
				{ <i>Loligo</i> .
				{ <i>Sepioteuthis</i> .
				{ <i>Sepia</i> .
CEPHALOPODA.	TETRABRANCHIATA ¹	TETRABRANCHIATA ¹	<i>Belemnitidae</i>	{ <i>Belemnites</i> , &c.
				{ <i>Spirula</i> .
	TETRABRANCHIATA ¹	TETRABRANCHIATA ¹	<i>Ammonitidae</i>	{ <i>Ammonites</i> , &c.
				{ <i>Baculites</i> , &c.
				{ <i>Nautilus</i> , &c.
				{ <i>Orthocera</i> , &c.

PLATE XXI.

- Fig. 1. *Cranchia scabra*, dorsal aspect; natural size.
2. *Cranchia scabra*, ventral aspect; natural size.
3. *Cranchia scabra*, head, with the mantle, *a, a*, laid open to show the attachment of the funnel *b*, by means of the muscular membranous processes or 'brides', *c, c*. Magnified.
4. Head and mouth of *Cranchia scabra*, showing the webs, *a*, connecting the six dorsal arms; the outer lip, *b*, the inner lip, *c*, inclosing the gaping mandibles. Magnified.
5. A small portion of the skin of *Cranchia scabra*, showing the denticulate processes, highly magnified.
6. *Loligo laticeps*, dorsal view; natural size.
7. *Loligo laticeps*, ventral view; natural size.
9. A sucker of one of the short arms, magnified.

¹ The subdivision and grouping of the very numerous members of this order must repose entirely on a study of the modifications of the shell and other enduring parts; and I have here introduced provisionally the two principal divisions as proposed by M. D'Orbigny, merely for the purpose of citing the principal genera in exemplification of the *Tetrabranchiate* Order.

Fig. 8 & 10. A sucker of one of the peduncles, magnified.

11. Head of *Loligo laticeps*; *a*, outer lip, *b*, inner lip; magnified.
12. *Octopus semipalmatus*, dorsal view; natural size.
13. *Octopus semipalmatus*, ventral view, with the mantle laid open, magnified;
a, the crescentic ridge on the side of the base of the funnel, articulating
with *b*, the corresponding cavity in the mantle: the other parts correspond
with those in the common *Poult* (*Octopus vulgaris*).
14. *Argonauta hians*, Sol., withdrawn from the shell; (three times the natural
size of the specimen figured). The mantle is laid open to show the vertical
septum, and *a* and *b*, the dislocated joint of the funnel of the right side.
15. An *ovum* of the same specimen, magnified.
16. The anal valves of a *Decapodous Cephalopod* (an *Sepioteuthidis species*?) from
Port Jackson. The upper figure shows them closed; the lower figure, open.
Natural size¹.
17. The organ of hearing of the *Cuttle-fish* (*Sepia officinalis*): both vestibular
cavities are laid open, showing the obtuse elastic processes which are in
contact with the capsule of the otolithe or calcareous body; the capsule is
laid open on one side. Natural size.
18. Female organs of generation of *Rossia palpebrosa*, Owen. Natural size.
a. *Ovum* in its reticulate ovisac or *calyx*.
b. Ovisac, in the act of discharging its *ovum*.
c. Discharged ovisacs.
d. Oviduct.
e. Terminal gland of the oviduct.
f. f. *Ova* passing through the oviduct.
g. g. Accessory ovarian or nidamental glands.
h. h. *Corpora succenturiata*.
19. *Corpus succenturiatum* of the *Cuttle-fish* (*Sepia officinalis*).
20. The same; one lobe bisected, to show its structure.

¹ As this sheet was going through the press, I received from Mr. George Bennett three entire specimens of the *Cephalopod* from Port Jackson, of which the *viscera* are described in the preceding pages, proving it to be a species of *Sepioteuthis*.

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