

every one that the bird is intermediate in its coloration between a Mallard and a Gadwall.

"The head, the wing, and the lower parts are specially noticeable, and the only conclusion one can come to is that it is a hybrid. Complete evidence on the subject of naturally bred hybrids of course it is almost impossible to obtain, but I do not see how this bird can be explained in any other way."

Mr. E. T. Newton exhibited and made remarks on a small and abnormally shaped egg of the Common Fowl.

The following papers were read:—

1. On the Geographical Distribution of Slugs.

By T. D. A. COCKERELL, F.Z.S.

[Received March 12, 1891.]

The Slugs, or naked Land-Mollusca, are found in almost every inhabitable part of the globe, but the distribution of the several families and groups is much more restricted, presenting features of considerable interest. Salt water is fatal to Slugs, and it is evident that on land they are little fitted for extensive migrations, their tardy pace being proverbial. They frequent old logs and trunks of trees, and may very possibly be carried down rivers or even over short arms of the sea on floating timber; but, broadly speaking, their means of distribution may be said to be almost as small as those of any group of living organisms, not excepting the Mammalia and Amphibia. It follows, therefore, that their geographical distribution offers points of special value as bearing on questions relating to the former extent of land, and also, perhaps, to the climate of earlier times.

For various reasons, which need not be discussed in the present paper, it is practically certain that at least the great majority of Slugs have descended from testaceous forms. This is especially clear in the *Limacidae*, where in *Parmacella* and other genera the young is much more enclosed in a shell than the adult; while the life-histories of many of the slug-like *Helicarioninae* are suggestive of a series of the still existing adult forms.

It is also evident that the Slugs are of polygenetic origin, a fact which should prevent their being nearly all classed under a single family, as is still sometimes done. Of the six families of Slugs recognized in the present paper, five are more nearly allied to as many testaceous groups than to each other.

The classifications of various authors are exceeding diverse, and especially does there seem to be the widest divergence of opinion among good authorities as to what constitutes a family. Thus Ray Lankester¹ gives a family *Limacidae*, which includes three families

¹ Art. Mollusca, reprinted from Encycl. Brit. 1891.

according to my classification, two of which are usually considered more nearly allied to two of the genera he places in *Helicidæ* than to each other. On the other hand, Simroth¹ uses the family term *Urocyclidæ* for a group which I here place only as a tribe of the subfamily *Helicarioninæ*.

In order to bring the classification of the groups into a condition of approximate uniformity, I have to propose a partly new arrangement, based on the structural characters of the animals, and especially the jaw and lingual membrane. In this arrangement, for the sake of clearness, I have included the testaceous families which are more related to families of Slugs than to each other (see p. 216).

SUCCINEIDÆ.—*Janellinæ*.

A very remarkable subfamily, confined to the Australian region. The genera differ in the degree of development of the curious sulci-form grooves on the back. From an examination of some very interesting material in the British Museum, I am able to classify the generic groups more clearly than has been done before. The following genera may be recognized:—

ANEITEA, Gray, 1860.—This seems to be the most highly developed of the genera. The respiratory orifice is situated at the apex of a grooved triangle, the base of which forms part of the dorsal groove. The described species are seven in number:—

A. macdonaldi, Gray.—New Caledonia, and reputed also to occur in the New Hebrides.

A. hirudo (Fischer).—New Caledonia.

A. modesta (Cr. & Fisch.).—New Caledonia.

A. megalodontes (Q. & G.).—New South Wales. This is the *Limax megalodontes* of Quoy and Gaimard, from near Port Jackson. It may not belong here; the description is not very clear.

A. gräffei (Humbert).—Queensland and New South Wales. The British Museum has examples of this large species from Brisbane and Sydney (*Challenger Coll.*).

A. krefftii (Keferst.).—Australia. A specimen in the British Museum is from the head of the Murray River (*Sir G. Macleay*). This species is very close to the last, but *A. krefftii* is yellowish-white, while *A. gräffei* is grey and has the triangular “mantle” longer in proportion to its breadth.

A. schutei (Keferst.).—Australia.

Probably the number of species will be considerably reduced when they are better known. *Triboniophorus*, Humb., is a synonym of *A. eitea*.

ANEITELLA, n. gen., type *A. virgata* (Smith, P.Z.S. 1884).—This genus, from the Admiralty Is., differs from *Aneitea* in having only one of the grooves which form the triangular so-called mantle in that genus, namely that running obliquely backwards to the respiratory orifice. The only known species is well described and figured by

¹ Nov. Act. Ac. Cæs. Leop.-Car., 1890.

		Slugs.	Helicoid or Bulimoid Allies.
A. Jaw with an accessory quadrate plate ¹	a. No external shell, no true mantle	Succineidæ.	Succineidæ.
	b. Shell rudimentary, mantle present.	Subf. <i>Janellinae</i> .	
	c. Shell more or less external and spiral	Subf. <i>Hyalinacinae</i> .	
B. Jaw with no accessory quadrate plate.		Subf. <i>Succineinae</i> .	Succineinae
	1. Male and female genital orifices distinct	Vaginulidæ.	
	a. With a jaw	Subf. <i>Veronicellinae</i> .	
	b. With no jaw	Subf. <i>Vaginulinae</i> .	
	2. Male and female genital orifices not distinct.	Arionidæ.	Helicidæ.
	i. Central, lateral, and marginal teeth more or less quadrate		
	a. Jaw usually ribbed	Subf. <i>Philomycinae</i> .	
	β. Mantle covering body; shell none	Subf. <i>Arioninae</i> .	
	γ. Shell more or less whorled; shell internal, rudimentary, or none.	Subf. <i>Binneyinae</i> .	
	δ. Jaw smooth; shell none.	Subf. <i>Oopeltinae</i> .	
	ii. Central and lateral teeth more or less quadrate, marginals aculeate	Limacidæ.	Zonitidæ.
	a. Jaw ribbed		Subf. <i>Pristilominae</i> ² .
	b. Jaw smooth.		
	a. Shell non-spiral, internal; no caudal mucus-pore	Subf. <i>Limacinae</i> .	
	β. Shell apically more or less whorled; no caudal mucus-pore.	Subf. <i>Parnacellinae</i> .	
	γ. Shell more or less vitrinoid; no caudal mucus-pore.	Subf. <i>Vitrinae</i> .	Vitrinae.
	δ. Shell more or less whorled or rudimentary; mucus-pore well developed	Subf. <i>Helicarioninae</i> .	Helicarioninae.
	iii. Teeth all narrow.		
	a. Jaw none	Testacellidæ.	Oleacinidæ.
	b. Jaw present	Selenitidæ.	Selenitidæ.
	a. Jaw smooth	Subf. <i>Trigonochlaminae</i> .	Subf. <i>Selenitinae</i> .
	β. Jaw ribbed	Subf. <i>Cystopeltinae</i> .	

¹ It is to be understood that in this synopsis I give merely an indication of the main characters of each group, which are correlated with various other peculiarities not here mentioned.

² For *Pristiloma*, Ancey. Included here for comparison; no Slug of similar characters is yet known.

Mr. E. A. Smith as *Athoracophorus virgatus*, and the original specimens are in the British Museum.

ATHORACOPHORUS, Gould, 1852 (= *Janella*, Gray).—A New-Zealand genus, consisting of small species with a dorsal groove, but in the typical forms no triangular "mantle" like that of *Aneitea*.

A. bitentaculatus (Q. & G.).—New Zealand.

A. bitentaculatus forma *antipodarum* (Gray).—New Zealand. Gray's type is in the British Museum, as well as a specimen from Wellington (*Otago Univ. Museum*). The variety differs from the type in being without spots.

Subg. *Konophora*, Hutton.—This subgenus or section scarcely differs from *Athoracophorus*, but the dorsal groove, in a specimen in the British Museum, is not carried forward medially beyond the point where it branches, and the diverging branches converge below the tentacles and unite just above the mouth.

A. marmoreus (Hutton).—New Zealand, South Island.

A. marmoreus forma nov.: 22 millim. long (in alcohol). Whitish, with scattered pale brownish depressed-raised tubercles, foot with a fairly well-defined margin. Dunedin (*Otago University Museum*), in the British Museum. This form differs very much in colour from Hutton's description of the type.

Subg. *Pseudaneitea*, nov.—Small Slugs of New Zealand and the Auckland Is., resembling *Athoracophorus*, but showing a decided tendency towards the formation of a "mantle-area" like that of *Aneitea*. The *Janella papillata* of Hutton may be taken as the type.

A. papillatus (Hutton).—New Zealand, North Island and South Island; also Auckland Is. and Chatham Is. A specimen from Dunedin (*Otago University Museum*) is in the British Museum. This species is widely different from *A. bitentaculatus*, of which it was considered a variety. The "mantle-area" is quadrangular, and the edges of the foot are excavate-grooved. The dorsal groove persists somewhat on the face.

A. verrucosus, V. Mts. in Simroth. Auckland Is. Very nearly allied to the last. The "mantle-area" is triangular.

A. marmoratus, V. Mts. in Simroth. Auckland Is. This will probably form a distinct subgenus or section. The specific name is unfortunately chosen, as there is already a *marmoreus* of Hutton.

NEOJANELLA, n. g. The most simply developed of the family, lacking both the "mantle-area" and the dorsal groove,

Neojanella dubia, n. sp.—Length (in alcohol) 53 millim., breadth 11 millim. Sole not differentiated into parts, and only a very slight groove between the sole and back. No "mantle-area." Respiratory orifice situated on the back, slightly to the right of the median line. Tail rounded, flattened, no keel, no mucus-pore. Sole pale yellowish. Back pale yellowish, marbled all over with black or dark bluish grey. Respiratory orifice pale, on a pale patch, which is ringed with black. Head injured and shrivelled in the specimen described.

External genital orifice on a pale patch, below and slightly anterior to respiratory orifice. No regular dorsal grooves.

Genital orifice from head 13, from respiratory orifice 5, from sole $2\frac{1}{2}$ millim. Respiratory orifice from head 16, from genital orifice 5, from sole 7 millim.

Described from a specimen in the British Museum, from the south side of Cook's Straits, New Zealand (*Wellington Museum*).

Hyalimacinae.

Contains the genus *Hyalimax*, H. & A. Ad., with one species in the Andaman Is., one in the Nicobar Is., one in Bourbon, two in Mauritius, and one only on the Asiatic mainland—*H. viridis* Theob., of Pegu.

Succineinae.

The typical but testaceous genus *Succinea* is widely distributed in both hemispheres. A slug-like genus, *Omalonyx*, d'Orb, is found in Trinidad, British Guiana, Brazil, and La Plata, and reported also from Guadeloupe and Juan Fernandez. A specimen in the British Museum from Pernambuco (*H. N. Ridley*) may be *O. patera*, Döring; it is paler and less marked than *O. unguis*, Fér.

VAGINULIDÆ.—*Veronicellinae.*

This subfamily consists of the genus *Veronicella*, Blainv. (*Vaginula*, Fér.), with very numerous species in tropical regions, and the monotypic genus or subgenus *Leonardia*, Tapp.-Can., which differs in the more posterior position of the female genital orifice. The genus *Veronicella* consists of about 133 species, distributed as shown on pp. 219–220. The correct numbers cannot be exactly ascertained, as it is probable that some of the species will prove synonymous with others, while others may have to be placed in distinct genera¹. It is also probable that many species remain to be discovered. The numbers given for each country, added together, make more than the total of 133, owing to the fact that several species inhabit more than one country. As a rule, however, the species have not a wide distribution; very many are peculiar to islands. There are no species in the Palæarctic or Nearctic Regions, the occurrence of *V. floridana* in Florida being merely an indication of the West-Indian affinities of the fauna of that State; while the anomalous fact of a species (*V. schivelyæ*, Pilsbry) in Bermuda seems to find its explanation in the probable introduction of the Bermuda species

¹ For example, I have recently examined specimens in the British Museum from the Neotropical region which seem worthy of at least subgeneric distinction, namely a species from Rio Janeiro referred to *V. taunaysi*, Fér., and the true *Veronicella lævis*, Blainv., from Jamaica. Férussac's name *Vaginula* may be used for the former, and thus we get:—

(1) *Veronicella*, Blainv. Sole narrow, rounded and not projecting beyond mantle posteriorly. Female genital orifice post-median. (Type, *V. lævis*, Blainv.)

(2) *Vaginula*, Fér. Sole broader, projecting beyond mantle posteriorly. Female genital orifice antemedian. (Type, *V. taunaysi*, Fér.)

from Mexico. I have compared the description of *V. schivelyæ* with that of the Mexican *V. moreleti*, Crosse and Fischer, and they would certainly seem to be the same species, though the female genital orifice of *V. schivelyæ* is said to be more posteriorly situated than that of *V. moreleti*.

DISTRIBUTION OF VERONICELLA.

(1) *Neotropical Region.*

Uruguay.	1 species.	Buenos Ayres.	3 species.
Brazil	16 „	Peru	1 „
Venezuela	4 „	Chile	6 „
Ecuador	11 „	Argentina	4 „
Guiana	2 „	Mexico	4 „
Bolivia	1 „	Nicaragua	1 „
Cuba	2 „	Florida	1 „
Haiti	2 „	Bermuda.	1 „
Jamaica	2 „	Porto Rico	2 „
Dominica	1 „	St. Vincent	1 „
Martinique	1 „	St. Thomas	2 „
Guadeloupe	1 „	Paraguay	3 „
Trinidad	1 „		

V. olivacea, Stearns, is reported from California, but it does not appear to be native there. *V. marianita*, Cousin, lately described from Ecuador, is apparently identical with *V. solea*, d'Orb.

(2) *Ethiopian Region.*

Natal	1 species.	Madagascar	5 species ¹ .
Delagoa Bay	1 „	Comoro Is.	3 „
Mozambique	1 „	Mauritius	4 „
Zanzibar	1 „	Bourbon	1 „
Liberia	1 „	Rodriguez	1 „
Gold Coast	1 „	Seychelles	5 „
Princes I.	1 „		

(3) *Oriental Region.*

India	2 species.	Ceylon	4 species.
Burmah	1 „	Sumatra	4 „
Siam	2 „	Philippines	3 „
Cochin China.	2 „	Nias	1 „
Camboja	1 „	Borneo	4 „
China	8 „	Java	12 „
Malacca	2 „	Celebes	1 „
Saleyser Is.	1 „	Flores	1 „
Moluccas	3 „	Amboina	1 „

¹ In Madagascar we get a subgenus *Imerinia* (subg. nov.), which has the sole very narrow, not projecting posteriorly; mantle above and below thickly impressed-punctate, and above with scattered raised warts; ♀ orifice postmedian, not very near to sole; median dorsal line slightly impressed; anterior right edge of mantle sometimes tufted with red-brown bristles. This subgenus is founded on some specimens from Imerina in the British Museum, which will be described more fully elsewhere.

(4) *Australian Region.*

New Guinea . . . 2 species. Queensland . . . 3 species.
 New Caledonia . 1 „

There are also specimens from Port Elizabeth, S. Africa, Panama, Honduras, and St. Lucia in the British Museum collection, of which I hope to write at some future time¹.

Vaginulinæ.

While the *Veronicellinæ* have a ribbed jaw and quadrate marginal teeth, the *Vaginulinæ* have no jaw and the teeth all aculeate. Thus the two subfamilies differ from one another much as the *Arionidæ* differ from the *Testacellidæ*, so far as these particulars are concerned, but in other respects they seem so closely allied that they may be united under a single family. It would be interesting to ascertain whether the *Vaginulidæ* are carnivorous, as from their structure they should be.

Under *Vaginulinæ* are three genera:—*Rathousia*, Heude, with three species, from China; *Vaginulus*, “Stol.”², Cochin China and the Malay Peninsula; and *Atopos*, Simroth, found in Amboina and Mindanao, and apparently also in New Guinea and Queensland. Perhaps these three genera will not all prove distinct, but I have not made any critical examination of them myself. Superficially, the species of *Vaginulus* may be known by their subcylindrical shape and broad sole, *Veronicella* being flattish with a narrow sole. A species which I refer to *Vaginulus* is in the British Museum, from Penang; and an *Atopos* (or something closely allied) from Huon Gulf, New Guinea. This last is probably the *V. prismatica*, T.-Can., which is, I suppose, a species of *Atopos*³.

ARIONIDÆ.—*Philomycinæ.*

Consists of a single genus *Limacella*, Blainv. (*Philomycus*, Raf.), which I have treated in some detail in Ann. Mag. N. H. for Nov. 1890. The distribution of *Limacella* is very remarkable. It occurs in Central America and Eastern North America, but not at all west of the Rockies. It reappears in the Chino-Malay and Indian regions, the only intermediate localities being Japan and the Sandwich Is.

¹ Dr. Simroth has just published a paper (see Bes. Abdr. nat. Ges. Leipzig) in which many new species are indicated; I have altered the statistics above so as to include these. For the anatomy of many species of this genus see Semper, Reisen im Arch. Phil. 1885.

² Stoliczka is quoted as authority for this genus as here limited, but he did not actually propose a genus *Vaginulus*; indeed he described (Journ. As. Soc. Bengal, 1873) a species from Penang with the characters of this genus under the head of *Veronicella birmanica*. *Vaginulus*, as here understood, was defined by W. G. Binney in 1879.

³ Since this was written, I have received a letter from Dr. Simroth, to whom I had sent some particulars of the Penang and Huon Gulf specimens. He thinks that the Penang one (which is certainly a species of *Vaginulus*, W. G. Binney) is congeneric with his *Atopos*, and that the Huon Gulf one (apparently *V. prismatica*, T.-Can.) probably represents a new genus or subgenus.

Arionince.

There are seven recognizable genera in this subfamily.

Arion, with numerous described species, is confined to the European region, except that species have been introduced by human agency into North America, New Zealand, and St. Helena. The St. Helena species is *A. hortensis*, Fér.; six specimens from this locality are in the British Museum, collected by Mr. A. E. Craven. The New Zealand species was described as a new species, *A. incommodus*, Hutton; but a specimen in the British Museum from Dunedin (*Otago Univ. Mus.*) shows it to be the *cinereo-fuscus* form of *A. subfuscus*, Drap. The genus *Arion* also occurs in Madeira and the Azores, where it has some appearance of being native, though none of the species are peculiar. There are two specimens of *A. subfuscus* from Madeira in the British Museum (*Mr. Mason*), and *A. empiricorum*, Fér., has been recorded from there. Among the Azores species there is, according to Simroth, a small insular variety of *A. lusitanicus*, Mab.

Ariunculus, Lessona, is a small genus of the Mediterranean region, with one species in Sardinia, and three in Piedmont. One of the latter is also found in the Dept. of Var, in S.E. France.

Geomalacus, Allman, with its subgenus *Letourneuxia*, Bgt., has nine supposed species, found in different parts of Portugal and Algeria, with one species at the Straits of Gibraltar and another in Co. Kerry, Ireland. The distribution of the Irish species, *G. maculosus*, is very interesting, as it seems to be confined to a small district in S.W. Ireland, and Portugal, though it has been reported also from N.W. France. It is also worthy of notice that in the more northern part of its range the genus shows a strong tendency to lose its bands and become dark with pale spots, while the southern species are very distinctly and invariably dark-banded.

Tetraspis, Hagenm., an extraordinary genus with a mantle-aperture, from Carniola, may safely, I think, be put on one side, because Hagenmüller's description and figure seem to belong merely to a specimen of *Arion* allied to *hortensis*, with an artificially-made hole in the mantle! The flexion of the mantle-bands does not prove the hole to be normal, as *A. alpinus*, which has no mantle-aperture, has them strongly curved outwards much as in *Tetraspis*. *Aspidoporus*, Fitz., 1833, from Austria, is another supposed genus with mantle-aperture, founded really on a species of *Amalia*¹.

The next genus of the subfamily is met with in the far-distant Himalayas, namely, *Anadenus*, Heynem. For an account of the species see Ann. Mag. Nat. Hist., Oct. 1890. There are six described species, some of them of great size. From the Himalayas eastward there are no other Asiatic representatives, the subfamily being, so far as is known, entirely absent in the Chinese, Malay, and Australian regions. It is also absent in South America, and in all parts of North America except the Pacific region, where it is largely developed, with three distinct genera. *Ariolimax*, Mörch, containing some

¹ See Heynemann, Jahrb. d. mal. Ges. 1884.

forms of considerable size, is found along the Pacific coast of the United States and in British Columbia, while a subspecies of *A. californicus* occurs even so far south as Costa Rica. *Prophysaon* has a somewhat similar distribution, but does not go into Central America; it has its strongest development in the State of Washington, and goes inland as far as Idaho.

Anadenulus, a monotypic genus allied to *Anadenus*, is confined to Southern California.

Binneyinæ.

This subfamily is proposed for certain slug-like genera, resembling the *Helicarioninæ* outwardly, but having the jaw and dentition of *Arioninæ*. *Binneya*, J. G. Coop. (= *Xanthonyx*, Cr. & F.), may be taken as the type. It is found in Mexico and on Santa Barbara Island, off the coast of California. Mr. W. G. Binney sent me a shell of *B. notabilis* from the latter locality. *Cryptostrakon*, W. G. Binn., from Costa Rica, and *Hemphillia*, Bl. & Binn., from the N.W. United States, both monotypic genera, may also be conveniently referred here, and also *Peltella* from Brazil, with the allied or identical West-Indian genus *Gæotis*, Shuttl. Curiously, also, the genus *Otoconcha*, Hutton, from North Island, New Zealand, has all the characters of this subfamily, nor is this the only resemblance between the Mollusca of Western North America and New Zealand.

Oopeltinæ.

Contains only the genus *Oopelta*, Mörch, in Heynem., from the Guinea and Cape of Good Hope regions. I have never seen the type species, *O. nigropunctata*, but I refer the "*Arion*" *aterrimus*, Gray, contained in the British Museum, to this genus.

LIMACIDÆ.—*Limacinæ.*

(1) *LIMAX*, auctt.—This genus, as restricted by modern authors, is indigenous only in the Western Palæarctic or European region. It is true that many species of *Limax* have been described from distant regions, but in every case, so far as can be ascertained, they are either European species introduced (thus *L. flavus* received two synonyms in Australia) or they do not belong to *Limax* at all. The most typical form of *Limax* has its greatest development in Northern Italy, and consists of numerous species or subspecies allied to *L. maximus*, L., and *L. cinereoniger*, Wolf. Allied to these is *L. flavus*, L., which has become almost cosmopolitan through its introduction into various countries by human means. Thus, the British Museum contains examples of this species from Rarotonga and the New Hebrides (Rev. Wyatt Gill), St. Helena (J. C. Melliss), Sydney ('*Challenger*' Coll.), Savannah, United States (W. G. Binney), and I have received it from Washington, U.S.A. (Dr. R. E. C. Stearns), Lexington, Virginia (Prof. J. H. Morrison), and Burlington, New Jersey (W. G. Binney). Another subgroup (*Lehmannia*, Heyn.) has its type in *L. marginatus*, Müll., a species widely distributed in

Europe, frequenting beech-woods, and often found at considerable altitudes above the sea. In Ireland it has developed a remarkable spotted race, *maculatus*, Roebuck.

Limacopsis or *Frauenfeldia* is a group belonging to S.E. Europe, at present little known.

(2) MALACOLIMAX, Malm.—A genus with six species intermediate in some respects between *Limax* and *Agriolimax*, belonging to the Western Palæarctic region. Mr. Pollonera has sent me *M. nyctelius*, Bgt., from Algeria, and *M. valentianus*, Fér., from Barcelona.

Mesolimax, Poll., founded on *M. brauni*, Poll., from Asia Minor, is somewhat similar, but more allied to true *Limax*.

(3) AGRIOLIMAX, Mörch.—This genus, differently from *Limax*, is exceedingly widely distributed, having *apparently* indigenous species in the Palæarctic, Ethiopian, Australian, Nearctic, and Neotropical regions. It is found, however, that all the species outside of the Palæarctic region resolve themselves into either (1) *A. agrestis*, L., of Europe, introduced, or (2) allies of the European *A. lævis*, Müller. Dr. Simroth is of the opinion that these numerous *lævis*-allies are all referable to the true *A. lævis*; but I have examined a good many of them, and am confident that a few species of non-Palæarctic *Agriolimax* will have to be kept as valid. In North America I should regard *A. campestris*, Binn., as a species, with *montanus*, Ing., *hyperboreus*, Wst., and *occidentalis*, Coop., as slight races of it.

A. berendti, Strebel, of Central America, has a Californian race *hemphilli* (*Limax hemphilli*, W. G. Binn., 1890); this species resembles *L. agrestis* rather than *campestris* in its dentition. I shall have occasion to discuss the genus *Agriolimax* in detail at some future time, and so will not give further particulars here.

(4) AMALIA, Moq.—Consists of three sections:—*Subamalia*, Poll., with four reputed species from S.E. Europe; *Tandonia*, L. & P., with many species, all European, except one in Syria (concerning which see Ann. Mag. N. H., Oct. 1890); and *Pirainea*, L. & P., which is very well developed in the Mediterranean region, occurs throughout Western Europe and in the Atlantic Islands, and also at the Cape, in Brazil, in Juan Fernandez, in the Sandwich Islands, on the Pacific coast of North America, in New Caledonia, and in New Zealand, Australia, and Tasmania. It seems to be native outside of the European region in North America (the Pacific coast *only*) and in New Zealand and Australia; but its wide distribution elsewhere is no doubt largely due to accidental introduction by human means. Broadly speaking, *Pirainea* may be said to be cosmopolitan in *damp temperate* regions; but I will not here give the distribution in detail, as I shall treat the group fully on another occasion.

Prof. Ralph Tate in 1881 described two species of *Amalia* (as *Milax*) from the Australian region. *A. tasmanica*, from Tasmania, seems allied to the New-Zealand *A. antipodarum*, while *A. nigricola*, from Adelaide, South Australia, should be compared with *A. maura* (Q. & G.) from New South Wales. *A. nigricola* has been reported as *A. nigricollis* from Tasmania, but I believe erroneously.

The genus or subgenus *Gigantomilax*, Bttg., was founded on a large species from the Caucasus. *Lytopenelte* and *Platytoxon* are names used for a West-Asiatic group with few species, seemingly intermediate between *Amalia* and *Agriolimax*.

(5) *EUMILAX*, Bttg. (*Paralimax*, Bttg.).—Consists of species from the region of the Caucasus and Armenia, with the external appearance of *Amalia* and the dentition of *Agriolimax*, but differing obviously from both these genera in the anterior position of the respiratory orifice. I have examined specimens of *Paralimax intermittens*, Bttg., and *Eumilax brandti*, V. Mts., in the British Museum, and they seem to belong to the same genus. *Eumilax*, being the prior name, must be used.

Parmacellinae.

This subfamily contains only the genus *Parmacella*, Cuv., which is, perhaps, the most highly specialized of all the Slugs. There are 8 supposed species, found in Western Asia, Egypt, Algeria, Morocco, Spain, Portugal, and the Canary Is.

A subspecies of *P. valenciennii*, which I described as var. *maculata*, is found, together with its form *olivacea*, on both sides of the Straits of Gibraltar. It is interesting that the forms of *P. valenciennii* found at Gibraltar and Tangier should be identical; further north, in Portugal and France, the species gradually loses the dark markings on the mantle and becomes spotless.

Vitrininae.

Vitrina, Drp., is a testaceous genus characteristic of the Palæarctic and Nearctic regions and the Atlantic Islands. Many species have been described from South Africa and other localities, but until the soft parts of all are known, it will not be possible to say how many may be really referable to *Helicarion*. Other slug-like genera referred to this subfamily are *Vitrinoidea*, *Vitrinopsis*, and *Vitrinoconus* of Semper, from the Philippines, and *Parmella*, H. Ad., from the Fiji Is.

Helicarioninae.

I have given a table of the genera of this subfamily in Ann. Mag. Nat. Hist. for Jan. 1891. Their distribution is in many ways instructive. The *Urocyclus*-group is very characteristic of, and confined to, the Ethiopian region.

Estria and *Aspidelus*, from the Guinea region, are two monotypic genera which may prove identical, or at least only subgenerically distinct.

Vitrinozonites from the Eastern United States, and *Velifera* from Costa Rica, represent the subfamily in America.

Ibycus occurs in the Himalayas, in Siam, and in Java; it also exists in Borneo, if, as I believe, the *Parmarion baccarii* and *P. doriae* of Issel (which are probably two forms of the same species) are correctly referable to it. *Girasia* is specially characteristic of the

Indian region¹. *Mariaella*, a very distinct genus, has almost identical forms in S. India, Ceylon, and the Seychelles. *Parmacochlea* has a single species from the northern extremity of Queensland, but is represented in the Indian region by a subgenus *Pseudaustenia* (nov. nom.) of *Ibycus*, the type of which is the *Africarion ater* of Godwin-Austen. *Austenia* is a genus of the Indian region, with some very different species, which will probably form new subgenera.

Helicarion is very numerous in species, about 101 being known. The genus is quoted from Africa, the Indian, Chinese, and Malay regions, Australia, &c. It is very noteworthy, however, that it seems to be absent in New Zealand, the *H. dimidiatus* of that island being an *Otoconcha*. It is found, nevertheless, in the Auckland Is. (*H. zebra*, Le Guill.), Lord Howe's I. (*H. hilli*, Cox), and New Caledonia (*H. keppelli*, Pfr.). It is best developed in Australia (18 species) and the Philippines (17 species). When the animals are fully known, the genus will doubtless have to be subdivided. Such species as *H. cumingii*, Beck, and *H. bocki*, Smith, might be separated from *Helicarion* by their shells alone, at least subgenerically.

H. vitrinina and *H. ramsayi* of Liardet, from the Fiji Is., probably represent a single species showing colour-variation of the animal.

TESTACELLIDÆ.

Testacella and *Daudebardia* are genera belonging to the European, or, more precisely, Western Palearctic, region, each with a fair number of species. These genera have also been reported from New Zealand, but probably the species referred to by Hutton (Trans. N. Z. Inst. 1883) belong to some other genus. *Chlamydephorus* is a distinct and peculiar genus from South Africa, with one species. *Selenochlamys*, Bitg., founded on a species from Transcaucasia, is allied to *Daudebardia*, but has no shell.

SELENITIDÆ.—*Trigono-chlaminae*.

A family allied to *Testacellidæ*, but possessing a jaw. The present subfamily includes *Trigono-chlamys* and *Pseudomilax* from the Caucasian region, and *Plutonia* from the Azores, the latter monotypic².

*Cystopeltinae*³.

Contains only the remarkable genus *Cystopelta* of Tate, founded on a single species, *C. petterdi*, found in Tasmania.

¹ The group of *G. crocea*, G.-A., although true *Girasia*, shows a resemblance to *Mariaella* in some of its characters. The species which I described as *Girasia depressa* I now consider to be a variety or subspecies of *G. crocea*.

² A most important work by Dr. Simroth on the Portuguese, Azores, and other Slugs has just appeared (Nova Act. Acad. Cæs. Leop.-Car. 1891), containing a detailed account of *Plutonia*.

³ Mr. Hedley has lately published a very interesting paper on *Cystopelta* in Proc. Linn. Soc. N. S. W. 1890, p. 44. It would seem that this subfamily is intermediate between *Selenitidæ* and *Helicarioninae*.

This completes the subfamilies and recognizable genera of Slugs. I have in this paper preferred to give the facts almost without any discussion of the problems illustrated by them, partly because such a discussion would be more suitable in connexion with a paper of less limited scope, and partly because it would render the present contribution unduly long.

2. On a Viviparous Bathybial Fish from the Bay of Bengal.

By A. ALCOCK, M.B., Surgeon I.M.S. (Communicated by Prof. J. WOOD-MASON, F.Z.S.)

[Received March 16, 1891.]

In the 'Annals and Magazine of Natural History' for November 1889 (vol. iv. ser. 6, pp. 389-390), I described under the name of *Saccogaster maculata* a new type of Brotuline Ophidiids allied to *Catalax*. The two specimens upon which the genus was established were described as females $3\frac{3}{8}$ and 4 inches long, with gravid ovaries; they were taken in 193 fathoms off the mouths of the Gangetic Delta.

Among the characters which distinguish *Saccogaster* the two most marked are its sac-like abdomen and its loose imperfectly-scaled skin.

On the 24th December last, in a very successful haul of the trawl in 240 fathoms off the mouths of the Kistna Delta, another specimen of *Saccogaster maculata* was obtained. It proved to be an adult male, $3\frac{1}{2}$ inches long, with ripe milt. Though otherwise resembling the female in external characters, it differs in having a deep post-anal depression or excavation, which is filled by a large bilobed papilla with the genital pore opening into the groove between the lobes. The papilla is thick, fleshy, and smooth; each lobe is about 2 mm. long and 1.25 mm. broad, and is pigmented at the apex.

In consequence of the discovery of this genital papilla a microscopic examination of a portion of one of the ovaries of the original type specimen was made, and it was found that in the ova as they lie *in situ* the development of the embryo is already far advanced.

Unfortunately the material is not in the best state of preservation, but the ova are still in a sufficiently good condition to show the general relations of the embryo.

The embryos are vermiform; they are about 1.5 mm. in length, and are closely applied to the yolk-sac, which they embrace through rather more than three-quarters of its circumference; the cerebral lobes, optic vesicles, and long free tail-fold are plainly apparent, but beyond these and the continuous bright line of the notochord nothing can now be made out; the yolk-sac is a little more than



Cockerell, Theodore D. A. 1891. "On the Geographical Distribution of Slugs."
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