THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—Linnæus.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—Bruckner, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. Taylor, *Norwich*, 1818.

ALERE FLAMMAM

3 5 ✓

CONTENTS OF VOL. VI.

[SIXTH SERIES.]

NUMBER XXXI.

Page

I. On certain Points in the Anatomical Nomenclature of Echinoderms. By P. HERBERT CARPENTER, D.Sc., F.R.S., F.L.S., Assistant Master at Eton College 1

II. Notes on some West-Indian Longicorn Coleoptera, with Descriptions of new Genera and Species. By C. J. GAHAN, M.A. .. 23

III. On the Ova of *Gobius*. By ERNEST W. L. HOLT, St. Andrews Marine Laboratory. (Plate II.) 34

IV. Notes on Radiolaria from the Lower Palæozoic Rocks (Llandeilo-Caradoc) of the South of Scotland. By GEORGE JENNINGS HINDE, Ph.D. (Plates III. & IV.) 40

V. Revision of British Mollusca. By the Rev. Canon A. M. NORMAN, M.A., D.C.L., F.R.S., F.L.S., &c. 60

VI. Description of a new Snake of the Genus *Glauconia*, Gray, obtained by Dr. Emin Pasha on the Victoria Nyanza. By G. A. BOULENGER 91

VII. On a new Genus and some new Species of Shells from Lake Tanganyika. By EDGAR A. SMITH 93

VIII. Notes on the Genus *Dyschorista*, Led., a small Group of Moths allied to *Orthosia*. By A. G. BUTLER 96

IX. Descriptions of two new Species of Scorpions brought by Emin Pasha from the inland parts of East Africa. By R. I. POCOCK, of the British Museum (Nat. Hist.). (Plate I. figs. 1 and 2.) 98

X. On *Ebalia nux*, Milne-Edwards. By R. I. POCOCK 101

XI. On some new Species of African *Lycænidæ* in the Collection of Philip Crowley, Esq. By EMILY MARY SHARPE 103

XII. On some Eastern Equatorial African Coleoptera collected by Emin Pasha, with Descriptions of two new Longicornia. By CHARLES O. WATERHOUSE. (Plate I. fig. 3.) 107

XIII. On the Organization of the Cyprides. By Prof. CARL CLAUS 108

Page

Proceedings of the Geological Society .... 113—118

William Sweetland Dallas; Description of a new Cottoid Fish, by Tarleton H. Bean, Ichthyologist, U. S. Fish Commission; Model of the "British Marine Area," by the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.; Preliminary Account of a new Australian *Peripatus*, by Arthur Dendy, M.Sc., F.L.S.; On the Compound Eyes of Arthropods, by S. Watase; Variations in *Bulimus exilis*, by Dr. B. Sharp; Remarks on the Exuviæ of Snakes, by Dr. B. Sharp .... 118—124

NUMBER XXXII.

XIV. The Inconsistencies of Utilitarianism as the Exclusive Theory of Organic Evolution. By Rev. John T. Gulick 125

XV. On a Viviparous Caddis-fly. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, Calcutta 139

XVI. A Short Account of a small Collection of Myriopoda obtained by Mr. Edward Whymper in the Andes of Ecuador. By R. I. Pocock, of the British (Natural-History) Museum 141

XVII. List of Land- and Freshwater-Shells collected by Dr. Emin Pasha in Central Africa, with Descriptions of new Species. By Edgar A. Smith. (Plates V. & VI.) 146

XVIII. On a new Species of *Guiraca*. By Edward Bartlett, Curator of the Maidstone Museum 168

XIX. Descriptions of two new Cyprinodontoid Fishes. By G. A. Boulenger 169

XX. Description of a new Squirrel from Borneo. By Oldfield Thomas 171

XXI. On the Anatomy of Horny Sponges belonging to the Genus *Hircinia*, and on a new Genus. By H. Fol 172

XXII. Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. XII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c. 174

XXIII. On the Anatomy of *Sesia tipuliformis* and *Trochilium apiforme*, Linn. By Prof. E. K. Brandt 185

XXIV. On the Circulatory System of the Carapace in the Decapod Crustacea. By E. L. Bouvier 190

XXV. Description of a new Species of *Mormyrus*. By G. A. Boulenger 193

New Book:—A Synonymic Catalogue of Recent Marine Bryozoa. By [Miss] E. C. Jelly 194

On two new Species of Coccidea infesting the Stickleback and the Sardine, by P. Thélohan 194

NUMBER XXXIII.

Page

XXVI. Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.—No. 16. On the Bathybial Fishes collected in the Bay of Bengal during the season 1889–90. By A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey. (Plates VIII. & IX.) .. 197

XXVII. British Fossil Crinoids.—III. *Thenarocrinus callipygus*, gen. et sp. nov., Wenlock Limestone. By F. A. Bather, M.A., F.G.S. (Plate X.) 222

XXVIII. On the Development of *Pyrosoma*. By Prof. W. Salensky 236

XXIX. On supposed new Species of Land-Mollusca from Borneo belonging to the Genera *Opisthostoma* and *Diplommatina*. By Lieut.-Col. H. H. Godwin-Austen, F.R.S., F.Z.S., &c. (Plate VII.).... 244

XXX. Notes on Longicorn Coleoptera of the Group *Cerambycinæ*, with Descriptions of new Genera and Species. By Charles J. Gahan, M.A., Assistant in the Zoological Department, British Museum 247

XXXI. Descriptions of new Species of African *Lycænidæ*, chiefly from the Collections of Dr. Staudinger and Mr. Henley Grose Smith. By W. F. Kirby, F.L.S., F.E.S., &c. 261

Leaf-winged Locust, by J. J. Quelch, B.Sc.; On the Histological Constitution of certain Nematodes of the Genus *Ascaris*, by M. Léon Jammes 275, 276

NUMBER XXXIV.

XXXII. Notes on Slugs, chiefly in the Collection at the British Museum. By T. D. A. Cockerell 277

XXXIII. On the Relationship of the Rodentia to the Marsupialia. By Dr. A. Fleischmann 289

XXXIV. Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.—No. 18. On the Bathybial Fishes of the Arabian Sea, obtained during the season 1889–90. By A. Alcock, M.B., Surgeon I.M.S., Surgeon Naturalist to the Survey 295

XXXV. On the Ophidian Genus *Pseudoxyrhopus*, Gthr. By G. A. Boulenger 311

XXXVI. A New Theory of *Pterichthys*. By A. Smith Woodward, F.Z.S. 314

XXXVII. Notes on the Palæozoic Bivalved Entomostraca.—No. XXIX. On some Devonian Entomides. By Prof. T. Rupert Jones, F.R.S., F.G.S. (Plate XI.) 317

Page

XXXVIII. Notes made during the present Year on the Acceptance or Rejection of Insects by Birds. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c. 324

XXXIX. Revision of British Mollusca. By the Rev. Canon A. M. NORMAN, M.A., D.C.L., F.R.S., F.L.S., &c. 327

XL. *Ebalia nux*: a Reply to Mr. R. I. Pocock. By the Rev. Canon NORMAN, F.R.S. 342

XLI. Descriptions of some new Species of African Butterflies in the Collection of Captain G. E. Shelley. By EMILY MARY SHARPE 346

XLII. Notes on the Racquet-tailed Rollers. By H. E. DRESSER, F.Z.S. &c. 350

On the Occurrence of *Eublepharis macularius* in Transcaspia, by G. A. Boulenger; Additional Notes on *Peripatus Leuckarti*, by J. J. Fletcher, M.A., B.Sc. 352

NUMBER XXXV.

XLIII. Report on the Corals from the Tizard and Macclesfield Banks, China Sea. By P. W. BASSETT-SMITH, Surgeon R.N. (Plates XII.–XIV.) 353

XLIV. Descriptions of new Species of *Pedaria*, with Observations on allied *Scarabæidæ*. By CHARLES O. WATERHOUSE 374

XLV. Notes on Slugs, chiefly in the Collection at the British Museum. By T. D. A. COCKERELL 380

XLVI. A List of the Species of *Achatina* from South Africa, with the Description of a new Species. By EDGAR A. SMITH 390

XLVII. Summary of Researches into the Anatomy and Histology of Nemertines, with Contributions to their Classification. By Dr. OTTO BÜRGER 394

XLVIII. On the Fate of the Quadrate in Mammals. By Dr. BROOM, M.B., C.M., B.Sc. 409

XLIX. On the Distinctive Cranial Characters of the Iguanoid Lizards allied to *Iguana*. By G. A. BOULENGER 412

L. The Genera *Trigaster* and *Benhamia*. By W. BLAXLAND BENHAM, D.Sc., Assistant to the Jodrell Professor of Zoology, University College, London 414

LI. On a new Species of *Gyracanthus*. By R. H. TRAQUAIR, M.D., F.R.S. 417

New Book:—A Monograph of the Horny Sponges. By ROBERT VON LENDENFELD 418

Page

On the Discovery of a Jurassic Fish-Fauna in the Hawkesbury Beds of New South Wales, by A. Smith Woodward; The Fossil Fishes of the Hawkesbury Series at Gosford, New South Wales, by A. Smith Woodward; Is *Asterias tenuispinis*, Lamk., a "British" Species?, by Prof. F. Jeffrey Bell 423, 424

NUMBER XXXVI.

LII. Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.—No. 20. On some undescribed Shore-Fishes from the Bay of Bengal. By A. ALCOCK, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey 425

LIII. Report on the Corals from the Tizard and Macclesfield Banks, China Sea. By P. W. BASSETT-SMITH, Surgeon R.N. 443

LIV. On new Longicorn Coleoptera from Madagascar. By C. J. GAHAN, M.A. 458

LV. Descriptions of four new Species of Terrestrial Mollusca from South Africa, with Observations on *Helix Huttoniæ* (Bens.). By JAMES COSMO MELVILL, M.A., F.L.S., and JOHN HENRY PONSONBY, F.Z.S. 466

LVI. On *Ebalia nux*, Milne-Edwards: a Reply to the Rev. Canon Norman. By R. I. POCOCK 469

LVII. On the Generic Name of *Asterias sanguinolenta*, O. F. Müller. By F. JEFFREY BELL 472

LVIII. Descriptions of some new Genera of *Pyralidæ*. By W. WARREN, M.A., F.E.S. 474

LIX. On the Fossil Fishes found at Achanarras Quarry, Caithness. By R. H. TRAQUAIR, M.D., F.R.S. 479

LX. The Fauna of Amber. By Herr RICHARD KLEBS, of Königsberg 486

LXI. Observations on some Fossil Fishes from the Lower Carboniferous Rocks of Eskdale, Dumfriesshire. By R. H. TRAQUAIR, M.D., F.R.S. 491

LXII. Descriptions of new Species of *Crocidura*. By G. E. DOBSON, M.A., F.R.S. 494

New Books:—A Treatise on the Common Sole (*Solea vulgaris*), considered both as an Organism and as a Commodity. By J. T. CUNNINGHAM, M.A. &c.—A Zoological Pocket-Book, or Synopsis of Animal Classification. By Dr. EMIL SELENKA and J. R. AINSWORTH DAVIS........................... 497—502

Page

Is *Asterias tenuispina*, Lamk., a British Species?, by Rev. Canon A. M. Norman; *Aspidiotus bicarinatus* a Lepidopterous Larva, by E. E. Green; Note on *Irrisor Jacksoni*, sp. n., by R. Bowdler Sharpe 502, 503

Index 504

PLATES IN VOL. VI.

Plate I. New Scorpions.—New Longicorns.
II. Development of the Ova of Gobius.
III. } IV. } Radiolaria from the Lower Palæozoic Rocks.
V. } VI. } New Land- and Freshwater-Shells.
VII. New Land-Mollusca.
VIII. } IX. } New Genera and Species of Fishes from the Bay of Bengal.
X. Thenarocrinus callipygus.
XI. Devonian Entomides.
XII. } XIII. } XIV. } Tizard and Macclesfield Coral-Banks in the China Sea.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 31. JULY 1890.

I.—*On certain Points in the Anatomical Nomenclature of Echinoderms.* By P. Herbert Carpenter, D.Sc., F.R.S., F.L.S., Assistant Master at Eton College.

The object of the following paper is to put in a plea for a greater precision of nomenclature in works on Echinoderm morphology than has been hitherto adopted by many authors, more especially those who have made incidental rather than special studies in some branch of Echinoderm research. Many of them are justly distinguished in other lines of scientific work; but, owing to their imperfect acquaintance with the current Echinoderm literature, a vagueness and inaccuracy of nomenclature have crept into their writings in a manner which is both perplexing to the student and vexatious to the specialist.

I refer more especially to the frequent use of the same term for two or more structures which are not mutually homologous*, while, on the other hand, there are some cases in

* Since writing the above lines I have come across the following remarks by Hérouard on the same subject:—" Ce sont là des questions de détail, il est vrai, mais sur lesquelles j'insiste à dessein, car ces dénominations identiques attribuées par les différents auteurs et même parfois, comme je viens de le dire, par un seul et même auteur, à des organes

which homologies are universally recognized, though the fact does not appear in the nomenclature.

1. *The use of the term "Water-tube."*

The term "water-tube" seems to have been first used by A. Agassiz * for the two cœlomic diverticula of the archenteron in the Starfish-larva, this being "the name which denotes most appropriately the function they assume of circulating water through the body of the larva." He also applied the same name † to the gills or "papulæ" of Stimpson and Sladen, which are not developed till much later; but the first meaning which he gave to the term has not found acceptance in Europe, especially since the morphological importance of these water-tubes has been more fully realized, and they have been variously known as the cœlomic pouches, vaso-peritoneal sacs, &c.; while "water-tube" or "tube hydrophore" has been largely used by both English and French writers instead of the misleading term "sand-canal" or "stone-canal," which is so often totally inapplicable to the structure it is supposed to designate. In America, however, Brooks ‡ and Fewkes have continued to speak of the water-tubes of the Echinoderm-larva, and they use the same term when referring to the organs which are described as circular and radial water-vessels by European writers. This course seems likely to lead to much confusion, the more so as one at least, and sometimes both, of the larval cœlomic pouches do not in any way give rise to the "water-tubes" of the ambulacral system. Fewkes is an especial offender in this respect, for in his last publication but one he uses the term water-tube with different meanings on two successive lines §:—"Each of the five small *culs-de-sac*, *r w*, from the water tube on the ambulacral side of the young starfish forms a radial water tube of the starfish." Five pages later he says that the stone-canal is an internal calcifi-

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différents, créent, dans l'esprit du lecteur, une confusion pénible qu'il est parfois difficile d'éclaircir par une seule lecture et qui a contribué, pour une large part, à faire prendre dans certains cas, comme divergentes, des opinions qui ne différaient pas sensiblement l'une de l'autre" ("Recherches sur les Holothuries des Côtes de France," Arch. Zool. Exp. et Gén. vol. vii. 1889, p. 630).

* 'Embryology of the Starfish,' 1864. Reprinted in "North American Starfishes," Mem. Mus. Comp. Zoöl. 1877, vol. v. p. 13.

† *Ibid.* p. 52.

‡ 'Handbook of Invertebrate Zoology,' Boston, 1882, pp. 72, 135.

§ "On the Development of the Calcareous Plates of *Asterias*," Bull. Mus. Comp. Zoöl. 1888, vol. xvii. p. 7.

cation which "arises in the walls of the water tube," thus giving a third meaning to the same term, while Agassiz, as we have seen, has used it in yet another sense. Is it too much to ask on behalf of the student of the future that it be employed in one sense only? In the following pages it will be used to denote the madreporic or stone-canal.

2. *Dorsocentral and Centro-dorsal.*

These two names are frequently used as if they were synonymous, though in reality they denote plates of very different morphological characters.

The term "dorsocentral" appears to have been first used by the Messrs. Austin * for that part of a Crinoid which was called the pelvis by Miller, *i. e.* the ring of plates which rest upon the top stem-joint. In some cases five separate plates may be distinguished, in others only three, while in others there seems to be but one undivided plate with a stem-facet on its lower surface; and even this facet is absent on the central plate of *Marsupites.* Owing to the rapid spread of the Müllerian terminology, in which the lowest plates of the Crinoidal calyx were designated basals, the collective name "dorsocentral" applied to them by Austin never found general acceptance. But in Lovén's classical work † on the Echini the term "dorsocentral system" is used to denote the central plate in the apex of a young Urchin, together with the two rings of genital and ocular plates around it. He regarded the central plate of *Marsupites* as homologous with that of the Urchin, and also compared the ocular plates of the latter to the radials of *Marsupites*, two determinations which I fully accepted when writing on the subject in 1878 ‡, though I could not follow Lovén in the other homologies which he proposed, nor in his views respecting the primitively compound nature of the dorsocentral plate. I suggested at the same time that the homologue of the latter was to be found in the terminal plate at the base of the stem in the stalked larva of *Comatula*, which I carefully distinguished from the enlarged upper stem-joint or centro-dorsal piece. Sladen § adopted this view in 1884, since which time the

* "Descriptions of several new Genera and Species of Crinoidea," Ann. & Mag. Nat. Hist. 1843, vol. xi. p. 196.

† "Études sur les Échinoïdées," Kongl. Svenska Vetenskaps-Akademiens Handlingar, 1874, Bd. xi. no. 7, p. 65.

‡ "On the Oral and Apical Systems of the Echinoderms," Quart. Journ. Micr. Sci. 1878, vol. xviii. p. 359.

§ "On the Homologies of the Primary Larval Plates in the Test of Brachiate Echinoderms," Quart. Journ. Micr. Sci. 1884, vol. xxiv. p. 25.

central plate of the Echinoderm apical system has been repeatedly noticed by us both and also by others under the name "dorsocentral;" and zoologists have been warned again and again not to confuse it with the enlarged top stem-joint in the stem of many Crinoids, for which, in the case of *Comatula*, Müller and his successors had employed the name "centro-dorsal." Early in 1887 Duncan and Sladen *, writing on the morphology of the Saleniidæ, frequently referred to the so-called sur-anal plate of Echinids as the dorsocentral, mentioning at the same time its homologies in the Asterids and Ophiurids. Fewkes †, who had previously confounded dorsocentral and centro-dorsal, wrote a short time later in the same terms. But all our efforts to obtain a greater precision of nomenclature seem to have been in vain, for even such a well-informed writer as the late Professor Neumayr ‡ alluded in 1888 to "die centrodorsale Platte bei Salenien." Unaware, too, that the presence of independent under-basals in the *Antedon*-larva had been announced by Bury § in 1887, he concluded that they are represented by the "centrale Platte," by which he meant the enlarged top stem-joint or centro-dorsal. But as he also recognized the fact that these under-basals are well developed in *Marsupites* and enclose "eine grosse centrodorsale Tafel," he was driven to the following conclusions ‖:—"Es scheint demnach, als ob die centrodorsale Platte der ausgewachsenen Crinoiden durchaus nicht immer dieselbe morphologische Bedeutung hätte, und auch durchaus nicht nothwendig immer dem gleichnamigen Theile der *Antedon*-Larve entspräche." But is it so certain that the central plate in the calyx of *Marsupites* should be called a centro-dorsal at all, *i. e.* that it is an enlarged top stem-joint? Twelve years ago I gave reasons for believing it to be a primitively imperforate plate homologous with the dorsocentral of *Salenia*, and not a top stem-joint with its central canal obscured by a secondary calcareous deposit ¶. My arguments have never been refuted; but palæontologists have nevertheless continued to speak of the centro-dorsal of *Mar-*

* "On some Points in the Morphology and Classification of the Saleniidæ, Agassiz," Ann. & Mag. Nat. Hist. 1887, ser. 5, vol. xix. pp. 119, 121.

† Bull. Mus. Comp. Zoöl. 1888, vol. xvii. p. 38.

‡ 'Die Stämme des Thierreichs,' Wien, 1889, Bd. i. p. 493.

§ "The Early Stages in the Development of *Antedon rosacea*," Report of the Fifty-seventh Meeting of the British Association, held at Manchester, 1887: London, 1888, p. 735. Also Proc. Roy. Soc. 1887–88, vol. xliii. p. 299.

‖ *Op. cit.* p. 493.

¶ Quart. Journ. Micr. Sci. 1878, vol. xviii. pp. 380, 381.

supites, as if its homology were quite undoubted; and it is not surprising therefore that its coexistence with under-basals in that type should have driven Neumayr to the conclusion that something was wrong. *Salenia* has a dorsocentral only. *Marsupites* has a dorsocentral and under-basals. The *Antedon*-larva has a dorsocentral at the bottom of the stem, a centro-dorsal at the top, and under-basals resting upon it. If these facts be carefully borne in mind, much that has seemed so obscure both to Neumayr and to his predecessors receives its proper explanation.

3. *Basals and Under-basals.*

The nomenclature of the plates forming the dicyclic base in many Crinoids is still somewhat wanting in uniformity and precision. Twelve years ago * I pointed out that the so-called parabasals of the dicyclic Crinoids are the real homologues of the basals in the monocyclic forms, the lower ring of plates in the dicyclic Crinoids being an additional element in the calyx. I proposed to call the latter "under-basals," retaining the name "basals" for the plates immediately below the radials, both in the dicyclic and in the monocyclic forms. Every scientific palæontologist † now admits that the latter plates are homologous throughout the whole series of Crinoids, and the proposed change in the nomenclature has been adopted by the leading writers on Crinoids in this country, Australia, Canada, the United States, France, and Switzerland, and also by Ludwig, the chief German writer on Echinoderms. Zittel ‡, however, while accepting both the homology and the term under-basals, or, as he put it, "infrabasals," believed that the use of the name basals for the upper plates of the dicyclic base would lead to confusion; and so he retained for them the Müllerian name parabasals, thus giving two different names

* *Ibid.* pp. 366, 367.

† Walther, writing in 1886, homologized the infrabasals of Dicyclica with the basals of Monocyclica ("Untersuchungen über den Bau der Crinoiden," Palæontographica, 1886, Bd. xxxii. p. 189). His conclusions, however, were largely based upon questions of transcendental morphology which were suggested by his study of the Pentacrinoid larva of *Antedon*. Among them are his remarkable identification of the five primary tentacles of the larva with the clavicular pieces on the radial axillaries of the adult, which has already been noticed in this Journal (ser. 5, vol. xix. p. 88); and as Bury has demonstrated the presence of under-basals in the larva, which were overlooked by Walther, as by all his predecessors, Walther's views respecting the homologies of the basals of the adult *Antedon* and other apparently monocyclic forms are no longer tenable, as he will no doubt admit when he next writes upon the subject.

‡ 'Handbuch der Palæontologie,' Bd. i. pp. 327, 328.

to one and the same set of plates, a method which, as it seems to me, is still more likely to confuse the student. The German palæontologists have naturally followed Zittel, and continue to speak of the dicyclic base as composed of parabasals and infrabasals, a course which will not be made easier by some recent discoveries. Thus, for example, de Loriol has found infrabasals in two species of *Millericrinus* *, and the plates above them, hitherto called basals, must now be known as parabasals in these two species, though retaining the simpler name in all the remaining species of the genus. This will be an endless source of confusion, and another is afforded by Zittel's own description of the calyx of *Pentacrinus.* He states that it contains five basals, but adds that five infrabasals are sometimes present. According to his terminology, however, the species possessing them † should have no basals, but parabasals; but he gives no hint of this. Then, again, Bury has recently demonstrated the presence of infrabasals in *Antedon rosacea*; so that in Zittel's terminology the plates hitherto called basals in this type must now be known as parabasals, though their homologues in the apparently monocyclic fossil *Comatulæ* will retain their old name. In these three genera therefore—*Millericrinus*, *Pentacrinus* (in the widest sense), and *Antedon*—some species are known to be dicyclic, while others are not, though the latter are in all probability only pseudomonocyclic, to use the convenient term proposed by Bather ‡. But in Zittel's terminology the generic diagnosis will have to run somewhat as follows:—"Calyx composed of radials and basals, or of radials, parabasals, and infrabasals." Would it not be infinitely simpler and less confusing to say "Calyx composed of radials and basals, sometimes with the addition of infrabasals"? If this be admitted, it is clear that the same principle may be extended to definitions of families and larger groups, and the misleading term parabasals will then have to be finally abandoned.

The term "subradials" was proposed in 1854 by de Koninck and Le Hon instead of parabasals, and was generally adopted by the leading American palæontologists, *e. g.* Hall, Billings, Meek and Worthen, and Whitfield. As long as the homology of the plates so named with the basals of monocyclic Crinoids remained unrecognized, this name was in

* 'Paléontologie Française,' Terrain Jurassique, tome xi. pt. i. pp. 553, 566.

† These species are now referred to *Extracrinus.*

‡ "British Fossil Crinoids," Ann. & Mag. Nat. Hist. 1890, ser. 6, vol. v. p. 316.

many respects preferable to parabasals. But it was demonstrated in 1878 that the parabasals or subradials of dicyclic Crinoids are the real basal plates, and that the plates hitherto called by that name are an additional element in the calyx, for which the name under-basals was proposed. Messrs. Wachsmuth and Springer adopted this change in Part I. of their 'Revision of the Palæocrinoidea,' which appeared in the following year, and their example has been followed by five writers on Crinoids in the United States, including the late Professor Worthen himself, and two in Canada. With the exception of the late Professor Quenstedt all the continental palæontologists * who have written on Crinoids in general during the last decade have abandoned the use of the term basals for the lower ring of plates in the dicyclic base in favour of under-basals or infrabasals; so that it has really seemed as if the rational system of nomenclature was coming into general use. In America, however, S. A. Miller has steadily declined to adopt it, and he has continued to use the purely empirical terminology of de Koninck. His reasons for this course were stated as follows in 1883:—"Most American authors, and I might say all, until quite recently, have called the plates, in the first ring above the column, the basals, and when the second exists they have called them subradials. Certainly no names can be easier or more expressive. . . . The policy of changing the nomenclature may well be doubted, and ought not to be entered upon without the clearest conviction, that, by so doing, error of some kind is being eradicated" †. In reply to this it was pointed out ‡ that the change had been proposed expressly to avoid the error of giving the same name "basals" to parts which are not homologous in monocyclic and in dicyclic Crinoids respectively. This argument does not seem to have produced any impression upon Miller; for in the useful Catalogue of North American Palæozoic fossils which he has recently published he still uses the term basals for the lowest plates of the dicyclic calyx. The confusion into which he is thus led

* Dalmer, Fritsch, and Wagner describe the dicyclic base of *Encrinus* as composed of inner and outer basals. Neumayr used the same terminology for dicyclic Crinoids generally, with the collective names *basis* and *infrabasis*; but he took especial care to point out that the former and not the latter is homologous with the basis of monocyclic Crinoids.

† "*Glyptocrinus* redefined and restricted, *Gaurocrinus*, *Pycnocrinus*, and *Compsocrinus* established, and two new Species described," Journ. Cincinn. Soc. Nat. Hist. 1883, vol. vi. p. 218.

‡ "On a new Crinoid from the Southern Sea," Phil. Trans. 1883, p. 932.

Date.	Basals and Parabasals.	Basals and Subradials.	Under-basals and Basals.	Infrabasals and Parabasals.	
1841.	Müller.				
1854.		de Koninck & Le Hon.			
1878.			Carpenter.		
1878.		Oehlert.			Abandoned, 1882.
1879.	*Beyrich.*				
		S. A. Miller.			
					Abandoned, 1887.
	von Koenen.				
		Ulrich.			
			Wachsmuth & Springer.		
		Wetherby.			Abandoned, 1880.
				Zittel.	
1880.			Wetherby.		
		White.			
1881.		*Grant.*			
					Abandoned, 1882.
	Trautschold.				
1882.				C. Barrois.	
			de Loriol.		
			Oehlert.		
				Studer.	
				Trautschold *.	
		Whitfield.			
			H. S. Williams.		
1883.			Gaudry.		
			Walcott.		
		Worthen.			Abandoned, 1884.

1884.				Fraipont.	
1885.		Ratte.	Worthen. W. R. Billings.	Waagen.	Abandoned, 1886.
1886.	Quenstedt.	Ringueberg.	Ludwig. Ratte.	Walther. Follmann.	Abandoned, 1888.
1887.			von Koenen. Bury.		
1888.			Neumayr. Ringueberg.	Eck. Steinmann & Döderlein.	
1889. 1890.		Miller & Gurley.	Whiteaves. Bather. Nicholson.		

The authors whose names are in italics have not written on dicyclic Crinoids since 1882.

A comparison of the second with the last two columns shows that Miller's nomenclature is not so "well established" as he appears to think.

* Trautschold (Bull. Soc. Imp. Nat. de Moscou, tom. lvii. 1882 (1883), pp. 201–203) has proposed the name "supra-basals" instead of "parabasals." For some remarks on this question see Quart. Journ. Micr. Sci. vol. xxiv. 1884, pp. 19, 20.

will be evident from the following passage *:—" Carpenter and Wachsmuth call the 'subradials' the 'basals' in all cases where they occur, and the lower plates 'under-basals;' but where there are no 'subradials' they follow the well-established nomenclature in calling the first circle of plates 'basals.'" These very plates, however, are recognized by other palæontologists as representing the subradials, which Miller says are not found in monocyclic Crinoids. It is unfortunate that a work which is likely to be so generally used by students and collectors should in this respect be some years behind the times. The only American writers on Crinoids besides Miller † who have not yet publicly adopted the rational nomenclature are Hall, Grant, Ulrich, White, and Whitfield; but I am not aware that any one of them has written on dicyclic Crinoids since 1882, so that they have had no need to make a decision. One would have thought that the conversion in succession of Messrs. Wetherby, Worthen, and Ringueberg would have led Miller to reconsider his position, which is at present a somewhat isolated one, as is shown in the accompanying table (pp. 8 and 9); and he cannot therefore any longer claim to be using "the established or prevaling methods of description" as he did in 1883.

I have endeavoured to show that the German palæontologists do not always employ the term basals when they might advantageously do so. Fewkes, on the other hand, has used it too freely. Referring to certain plates which appear on the abactinal hemisome of the young *Amphiura*, he says that they "form in the interradii, and may therefore be called interradials or basals;" ‡ and he continues:—" The first set of interradial plates may be known as the abaxial basals or first interradials." In the next line these are called "abaxial interradials," and a little further on (p. 130) he mentions a new plate as "beginning to form between an abaxial and an adaxial interradial." Replying to my criticisms on the looseness of his terminology § and the way in which he has confused terms which previous writers on Crinoid morphology

* 'North American Geology and Palæontology,' Cincinnati, 1889, p. 212.

† Since the above was written Messrs. Miller and Gurley have published descriptions of some new Crinoids, in which the term subradials is still employed—"Description of some new Genera and Species of Echinodermata from the Coal measures and Subcarboniferous rocks of Indiana, Missouri, and Iowa," Journ. Cincinn. Soc. Nat. Hist. 1890, vol. xiii. p. 3.

‡ "On the Development of the Calcareous Plates of *Amphiura*," Bull. Mus. Comp. Zoöl. 1887, vol. xiii. p. 128.

§ "On the Development of the Apical Plates in *Amphiura squamata*," Quart. Journ. Micr. Sci. 1887, vol. xxviii. p. 313.

had endeavoured to keep distinct as denoting different structures, he denies that he has anywhere made use of the combination "adaxial interradials," and implies that I have criticised him unfairly *. The combination does occur, however, but in the singular number, on p. 130 of his paper, as I have quoted above, though he seems to have entirely forgotten his use of it.

He also attempts to justify himself by stating that "Sladen in considering certain starfishes uses interradial for basal, and to explain what he means by interradials uses the following combination :—'interradials (*i. e.* basals).'" I am sorry to say, however, that Fewkes is again in error, and that he has not quoted Sladen correctly. He does not seem to have appreciated the fact that the whole point of my criticism related to his use of the words interradial and basal as substantives with identical meanings, and he quotes Sladen as having done so. Sladen's expression, however, is "interradial (*i. e.* basal) plate" †. Of course the basal plates are interradial, *i. e.* situated between the rays; but they are not *interradials* as this term has been understood by students of the Crinoidea since the time of Müller, and Sladen did not call them so, though Fewkes did.

The question is not a very important one; but I cannot help thinking it desirable that terms which have a very definite meaning in the anatomy of one type should only be applied to homologous parts in descriptions of other types; and when Fewkes writes about the "abaxial basal" or "adaxial interradial" of an Ophiurid it appears to me that he is placing needless obstacles in the way of the students of a subject which already bristles with difficulties.

4. *The Radial Plates.*

The name "Radialia" was given by Müller to all the plates situated in the direction of the rays between the basals and the first axillary (inclusive) of a Crinoid with more than five arms. His terminology was employed by Rœmer, Beyrich, de Koninck, and other writers till the time of Schultze, who modified it very considerably ‡. He adopted the principle that the lowest articular facet indicates the boundary-line between radials and brachials. In his diagrams of *Taxocrinus*, *Zeacrinus*, *Rhodocrinus*, and *Actinocrinus* the first

* Bull. Mus. Comp. Zoöl. 1888, vol. xvii. p. 45.

† Quart. Journ. Micr. Sci. 1884, vol. xxiv. p. 33.

‡ "Monographie der Echinodermen des Eifler Kalkes," Denkschr. k. Akad. Wissensch. Wien, 1867, Bd. xxvi. Abth. 2, p. 117.

axillary is the third plate above the basal ring. But whereas Müller would have described each type as having three radials, Schultze said that this is only the case in *Actinocrinus* and *Rhodocrinus*, while *Taxocrinus* and *Zeacrinus* have but one radial followed by two brachials, of which the second is axillary. In the first two parts of the 'Revision of the Palæocrinoidea' Messrs. Wachsmuth and Springer used the expression primary radials for the ray-plates in the body up to the first axillary, *i. e.* the radials of Müller, while the following body-plates up to the next axillary (distichals of Müller) were called secondary radials, and so on, the term "brachials" being used to denote "free radial plates supporting the arms" *. At the same time, however, the American authors suggested that the arms fundamentally commence with the plates above the first radials, whether these be free or incorporated into the calyx †; and there are many reasons for adopting this view, as I explained in the Report on the 'Challenger' Crinoids ‡. In practice, however, Wachsmuth and Springer, like myself, found it more convenient to regard the arms as beginning with the first free plate beyond the calyx, and they described *Encrinus* as having but one radial followed by two brachials, the second axillary and bearing the arm-plates, which the older writers had regarded as brachials following a series of three radials.

In Zittel's 'Palæontology' § Schultze's views are adopted and extended to the Neocrinoids, so that the calyx of *Comatula* and *Pentacrinus*, *Encrinus* and *Millericrinus*, is described as having but one radial followed by two brachials. *Apiocrinus*, however, is said to have three radials, from which it would appear that in Zittel's opinion the first articular facet in this type is on the third or axillary radial. This, however, is not the case, as was pointed out by myself in 1881 ||, and more recently again by de Loriol ¶. In any well-preserved calyx of *Apiocrinus* which has the upper face of a first radial exposed, a definite facet for a muscular articulation of the usual character is plainly visible. This point is well shown in de Loriol's figure of *A. elegans* **. There is a perforated transverse ridge with muscular fossæ above it and a dorsal fossa

* *Op. cit.* part i. 1879, p. 27 (of separate copy).

† *Ibid.* part ii. 1881, p. 10.

‡ Part i. pp. 47, 48.

§ *Op. cit.* p. 339.

|| "On two new Crinoids from the Upper Chalk of Southern Sweden," Quart. Journ. Geol. Soc. 1881, vol. xxxvii. p. 134.

¶ *Op. cit.* p. 225.

** *Op. cit.* pl. xxxiii. figs. 2 *a*, 2 *b*, pl. xxxiv. figs. 6 *a*, 6 *b*.

which lodged the extensor ligament (muscle?). The plates of attachment for the flexor muscles between the first and second radials are in a more vertical position than the rest of the articular face, and when the second radials are in position five clefts are visible on the floor of the calyx, which were occupied during life by the five pairs of muscular bundles. These clefts are particularly well shown in Zittel's own figure of the interior of the cup of *Apiocrinus Parkinsoni* *, while in de Loriol's more recent figure of the same species † they likewise appear, together with precisely similar clefts between the radial axillary and the two brachials which it bears. The existence of a muscular articulation is admitted in the latter case, and it will scarcely be any longer denied that there is a similar articulation between the first and second radial. It is a peculiar one no doubt, owing to the great size of the dorsal fossa in some species of *Apiocrinus*. But this is well developed in some species of *Millericrinus*, e. g. *M. ranvillensis*, and a regular gradational series may be traced from the most *Pentacrinus*-like forms of *Millericrinus* through *M. ranvillensis* to *Apiocrinus elegans*, and thence to forms like *A. Meriani* and others with large dorsal fossæ.

Even in these last there are distinct indications of a muscular articulation, while whenever the distal faces of the second radials or the proximal faces of the axillaries are visible they present a vertical articular ridge for a bifascial articulation, exactly as in *Antedon rosacea* and in most *Comatulæ* ‡. We find therefore that in the calyx of *Apiocrinus* there are two articular facets below that on the axillary radial, which is the first one admitted by Zittel; and if Schultze's nomenclature be followed, *Apiocrinus* must be described as having but one radial, like *Encrinus* and *Pentacrinus*. The same will be the case with every other Neocrinoid except *Guettardicrinus*, a genus which, as defined by d'Orbigny, is not admitted by Zittel; but de Loriol has pointed out that in this type there are no articular facets on either of the three radials, nor even on the distal faces of the second joints after the axillary §; and, in fact, it has not yet been determined what plate of the body of this type does bear the first facet.

If, then, Schultze's nomenclature is to be extended to the Neocrinoids, *Guettardicrinus* is the only type which can be said to have more than one radial.

Steinmann and Döderlein ‖ admit that the arms *sensu stricto*

* *Op. cit.* p. 389, fig. 277 *b*. † *Op. cit.* pl. xxx. figs. 1 *a*, 1 *b*.

‡ De Loriol, *op. cit.* pl. xxx. fig. 2 *b*, pl. xxxiii. fig. 2 *a*, pl. lvi. figs. 2, 2 *c*.

§ *Op. cit.* p. 219.

‖ 'Elemente der Paläontologie,' Leipzig, 1888, p. 153.

begin immediately beyond the primary radials. But if the lower arm-plates form a part of the dorsal cup, those up to and including the first axillary are called radials, while their successors up to the next axillary retain their Müllerian name, distichals, those beyond them again being called distichals of the second order.

Ever since I began to write on the Crinoids, now some thirteen years ago, I have used this term distichals to denote the plates between the first and the second axillary (inclusive) of Crinoids with more than ten arms, whether these be free or united by interradial plates; while the plates up to and including the third axillary, should such occur, have been called palmars. This method has been adopted by other writers on recent Crinoidea, and has been found to work well in practice, as it is obviously much shorter to say "distichals" than "radials of the second order" or "brachials of the first order." "Palmars" in like manner is a preferable term to "radials of the third order," and the succeeding axillaries, when present, may be conveniently called first, second, third postpalmars, &c. For purely descriptive purposes it is not often necessary, either for recent or for fossil Crinoids, to refer to more than three axillaries above the radials, viz. distichal, palmar, and postpalmar; and Messrs. Wachsmuth and Springer have agreed to use these terms for the future in their descriptions of Palæocrinoids.

It has also seemed desirable to arrive at some sort of agreement as to the nomenclature to be adopted for the plates between the basals and the first bifurcation in Crinoids with ten or more arms. Müller called them all radials in every Crinoid, and the same course has been adopted by de Loriol and myself; while other authors have endeavoured to distinguish between the first plate and its successors according to their ideas respecting the position of the first articular surface or the extent to which the outer plates are included in the dorsal cup. But it will be evident from what has been said above that neither of these criteria is a satisfactory one, and that there is consequently a great want of unanimity between different authors, and even in different parts of the same work, so that the result cannot but be most perplexing to the student. All the leading writers are agreed, however, that the arms really commence with the first plates above the primary radials, and not above the first axillaries, *i. e.* that the plates which are sometimes called the outer radials, situated between the primary radials and the distichals, are really arm-plates; while, as Zittel has pointed out, there are developmental reasons for considering this to be the case *.

* *Op. cit.* p. 339.

Under these circumstances it has been agreed between Messrs. Wachsmuth and Springer and myself to describe all Crinoids as possessing but one radial in each ray; and it can then be referred to without the prefix "primary," which has hitherto been necessary in comparing this plate with what we believe to be its homologue in Urchins and Stellerids. All plates beyond this which lie in a radial direction are arm-plates or brachials, those beyond the first axillary being called for descriptive purposes distichals, palmars, and postpalmars, as explained above. But it now becomes necessary to find some convenient descriptive name for the plates between the radial primaries and the distichals, which have hitherto been known as the outer radials in the Neocrinoids generally. It is difficult to find a rational one which shall have the merit of brevity, and we have therefore decided to revert to the purely empirical term "costals." This was invariably employed by J. S. Miller * to denote the second radials, where he did not call them arm-plates, as will appear from the subjoined table (p. 16).

Miller's terminology was not strictly logical, and one can hardly expect that it should have been so; but at any rate it served as a foundation for much valuable work, and I think it only right to employ one of his terms when this is possible without straining analogy too far. The plates which Miller sometimes called first costals and sometimes scapulæ are far better described by Müller's name "radials;" but I think that we may fairly employ the names first and second costals for the second and third radials of Müller, now that it is agreed by every one that they are morphologically arm-joints.

In seven of the eight generic descriptions in which Miller used the term costals at all it was applied to plates in the direction of the rays, and in one genus only (*Cyathocrinus*) did he definitely give this name to interradial plates, and then in but three of its four species. It is somewhat unfortunate therefore that in his classical memoir on the Echinoidea Lovén should have proposed to specialize this name as denoting the primary interradial plates of the Echinoderm apical system, *i. e.* the genitals of Urchins and the basals of Crinoids †. I pointed this out in 1878 ‡, and Lovén, while admitting Miller's inconsistency, replied that "It has always been considered allowable to suggest the use in a strict sense of a term elsewhere vaguely applied" §. This is of course quite true; but the

* 'A Natural History of the Crinoidea,' Bristol, 1821.

† *Op. cit.* p. 73.

‡ Quart. Journ. Micr. Sci. 1878, vol. xviii. p. 363.

§ "On *Pourtalesia*, a Genus of Echinoidea," Kongl. Svenska Vetenskaps-Akademiens Handlingar, 1883, Bd. xix. no. 7, p. 64.

Nomenclature of J. Müller.	Basals.	Parabasals.	First Radials.	Second Radials.	Third Radials.
Nomenclature of Carpenter and de Loriol.	Under-basals.	Basals.	First Radials.	Second Radials.	Third Radials.
Nomenclature of J. S. Miller.					
Apiocrinus	....	Pelvis.	First Costals.	Second Costals.	Scapulæ.
Encrinus	....	Pelvis.	First Costals.	Second Costals.	Scapulæ.
Pentacrinus	....	Pelvis.	First Costals.	Second Costals.	Scapulæ.
Comatula	....	....	First Costals.	Second Costals.	Scapulæ.
Actinocrinus	....	Pelvis.	First Costals.	Second Costals.	Scapulæ.
Rhodocrinus	Pelvis.	Intercostals.	First Costals.	Second Costals.	Scapulæ.
Platycrinus	....	Pelvis.	Scapulæ.	Arm-plates.	
Cyathocrinus	Pelvis.	Costals, or Intercostals in one species.	Scapulæ.	Arm-plates.	
Poteriocrinus	Pelvis or Costals?	Intercostals.	Scapulæ.	Arm-plates.	
Marsupites	Costals or Pelvis?	Intercostals or Costals?	Scapulæ.	Arm-plates.	
Nomenclature now proposed.	Infrabasals.	Basals.	Radials.	First Costals.	Second Costals.

strict sense in which the term is to be used for the future should surely be that in which it was most generally used in the past. This is very far from being the case with Lovén's specialization of the term costals, as will be seen from the preceding table; and as his proposal has not been generally adopted by Echinologists, I think there can be no harm in employing Miller's name for plates which do lie in the direction of the rays of Crinoids, and were always called costals by him when not described as arm-plates, viz. those commonly known as the second radials. This being granted, it naturally follows that the axillary or third radials, the scapulæ of Miller, should be called the second costals; and these terms will be employed for the future by Messrs. Wachsmuth and Springer, Bather, and myself. Furthermore, in genera like *Metacrinus* and *Parisocrinus*, in which there may be four or five joints between the radial and the first axillary above it, the whole series, including the axillary, will in future be called the costals.

The use of this term also simplifies matters in another way. I pointed out in 1877 *, and have done so frequently since, that the first two joints beyond every axillary of a multibrachiate Neocrinoid are nearly always united, whether by syzygy or by bifascial articulation, in the same manner as the second and third radials. Now, however, we can say more briefly that there is generally the same mode of union between the first two free brachials and the first two distichals and palmars &c., when present, as between the first two costals. Thus, among the Palæocrinoidea this union is a syzygy in *Graphiocrinus* and *Scytalocrinus*. The same rule holds good in *Encrinus* (syzygy) and in *Apiocrinus*, *Millericrinus*, and *Bathycrinus* (articulation). Five of the eight recent species of *Pentacrinus* have the two costals, distichals, and palmars, and the first two free brachials respectively united by syzygy, while there are bifascial articulations between the two costals and the first pair of joints beyond them in each of the other three species. Some of the fossil Pentacrinidæ present indications of the same regularity, and it is also traceable in *Metacrinus*, though to a less extent, owing to its larger and more variable number of costals; and this is probably also the case in the Palæocrinoids with a similar character.

It is among the *Comatulæ*, however, that the regularity in question is most marked. Among the 120 species of *Antedon*

* "On the Genus *Actinometra*, Müll., with a Morphological Account of a new Species from the Philippine Islands," Trans. Linn. Soc., 2nd ser. Zool. vol. ii. p. 22.

noticed in the 'Challenger' Report there are but nine in which the first two joints beyond each successive axillary are not always united in the same manner as the two costals are. Thus in the three members of the *Elegans*-group the costals are united by syzygy, while the first two joints after each axillary are articulated. In the six members of the *Granulifera*-group the costals and the first two distichals are articulated bifascially. Five of the species have the corresponding palmars and brachials united by syzygy, while in the sixth this is replaced by a muscular articulation.

Among the eighty-four species of *Actinometra* the four members of the *Typica*-group have a syzygy between the two costals, palmars, postpalmars, and brachials respectively, while the first two distichals are articulated; and in the seven species of the *Fimbriata*-group the costals and the first pair of distichals are respectively united bifascially, while there is a muscular articulation between the first two joints after the distichal and all subsequent axillaries. The four members of the *Stelligera*-group again have the first two free brachials united by syzygy, while the corresponding joints of all the lower arm-divisions are articulated.

Excepting in these aberrant forms, therefore, the facts of Crinoid anatomy are in favour of the view that the plates called second and third radials by Müller really belong to the arms; and so I propose to abandon the use of R in the specific formulæ of the *Elegans*-, *Solaris*-, and *Typica*-groups*, and to substitute a *c*, indicating the costals, just as *d* stands for distichals and *p* for palmars. A glance of the illustrative formulæ given below, and especially those of *Actinometra solaris* and *A. paucicirra*, will show that this alteration makes them at once more simple and more symmetrical; and as it seems undesirable to have one *c* in the formulæ to indicate costals and another in the cirrus-notation, as proposed by Bell †, I propose to use *x*, *y*, *z* for the latter purpose instead of *a*, *b*, *c*. This has the further advantage of enabling us to write a simple *b*, and not *br*, to indicate the free brachials of the arms.

* See the Report on the 'Challenger' *Comatulæ*, pp. 53, 57.

† "An Attempt to apply a Method of Formulation to the Species of the *Comatulidæ*, with the Description of a new Species," Proc. Zool. Soc. Lond. 1882, p. 531. See also the Report on the 'Challenger' *Comatulæ*, pp. 43–59.

Illustrative Formulæ.

Antedon elegans	$\mathrm{A.\,R.}\,3.\,2.\,(2)\,\frac{b}{c}$	becomes	$\mathrm{A.}\,\frac{c}{2}\,.\,3.\,2.\,(2)\,.\,\frac{y}{z}.$
—— *inæqualis*	$\mathrm{A.}\,3.\,\frac{(p).\,br}{2}\,.\,\frac{b}{b}$	”	$\mathrm{A.}\,3.\,\frac{(p).\,b}{2}\,.\,\frac{y}{y}.$
—— *porrecta*	$\mathrm{A.}\,3.\,2\,\left\{(p).\,br\right\}\,.\,\frac{b}{c}$	”	$\mathrm{A.}\,3.\,2\,\left\{(p).\,b\right\}\,.\,\frac{y}{z}.$
Actinometra solaris	$a.\,\mathrm{R.}\,\frac{br}{2}\,.\,\frac{ab}{ab}$	”	$a.\,\frac{c.\,b}{2}\,.\,\frac{xy}{xy}.$
—— *paucicirra*	$a.\,\mathrm{R.}\,\frac{d.\,(p).\,br}{2}\,.\,\left(\frac{a}{a}\right)$	”	$a.\,\frac{c.\,d.\,(p).\,b}{2}\,.\,\left(\frac{x}{x}\right).$
—— *multibrachiata* ..	$a.\,\mathrm{R.}\,3.\,\frac{p.\,p'\,.\,.\,.\,.\,p^{\mathrm{vi}}\,br}{2}\,.\,\frac{b}{a}$	”	$a.\,\frac{c}{2}\,.\,3\,\frac{p.\,p'\,.\,.\,.\,.\,p^{\mathrm{vi}}\,b}{2}\,.\,\frac{y}{x}.$
—— *stelligera*	$a.\,2.\,2.\,(2).\,\frac{br}{2}\,.\,\frac{bc}{ab}$	”	$a.\,2.\,2.\,(2).\,\frac{b}{2}\,.\,\frac{yz}{xy}.$

5. *The use of the term "Axillary."*

The term " axillary " was introduced by Müller * and defined as follows :—" Das dritte *radiale* hat nach oben zwei dachförmig geneigte Gelenkflächen für die beiden darauf sitzenden Arme. Ich nenne es deswegen *radiale axillare*, es ist Miller's *Scapula*, dagegen nenne ich *brachialia axillaria* alle im Verlauf der Arme vorkommenden ähnlichen Glieder, auf denen zwei Theilungsarme aufsitzen."

The term has been generally used in the Müllerian sense during the last forty years, *i. e.* only with reference to plates which serve as points of division in the rays and arms, whether these be free or incorporated into the more or less rigid dorsal cup. Bather, however, has recently extended its use in a manner which is scarcely advisable at present, since it is not as yet justified by anatomical research. He has applied the name to the " bifurcating piece " in *Iocrinus* which gives rise both to the right posterior ray and to the ventral sac †. The lowest of the series of plates supporting the ventral sac—that which rests on the left upper edge of the bifurcating piece, and is marked × in Bather's diagram ‡—is regarded by him as having " originated as a plate morphologically corresponding to an ordinary brachial ; " and he

* " Ueber den Bau des *Pentacrinus caput Medusæ*," Abhandl. Berlin. Akad. 1841 [1843], p. 202.

† Ann. & Mag. Nat. Hist. ser. 6, vol. v. 1890, p. 320.

‡ *Ibid.* pl. xiv. fig. 5.

distinguishes it accordingly as the "Brachianal." He states that "in size and position it is just like the adjacent arm-plate" *. But is this really the case? Is there the same articulation between its under surface and the bifurcating piece below it as between the latter and the arm-plate of the right posterior ray? This has yet to be demonstrated; and until such a demonstration has been given the term "axillary" should not be applied to the bifurcating piece, as has been done by Bather. Whatever be the merits of his theory, as applied to other Fistulata, there appear to me to be grave doubts respecting the correctness of his interpretation of the plate × in *Iocrinus*. This is regarded by Wachsmuth and Springer as the first plate of the anal tube, and not in any way as a "special anal," or brachianal as Bather calls it; and if such be the case, the bifurcating piece on which it rests is not in any sense an axillary. Bather, however, not only calls it an axillary plate himself, but also represents the American authors and myself as having done the same, which is not the case. I did not state "that Wachsmuth and Springer homologize the lower half of the compound radial in *Dendrocrinus* with the upper axillary plate in *Iocrinus*." Neither did the American authors misquote me "as having suggested that the axillary plate of *Iocrinus* was an 'azygos' plate" †. Neither they nor I used the term "axillary" at all, so that there was no reason for Bather to represent us as having done so, more especially as we do not yet know that the plate in question is entitled to this name.

6. *Interambulacrals and Adambulacrals.*

In Müller's classical memoir, "Ueber den Bau der Echinodermen," after discussing the views of de Blainville and A. Agassiz respecting the interambulacral plates of a Starfish ‡, he proposed to distinguish the marginal plates of the ambulacra from the remaining interambulacral plates by the name "adambulacral." Those plates situated between the ambulacra on the ventral surface of the body, which are so well developed in the pentagonal forms, were called intermediary interambulacral plates; and in a third category he placed the lower marginal plates of the rays. The term adambulacral proved to be a very convenient one, and it soon found its way into the current nomenclature both of zoology and of palæontology. It was not, however, adopted by A.

* *Ibid.* p. 330. † *Ibid.* pp. 321, 322.
‡ Abhandl. d. Berlin. Akad. Jahrg. 1853 (1854), pp. 161, 162.

Agassiz, the plates generally known by this name being called interambulacral throughout his fine work on the North American Starfishes. Verrill used the same name for a while, but afterwards abandoned it in favour of adambulacral, and the same course was taken by Perrier. In a recent memoir on the development of the calcareous plates of *Asterias** Fewkes describes the plates in question as interambulacrals, with the remark, "adambulacrals of recent authors." The name, however, is much older than Fewkes implies, having been proposed by Müller and adopted by M. Sars, Salter, and Billings before 1860. Meek and Worthen and J. Hall used it in 1866–67, and, with the exceptions above mentioned, I know of no leading authority within the last twenty-five years who has used "interambulacral" to denote the marginal plates of the ambulacra of the Starfish †. Fewkes says with regard to them, "It may be as well to retain the old term, especially as they arise between ends of successive ambulacrals" ‡. This, however, is very far from being the real meaning of the old term as applied to the Urchins, for which group it was first employed. In a later communication again the two names *interambulacral* and *adambulacral* are used interchangeably by Fewkes §, on the ground that "the term interambulacral is not only the oldest, but is embryologically more accurate." As, however, there are at least three series of plates in Starfishes to which the name interambulacral has been applied, it would have conduced very considerably to the clearness of Fewkes's writings if he had followed the Müllerian plan of describing one of them as adambulacral; for when he speaks of interambulacrals it is sometimes difficult to determine to what series he is referring, and his use of the name for Müller's adambulacrals is the more likely to confuse, since his studies have led him to believe that "they are the same as the ambulacral" ‖. The position of the plates in question is not the less interambulacral because Müller called them adambulacral, to distinguish them from the other two sets of interambulacral plates which are not so closely related to the ambulacra. These are called marginals and interbrachials

* Bull. Mus. Comp. Zoöl. 1888, vol. xvii. p. 37.

† They have been called adambulacrals by the following authors:— Bell, Döderlein, Eck, Fraas, Ganong, Ives, de Loriol, Lütken, Ludwig, Meneghini, S. A. Miller, Perrier, Rathbun, G. O. Sars, Studer, Sturtz, Verrill, Viguier, Zittel.

‡ Bull. Mus. Comp. Zoöl. 1888, vol. xvii. p. 11.

§ "On the Serial Relationship of the Ambulacral and Adambulacral Calcareous Plates of the Starfishes," Proc. Boston Soc. Nat. Hist. 1889, vol. xxiv. p. 96.

‖ Proc. Boston Soc. Nat. Hist. 1889, vol. xxiv. p. 105.

by Fewkes; but he would have been more in accordance with the rational terminology now current if he had used intermediary or interambulacral for interbrachial*, and had adopted Müller's use of adambulacral.

On p. 105 of his last paper † we read, "The plates in the Echinoids called adambulacrals which lie between the system of plates generally known as ambulacral are regarded as the same as the marginal plates of the starfish." This passage can only refer to the plates which are always called interambulacrals in the test of an Urchin, and I have been unable to discover that any author, except Fewkes, has ever called them adambulacral. Ludwig ‡, however, has pointed out that the ambulacral plates of an Urchin are in all probability homologous with the adambulacrals of a Starfish, and in his diagram of the skeleton of an Echinoid he marks these plates "Adambulacralia (sog. Ambulacralia)." Fewkes, on the other hand, speaks of "the so-called adambulacrals of sea-urchins" when he means the interambulacrals, auct., although no previous writer has employed the term in this sense, so that there was no reason for Fewkes to have done so. He accepts Ludwig's homology of these interambulacral plates (adambulacrals, Fewkes) with the marginals of the Starfish, as shown in the following table, copied from p. 106 of his memoir:—

Starfish.	Sea-Urchin.
1. Ambulacral rafters.	1. Wanting.
2. Peripheral ambulacrals §, generally called adambulacrals.	2. Ambulacrals.
3. Marginals.	3. Adambulacrals.

But he also remarks in a footnote, "The homologies here presented are essentially the same as those already published by Ludwig as far as the relationship between the ambulacrals of the starfish and the adambulacrals of the sea-urchin is concerned." There seems to be something wrong here, for it is clear that the adambulacrals of an Urchin cannot be homologous both with the ambulacrals of a Starfish (footnote) and also with its marginal plates (table).

It may be that a clerical error has been committed, the prefix *ad* being put in the wrong place in the footnote, and

* This term is not particularly applicable in the case of *Goniaster* and similar forms.

† Proc. Boston Soc. Nat. Hist. 1889, vol. xxiv. p. 105.

‡ "Entwicklungsgeschichte der *Asterina gibbosa*, Forbes," Zeitschr. f. wiss. Zool. 1882, Bd. xxxvii. p. 73.

§ These "peripheral ambulacrals" are also called interambulacrals by Fewkes, and in his figure on p. 99 they are lettered *ad*, Adambulacrals!!

that Fewkes meant to express his belief in Ludwig's homology between the *adambulacrals* of a Starfish and the *ambulacrals* of the Sea-urchin. But if this be the case the only plates in the Urchin to which the name adambulacrals can properly be applied are those generally known as ambulacrals. Why, then, does Fewkes repeatedly use it for the interambulacrals? He implies that other authors have done so before him, but gives no references; and, so far as I can make out, there are none to be found.

This is not the first occasion on which I have had to comment on the looseness of Fewkes's Echinoderm terminology and the confusion resulting therefrom. It is much to be regretted that when he took up a branch of zoology different from that in which he has gained a well-merited reputation he did not make himself better acquainted with its nomenclature, and thus enable his readers properly to appreciate the value of his observations and of the conclusions which he has drawn from them *. As it is, however, one is constantly perplexed by his vague and inaccurate use of terms which were clearly defined by Müller and have since had a very definite meaning for nearly all students of Echinoderms.

II.—*Notes on some West-Indian Longicorn Coleoptera, with Descriptions of new Genera and Species.* By C. J. Gahan, M.A.

These notes chiefly refer to genera and species of Lacordaire's group Solenopterinæ, and may, to some extent, be regarded as a revision of that group. Outside of the Solenopterinæ the following genera and species are referred to or described:—

Stenodontes Chevrolati, sp. n.
—— damicornis, *Linn.*
—— exsertus, *Oliv.*
—— capra, *Dej.*
—— lævigatus, *Beauv.*
Mallodon bituberculatum, *Beauv.*
Elaphidion mutatum, sp. n.
—— tomentosum, *Chevr.*
Hormathus, g. n. (Ibidioninæ).
—— cinctellus, sp. n.
Phryneta verrucosa, *Drury* = P. melanoptera, *Thoms.*

Stenodontes Chevrolati, sp. n.

S. damicorni verisimilis, sed differt capite subtus valde rugoso-punctato; elytris nitidis, vix punctulatis.

Hab. Cuba.

* Compare Hérouard, *loc. cit.*

From *S. damicornis*, Linn., this species may be readily distinguished by the almost entire absence of punctuation from the elytra, as well as by the stronger and rugose punctuation of the underside of the head. In size, general form, and in the structure of the mandibles it agrees closely with *S. damicornis.*

The species was described by Chevrolat (Ann. Soc. Ent. de France, 1862, p. 273) under the name *S. damicornis*, Linn.—a very excusable error considering that the descriptions and figures of the latter species given by the older authors are equally applicable to the present species.

I am satisfied that the *S. damicornis* of Linnæus is correctly determined in the British Museum collection, as all the specimens are from Jamaica—the locality ascribed to it by Linnæus and Drury—and agree with a specimen so named in the Banksian collection. In all these specimens the elytra are scarcely glossy and are very finely and rather closely punctulate. The underside of the head is strongly enough, but not rugosely, punctured. In the fully-developed males the dorsal ridge of the mandible disappears gradually in front; in the males of *S. Chevrolati* this disappearance of the dorsal ridge is more abrupt.

From *S. exsertus*, Oliv., the males of *S. Chevrolati* may be distinguished by the strong inner tooth on each of the mandibles near its apex, and by the somewhat coarser punctuation of the underside of the head. I am unable to give characters which shall sufficiently distinguish the females of these two species. Locality and the character of the punctuation of the underside of the head may perhaps serve as helps. The specimens of *S. Chevrolati* in the British Museum collection are from Cuba, with the exception of one (a female) from the Bahamas; those of *S. exsertus* are from St. Domingo.

It is highly probable that the *S. capra* of Dejean and the *S. lævigatus* of Beauvois, both from St. Domingo, are forms of minor development of *S. exsertus*. The only differences I can detect relate to size and to the form of the mandibles, the latter in *S. capra* and *S. lævigatus* approaching more to the female form.

Mallodon bituberculatum, Beauv.

Judging from the figure and description of this species it seems to me that it is the female of *Mallodon maxillosum*, Drury.

Solenopterinæ.

Prosternodes scutellatus, sp. n.

Capite nigro, punctato; prothorace dorso in medio nigro, nitido, sparsim punctato et longitudinaliter sulcato; scutello pube sericea albo-flavescente dense obtecto; elytris basi nigrescentibus, deinde ferrugineis, omnino creberrime punctatis, marginibus apicalibus leviter denticulatis; episternis metathoracis, fascia obliqua metasterni utrinque, et vitta longitudinali abdominis utrinque, pube albo-flavescente sericea dense obtectis; pedibus nigrescentibus, punctatis; tarsis supra rufo-brunneis.

♂. Prothorace supra versus latera et subtus (medio excepto) minute confertissimeque punctato, marginibus lateralibus antice rotundato-curvatis; antennis corpore paullo brevioribus, articulis 4 apicalibus subtus sparsim villosis; tibiis anterioribus subtus versus apicem dense fulvo-villosis.

Long. 22–35 mm.

♀. Prothorace supra sparsim punctato, marginibus lateralibus subrectis, angulis anticis dentatis.

Long. 26 mm.

Hab. St. Domingo. British Museum collection and collection of Mr. Fry.

♂. Disk of the prothorax with two distinct, obtuse, longitudinal elevations, leaving a channel between; these elevations, the included channel, and a narrow oblique fascia on each side just anterior to the postero-lateral spine are all glossy and sparsely punctured; the rest of the surface of the pronotum is dull and finely and very closely punctured; the anterior margin of the prothorax is provided with a yellowish-white silky fringe. Scutellum somewhat semicircular and clothed with a dense yellowish-white silky pubescence. The elytra, at the base blackish, are for the rest of their extent of a reddish-ferruginous colour, and are entirely covered with closely-placed and rather strong punctures; the apical margins are faintly denticulate. A thick yellowish-white silky pubescence clothes the anterior coxæ and sides of the mesosternum, and forms a fascia on each of the metathoracic epimera, an oblique fascia on each side of the metasternum, and a longitudinal fascia on each side of the abdomen. The V-shaped figure thus formed on each side of the metathorax encloses a highly polished and impunctate space on the side of the metasternum. The middle regions of the sterna and abdomen are nitid and sparsely punctured. The abdomen is of a chestnut-brown colour. The legs are blackish and rather thickly punctured. The anterior tibiæ are furnished with a rather dense villosity underneath towards their distal end;

the anterior tarsi have a somewhat similar villosity on their posterior border. The antennæ, not much shorter than the body, are flattened below and slightly convex above; they are strongly enough punctured, with the punctures on joints three to seven chiefly confined to the lateral borders; the last four joints are somewhat villose underneath. The prosternal process is slightly emarginate behind.

Before seeing the female, which is in Mr. Fry's collection, I had placed this species in *Solenoptera*; but as the female has the sides of the prothorax nearly straight, with the anterior angles laterally produced or toothed, the species seems better placed in *Prosternodes*.

A distinct species from St. Domingo, to which Chevrolat had given the manuscript name *dominicensis*, somewhat resembles the preceding. The single male specimen in the collection is in too bad a condition for detailed description; but the chief points of difference may be mentioned:—Smaller (length 20 millim.). Antennæ relatively shorter, scarcely reaching to the middle of the elytra. Lateral margins of the prothorax less regularly crenulate. (Scutellum ?) Episterna of metathorax and sides of the abdomen with a less dense *greyish* pubescence. Metasternum without oblique fasciæ.

SOLENOPTERA, Serv.

That Chevrolat did not fully appreciate the chief differences between his genus *Elateropsis* and the genus *Solenoptera* of Serville is shown by the fact that he included in the former a true species of *Solenoptera*, viz. *S. sulcicollis*, Thoms. The scutellum in this species is as broad as it is long and somewhat rounded behind. In the male the pronotum is finely and very closely punctured towards the sides—a sexual character to be met with in all the species of *Solenoptera*, and, as far as I know, not occurring in the genus *Elateropsis*.

Lacordaire has passed unnoticed this sexual character, but has pointed out the form of the scutellum as of considerable importance in distinguishing the two genera.

Solenoptera bilineata, Fabr. (*Prionus*), Syst. Ent. p. 163, has been omitted from Gemminger and Harold's Catalogue. The specimens of this species in the British Museum collection are ticketed Guadeloupe and Santa Cruz.

Solenoptera subcanaliculata, White, appears to be synonymous with *S. canaliculata*, Fabr. Fabricius's description applies exactly to the type of White's species. It is, however, probable that authors have included more than one variety under the Fabrician name. Olivier has figured and described a species with brown elytra, though the Fabrician description reads "elytra subscabra, nigra." I cannot find Olivier's type in the collection of Banks, where it is stated to have been. The *S. asteria*, Buq., of Dejean's Catalogue is a very distinct variety from Martinique and Guadeloupe, and answers fairly well to Olivier's description and figure of *S. canaliculata*. The specimens of *S. subcanaliculata*, White, in the British Museum bear no indication of locality; but two specimens in Mr. Fry's collection are ticketed Trinidad.

In the footnote below* will be found described an interesting new species of *Solenoptera* from Colombia. The description is taken from a single male specimen in Mr. Fry's collection.

Elateropsis, Chevr.

In describing Cuban species of this genus Chevrolat has again erroneously made use of Linnean and Fabrician names. Under the name *E. lineata* he has mixed up two distinct species—one the true *lineata* of Linnæus and Fabricius, the other the following:—

Elateropsis punctata, sp. n., ♀.

E. lineatæ similis, sed differt elytris sat fortiter et dense punctatis.

Hab. Cuba.

* *Solenoptera intermedia*, sp. n.

♂. Obscure ferruginea; elytris brunneo-testaceis, marginibus lateralibus pallidioribus; capite dense punctato, tenuissime griseo-pubescente; prothorace medio dorsi fere plano, nitido, valde rugoso-punctato, versus latera et subtus (medio excepto) minute confertissimeque punctato; scutello elytrisque valde rugoso-punctatis; corpore subtus fortiter sat denseque punctato, episternis meso- meta-thoracisque pube albo-sericea dense obtectis; pedibus subscabroso-punctatis; antennis punctatis, dimidium corporis nec attingentibus.

Long. 33; lat. ad humeros 11, ad medium prothoracis 12 mm.

Hab. Colombia. In the collection of Mr. Alexander Fry.

The prothorax in this species is but very slightly depressed and almost flat along the middle of the disk; its width across the middle is slightly greater than that of the elytra; from the middle it is narrowed, with a rounded curve on each side up to the anterior border; the margins are very faintly crenulate on the anterior half; the constriction on each side at the base is deep but short, so that the postero-lateral angles are at a small distance from the shoulders of the elytra. Though undoubtedly belonging to the genus *Solenoptera*, the species is shown, by the characters here given, to be somewhat intermediate between the latter genus and the Central-American genus *Holonotus*, Thoms. In colour and form it somewhat resembles *S. Thomæ*, Linn., but may be easily distinguished by the characters given above.

Resembles very much *E. lineata*, Linn., but has the two longitudinal ridges on the disk of the prothorax more flattened and more strongly punctured, and has the elytra strongly enough and rather closely punctured, the punctures being distinctly visible to the naked eye.

In *E. lineata*, Linn., the elytra are glossier and almost impunctate, the punctures being distant and so minute as to be scarcely visible except with the aid of a lens. In some specimens of *lineata* the elytra are very feebly coriaceous.

Chevrolat seems to have regarded the specific differences here given as sexual; but in this he was evidently mistaken, for the British Museum collection (including that of Chevrolat) does not contain a single male of either species, unless the view to be referred to further on can be accepted as correct.

Elateropsis rugosa, sp. n., ♀.

E. lineatæ similis, sed minor; elytris rugoso-punctatis; antennis fusco-ferrugineis.

Hab. —?

A single female example represents this species in the British Museum collection. In form and style of marking it resembles the preceding, but is sufficiently distinguished by the strong rugose punctuation of the disk of the prothorax and of the elytra. The antennæ are dark ferruginous towards the base, fuscous towards the apex.

A smaller (male) specimen, of a similar style of sculpture, devoid of pubescent bands or markings and with black antennæ, may possibly prove to be the male of this species. It also bears no indication of locality.

Elateropsis fuliginosa, Fabr., ♂.

In the males of this species the elytra are nitid, smooth (excepting a feeble rugosity towards the base), and are remotely and minutely punctulate.

These remarks also apply to *E. subpunctata*, Chevr., and, with the types of the two species before me, I am unable to discover any difference between them except one of size. *E. subpunctata* must, I think, be regarded as identical with, or at most as a small variety of, *fuliginosa*, Fabr. It must be remembered that Chevrolat in describing *subpunctata* compared it, not with the true *fuliginosa* of Fabr., but with *fuliginosa*, Chevr.—quite a distinct species, to which may be restored the following name, previously made use of by Chevrolat in manuscript:—

Elateropsis scabrosa, sp. n.

=*E. fuliginosus*, Chevr. (nec Fabr.), Ann. Soc. Ent. de France, 1862, p. 271.
=*Solenoptera scabrosa*, White, Cat. Brit. Mus. Longicornia, i. p. 53.

Nigra, subopaca; palpis, antennis pedibusque rufo-fulvis; prothorace dorso et elytris crebre subrugosoque punctatis.
Long. 23–31 mm.

Hab. Cuba, ♂ and ♀.

The females of this species are strongly and coarsely punctured on the disk of the prothorax and on the elytra. The antennæ do not reach quite to the middle of the elytra, and their last joint is short, scarcely, if anything, longer than the preceding joint.

The males are slightly less strongly sculptured; their antennæ reach beyond the middle of the elytra, and have the last joint distinctly longer than the preceding.

I have already mentioned that all the specimens of *E. lineata* and *E. punctata* in the British Museum collection are females. All the specimens of *E. fuliginosa*, Fabr., and *E. subpunctata*, Chevr., are, on the other hand, males. From these facts I have been led to suspect that *E. fuliginosa*, Fabr., is the male of *E. lineata*, Linn.; and this suspicion has been strengthened by finding that all the white-striped specimens of *Elateropsis* in the collection of Mr. Alexander Fry, who very kindly sent me the whole of his Solenopterinæ for examination, are also females, while the unstriped glossy specimens referable to *fuliginosa* and *subpunctata* are males. I have thus seen altogether twenty-two specimens, all females, of the three white-banded species mentioned above, and eleven specimens, all males, of *E. fuliginosa*, Fabr., and its questionable variety *E. subpunctata*, Chevr.

If it is proved to be the case that the white bands in the species of this genus are confined to the females, then it is very likely that some of the less strongly punctured specimens which I now regard as males of *E. scabrosa* are really males of *E. punctata*.

In *E. ebenina*, Chevr., there is no marked sexual difference, the males having the antennæ slightly longer than in the females, with the last joint relatively somewhat longer.

The described specimen of *E. venusta*, Chevr., is a female, and not a male as stated by Chevrolat in his description.

Elateropsis reticulata, sp. n.

♀. Nigro-fusca, opaca; capite dense punctato, tenuissime griseo-pubescente: prothorace fortiter rugoso-punctato, vitta obsoleta utrinque fulvo-pubescente; scutello punctato; elytris fortissime creberrimeque punctatis, castaneo-fuscis, versus latera et ad apicem rufo-castaneis, marginibus apicalibus distincte denticulatis; corpore subtus sparsim punctato; episternis mesothoracis, plaga triangulari mesothoracis utrinque et maculis quatuor abdominis utrinque fulvo-pubescentibus; segmento ultimo abdominis apice leviter emarginato; antennis dimidium elytrorum vix attingentibus, rufo-ferrugineis, versus apicem suf-fuscis, pedibus rufis, sparsim punctatis.
Long. 17, lat. 6 mm.

Hab. Cuba. In the collection of Mr. Alexander Fry.

The prothorax is convex above, with a very feeble channel or depression along the middle of the disk; on each side, in the unique specimen, there are traces of a fulvous pubescent vitta. The elytra are covered with a very strong, close, and reticulate punctuation.

This species most nearly resembles *E. 5-notata*, Chevr., but differs by its brownish elytra, its somewhat reddish antennæ, and reddish legs, by the triangular fulvous patch on each side of the metathorax, and finally by its punctuation.

E. 5-notata, Chevr., has the antennæ and legs black, the elytra almost entirely black. The prothorax is strongly and rather thickly, but not rugosely, punctured. The elytra in the type specimen are unfortunately much deformed, one being shorter than the other, and both being raised in places into large gall-like protuberances. Throughout their greater extent they are covered with intricate ridges. The body underneath is black, with here and there a faint greyish pubescence; the mesothoracic episterna are covered with a thick whitish pubescence.

The (*Prionus*) *vittatus* of Olivier, which the authors of the Munich Catalogue have placed in the genus *Elateropsis*, more probably belongs to the genus *Derancistrus*, Serv., and is possibly the male of *D. elegans*, Beauv.

Harmosternus, gen. nov.

Head excavated in the middle in front; the excavation continuous with a rather broad and shallow channel above.

Maxillary palpi much longer than the labial, their last joint securiform; the last joint of the labial suboblong. Antennæ reaching beyond the middle of the elytra, with the joints from the third slightly dilated towards their apices and each provided with one or two poriferous pits. Prothorax about as long as broad, and furnished on each side with two spines —one just behind the middle, the other between this and the anterior border; with the margin cut away obliquely in front of the anterior spine and sinuate between the two spines, as well as behind the submedian spine. Scutellum broader than long, slightly emarginate in the middle behind. Elytra very slightly and gradually narrowed towards the posterior extremity, each provided at the suture and at the extremity of the lateral margin with a small tooth; the apical margin between these teeth very feebly denticulate. Prosternal process truncate behind and very closely applied against the anterior border of the mesosternal process; the latter with a triangular emargination behind which receives the anterior termination of the metasternum.

This genus is perhaps most nearly related to *Elateropsis*, from which it differs by the bispinose margins of the prothorax, the posteriorly truncate and non-emarginate prosternum, and the short and broad scutellum.

Harmosternus anthracinus, sp. n.

♂. Niger; palpis femoribusque rufis; capite punctato; prothorace dorso inæquali, valde subrugosoque punctato; scutello subconcavo, sparsim punctato; elytris valde crebreque punctatis, punctis versus basin majoribus; tibiis tarsisque castaneo-fuscis; abdomine nigro, nitido, sparsissime punctato; antennis nigris, sparsim punctatis.

Long. 24, lat. 8 mm.

Hab. Cuba. In the collection of Mr. Alexander Fry.

Coal-black, with the palpi and femora reddish, the tibiæ and tarsi dark chestnut; slightly nitid on the middle of the prothorax and elytra. Prothorax uneven on the disk, strongly and somewhat rugosely punctured above, sparsely punctured underneath, with a space on the side just under the anterior half of the lateral margin more minutely and very closely punctured. Scutellum slightly concave from side to side, sparsely punctured. Elytra very strongly and closely punctured, with the punctures increasing in size and less closely packed towards the base. Abdomen very glossy and very sparsely punctured.

Elaphidion mutatum, sp. n.

Elaphidion tomentosum ♀, Chevr.

Castaneum, pube grisea dense obtectum, prothorace dorso quinque tuberculis—tuberculo medio cariniformi, tuberculis duobus posticis obsoletis; elytris basi dense punctatis, punctis pone medium evanescentibus, singulis elytris humero et plaga dorsali prope medium subnudis, castaneis, apicibus singulis bispinosis; antennis articulis 3^o et 4^o uni-, 5^o–10^m bispinosis.

Hab. Cuba, Florida.

Under the name *Elaphidion tomentosum* Chevrolat included two very distinct species. The females which he has described are the females of the present species, the male of which I saw in the possession of Dr. Horn when he was last on a visit to England. Two female specimens from St. Domingo, which are undoubtedly the females of *E. tomentosum*, are in the British Museum collection. Except in the much shorter antennæ these two present no differences of importance from the male. Like the male they have the prosternum truncated and vertical behind. In *E. mutatum* the prosternum is feebly arched and almost flattened behind, the species therefore belonging to the *Hypermallus* section of the genus. The spines at the apices of the joints of the antennæ do not stop with the seventh joint, as Chevrolat's description seems to imply, but, gradually becoming smaller, are met with up to the tenth joint. Dr. Horn's male specimen, which was from Keys, Florida, differed from the females only in having slightly longer and slenderer antennæ and in having the apical border of the last abdominal ventral segment pointed in the middle and sinuate towards the sides. In the female this segment is rather sharply rounded at the apex.

E. tomentosum, Chevr., bears a very strong resemblance to *E. mucronatum*, Say, but is to be distinguished by the much less close punctuation of the elytra and of the sides of the prothorax.

Hormathus, gen. nov.

This genus is formed for an interesting little species from St. Domingo belonging to the *Ibidion* group. It has the characters which Lacordaire has given for the genus *Cycnidolon*, with the following differences and additions:—Fifth joint of the antennæ, in addition to the third and fourth, strongly thickened, none of the joints carinated. Prothorax very slightly constricted in front of the middle. Elytra with their apices rounded and unarmed. Intermediate and posterior femora end in short rounded processes, and may be said to be unarmed. The femora have each a short carina on each side near their distal extremity. The antennæ in the male are but very little longer than the body. The body is almost wholly glabrous and furnished with some widely scattered long hairs.

From *Phormesium*, to which the genus is perhaps even more closely allied, it differs by the carinated tibiæ, the rounded apices of the elytra, and the two additional swollen joints of the antennæ in the male.

Hormathus cinctellus, sp. n.

Ibidion cinctellum, Chevr., MS.

Niger, nitidus; capite punctato; prothorace dorso leviter tri-tuberculato; elytris chalybeato-cyaneis, vix punctatis, singulis ad medium fascia transversa, nec suturam nec marginem attingente, flavescenti-alba; pedibus nigris, basi pedunculatis; antennis fuscis, (♂) corpore vix longioribus, articulis tertio ad quintum valde incrassatis, (♀) corpore multo brevioribus.

Long. $5\frac{1}{2}$–7 mm.

Hab. St. Domingo.

Head rather thickly punctured. Prothorax and elytra destitute of punctures, excepting the pits from which the few long scattered hairs come off. Elytra steel-blue, glossy, with purplish tints; each with an ivory-like transverse spot or fascia at about the middle of its length. Antennæ with the scape punctured, with, in the male, the third joint much longer and thicker than the scape and attenuate at its base, the fourth joint short, ovate, the fifth longer than the fourth, fusiform, the sixth and following joints normal, each about equal in length to the fifth. Body underneath glabrous, excepting a faint silvery-grey pubescence on the lateral pieces of the mesothorax and on the postero-lateral angles of the metasternum.

Phryneta verrucosa.

Lamia verrucosa, Drury, Exotic Insects, vol. i. p. 90, pl. xl. fig. 3.
Lamia sternutator, Fabr. Syst. Eleuth. ii. p. 293.
Phryneta melanoptera, Thoms. Rev. et Mag. de Zoologie, 1878, p. 65.

This interesting species appears to have been omitted from Gemminger and Harold's Catalogue. The genus to which it belongs is peculiarly an African one; but the present species was said by Drury and Fabricius to come from Barbadoes, a locality which the recent acquisition of some fine specimens to the British Museum collection proves to have been quite correct. M. Thomson, however, in redescribing the species under the name *Phryneta melanoptera*, ignored the fact that his specimen was ticketed Grenada, and assigned to the species the vague locality "Africa merid." M. René Oberthür, in whose possession Thomson's collection now is, has, at my request, compared Thomson's type of *melanoptera* with Drury's figure and description of *verrucosa*, and has assured me that the two species are undoubtedly identical. The species has not, so far as I know, been recorded from Africa, except, inaccurately, in the case just cited. Its presence in the Antilles can only be explained on the assumption that it was at one time transported from Africa.

In Mr. Fry's collection I have seen specimens from Trinidad and Barbadoes.

III.—*On the Ova of* Gobius. By Ernest W. L. Holt, St. Andrews Marine Laboratory.

[Plate II.]

On the 13th May, 1890, a dead shell of *Lutraria elliptica* was kindly given to me by Miss Traill, of St. Andrews, who had found it the previous day cast ashore on the West Sands, and whilst removing the sand with boiling water had detected certain foreign bodies adhering to it. This lady subsequently gave me two shells of *Solen siliqua*, collected on the same occasion, with similar bodies attached.

On examining the shell of *Lutraria*, the two valves of which were still united by the ligament, it was found that the inner surface of the left valve was entirely covered, save for a narrow margin, by a number of little whitish bodies.

The valves of both the razor-shells were widely open, and on the inner surface of the valves in each specimen a subcircular patch of similar bodies (about 2 inches in diameter) occurred.

The whitish bodies, on being submitted to the microscope, proved to be the ova of some Teleostean, and, from certain peculiarities of structure, are conjectured to be those of a goby, probably *Gobius minutus*, by Professor M'Intosh, who has kindly asked me to undertake their description.

The egg is elongated, its long diameter varying from 1·14 to 1·2 millim. The contour is somewhat pyriform and the narrow end (having a diameter from ·42 to ·48 millim.) is blunt and almost truncated. The larger end, on which the egg rests, is from ·68 to ·74 millim. at its greatest width and tapers rapidly below that point to a small facet or pedicle of attachment.

As seen in Pl. II. fig. 3, the shape of the egg is subject to slight variation. Of the egg-contents it is difficult to speak with certainty, as the treatment received may well have induced some changes.

In those which appeared to be the best preserved the perivitelline space is large and is principally in the lower region of the egg. The yolk is bean-shaped, and the embryo, which is somewhat advanced though without free caudal growth, lies in the long axis of the egg. Yolk and embryo together have a long and short diameter of about ·91 and ·37 millim. respectively. Both are of course opaque, but it is possible to make out what appear to be very numerous oil-globules of various sizes, occurring all over the yolk and apparently forming the bulk of that structure.

The zona radiata is very thin, showing under a high power the usual closely-set minute dots or punctures.

The apparatus for the attachment of the egg is the most remarkable feature. From the facet or pedicle of attachment (fig. 1, *p*) springs a hyaline structure, which spreads outward in the form of an umbrella. Under a high power this structure is seen to be pierced by alternate concentric rows of diamond-shaped or ovoid apertures (fig. 1, *sp*), which increase in size the further they lie from the pedicle, whilst, on the contrary, the proximal interstitial hyaline matter is more massive than that surrounding the more remote rows of apertures. Three or four such rows of apertures can be made out, beyond which the structure is continued in the form of a fringe of long and tapering threads, which adhere to the shell and to the threads of the adjacent ova (fig. 1, *fil.*). The ova, though very closely packed together (fig. 2), do not adhere to each other or to anything except by means of this tissue.

From the nature of the apertures the whole structure has the appearance of being composed of a number of threads, radiating from the pedicle and so arranged as to cross each other frequently in the proximal part of their course. But the closest examination under a high power (Zeiss D, Oc. 2) fails to support this appearance. The interstitial matter between the proximal rows of apertures is entirely homogeneous and cannot be resolved into fibres either in stained or unstained specimens; but between the larger distal apertures one can frequently make out a division into two strands, which do not as a rule cross each other, but seem to be merely apposed.

Filaments or processes are known to occur on the eggs of many Teleosteans. They were found by Hoffmann* in *Gobius minutus*, *niger*, and other species, *Heliasis chromis*, *Belone*, and *Blennius*. Eigenmann, in his recent excellent memoir "On the Egg-membranes and Micropyle of some Osseous Fishes" †, very clearly describes the development of the filaments in *Fundulus*. In this form they are developed all over the surface of the egg, whereas in our ova the process of attachment is confined to what is presumably the micropylar region. In *Fundulus* the filaments, originally arising internal to the granulosa, are shown to pass through and, in further development, to lie external to it, being "bent in a more or less regular manner first to one side and then to another," and "usually follow the margins of the granulosa cells," to which they are "correspondingly curved."

Eigenmann also notices rivet-shaped processes on the eggs of *Pygosteus*, and from certain phenomena noticed in his preparations suggests that "they are from the beginning adhesive." He describes a layer external to the zona in all eggs on which processes are found. Whether such a layer exists here I cannot say, nor can I speak with accuracy as to the relation of the attachment process to the zona.

But it seems possible that filaments may be developed in this form as in *Fundulus* and *Pygosteus* (though confined to a restricted area), and penetrating the granulosa in due course, so as to lie along the margins of the granulosa-cells, and "being from the beginning adhesive," may have set up with each other intimate relationships, resulting in the formation, by the adhesion and ultimate fusion of their proximal elements, of such a structure as is actually found in the extruded ova before us. The distal parts of the filaments, not coming into contact with each other, and thus remaining independent, may perhaps have extended over a considerable part of the granulosa, and the whole pedicle of attachment is probably everted on extrusion of the egg in the same manner as the outer membrane of the zona in *Osmerus*, described by Buchholz and Cunningham.

Eigenmann speaks of his "rivet-shaped processes" in *Pygosteus* as taking a much deeper stain than the membrane (external to the zona) in which they are set. Treated with

* Hoffmann, "Zur Ontogenie der Knockenfische," Verhandel. d. Kon. Ak. v. Wetenschappen, Amst. Deel xxi. 1881, p. 19.

† Bull. Mus. Comp. Zool. vol. xix. no. 2.

picro-carmine the pedicle of attachment in our ova takes the carmine stain very deeply, whilst the zona (and external membrane if present) is quite unaffected by it.

This seems to induce the belief that the process of attachment is similar in nature to filaments of an external membrane rather than representing an everted membrane as in *Osmerus*.

Turning to the question of the parent fish, Professor M'Intosh has kindly given me a drawing of the eggs of *Gobius niger* from the Channel Islands, which will be seen to present some points of resemblance to those under discussion. Both are considerably elongated and both possess filamentous processes at their lower ends. In *G. niger*, however, the meshwork is less distinct than in ours and the eggs are fixed in rows by the interlacing of their filaments. In both forms the perivitelline space would appear to be large *.

Of the nature of the yolk in Professor Prince's specimens or in *Gobius niger* I am unable to speak. The yolk in our eggs, however, presents great likeness to that of a larval form common in this bay and long since identified by Professor M'Intosh with a species of goby. Two species are common here, viz. *G. Ruthensparri* and *G. minutus*. In the Seventh Annual Report of the Scotch Fishery Board Professor M'Intosh, writing "On the Pelagic Fauna of the Bay of St. Andrews during the months of 1888," mentions young gobies (chiefly *G. minutus*) as occurring in some numbers in the net in July and August, ranging in size from 3·5 to 11 millim. Their occurrence much earlier (at stages too young for diagnosis of species according to our present knowledge of this genus) is frequent, but their ova have never been found here, probably because other forms have occupied attention. A few larval forms appeared this year in April and May, of one of which I append a figure (fig. 6). Larval gobies are readily distinguished by the characteristic pigmentation and very early appearance of a conspicuous air-bladder. The specimen figured measured 3·57 millim. The anus is slightly anterior to median, the pectorals are large and fan-

* Professor Prince, writing to me from Valentia under date May 25, 1890, describes some eggs that had just been found, during the cruise under the auspices of the Royal Dublin Society, in the pools about the Beginnish Islands. In shape they strongly resemble those of *G. niger*, and they are placed side by side on end, as in our form. From a rough sketch the perivitelline space appears very large; the length is about $\frac{1}{16}$ inch. Professor Prince is developing these eggs, and will no doubt be able to throw some light on to their species. Judging from the fact that a female *G. Ruthensparri* was taken in the same pool, he thinks it probable that they belong to that species.

shaped, the embryonic dorsal fin commences opposite the pectoral girdle. Embryonic fin-rays occur in the slightly spathulate embryonic caudal fin. There is a considerable preanal fin. The notochord is unicolumnar, and the hyoidean and mandibular apparatus well developed. The eye is greenish yellow. Black stellate chromatophores occur below the anterior end of the notochord, extending back as far as the air-bladder. Yellow pigment occurs amongst them. The air-bladder is greenish, with black dendritic pigment scattered over it. Above the anus and halfway between that point and the air-bladder occur two large masses of gamboge-yellow pigment (reddish brown by transmitted light), over each of which extends a large black dendritic chromatophore. Small black chromatophores extend along the ventral edge of the anterior two thirds of the abdomen and along the ventral edge of the postanal region to a point a little short of the caudal extremity. Halfway between the anus and the caudal extremity is another large yellow patch, overlaid by dendritic black pigment on the ventral region, and a similar but smaller dorsal patch lies just above it. No pigment occurs on the embryonic fins. The yolk is considerably reduced. It is darkish and appears to consist almost entirely of small oil-globules.

It is to be regretted that the information given by British authors as to the breeding of the Gobies is rather vague. Day ('British Fishes') gives June as the breeding time of *G. niger* and *G. minutus*, and May or June as that of *G. paganellus*. He also mentions, on the authority of a correspondent, that *G. Ruthensparri* attaches its eggs to the inside of an empty valve of *Mya arenaria*, but does not describe the egg or the method of attachment.

From the same authority it appears that the late Mr. Roberts, of the Scarborough Museum, had frequently bred this species in confinement.

Parnell ('Fishes of the Forth') mentions that *G. niger* and *G. gracilis* (*Parnelli*) spawn in June.

Couch ('British Fishes,' ii. p. 154) found a black Goby with enlarged roe in February, and very young ones which appeared to belong to the same species in the autumn. Beyond this I can find no information.

Note.—Since making the foregoing remarks two females of *Gobius minutus* were brought to the Laboratory from the estuary of the Eden *, the contents of whose ovaries leave no doubt but that this is the parent species.

* May 27, 1890.

I regret that great pressure of time * prevents me (as with the extruded ova) at present from making more than a superficial examination of them; but I hope at a future date to treat the subject in a manner more worthy of it. Meanwhile, however, in the light of my previous remarks a few notes may be of interest.

The two specimens (the stomachs of which were full of the *Cypris*-larvæ of *Balanus*) measure respectively 2 and $3\frac{1}{4}$ inches, and the ovaries, which are by no means ripe, are nearly in the same condition in both. The largest ova measure from ·6 to ·71 millim. in long diameter; they are ovoidal, with one end much broader than the other.

Numerous oil-globules can be made out, distributed in an irregular manner amongst the granular yolk-matter. The thin zona is visible by careful focusing adhering closely to the yolk, and having outside it another layer in which minute dots, presumably nuclei, are present—in fresh unstained specimens under a high power. This layer, the granulosa, is in its turn covered by the process of attachment (which is exactly similar to that of the extruded ova), a fact which justifies the supposition that the latter was everted at extrusion, as is the outer membrane in *Osmerus*.

The micropyle, a minute funnel-shaped depression, can be made out in favourable unstained specimens, where it is not hidden by the ruptured follicular epithelium. It lies at the broad end of the egg, and the process of attachment stretches out on all sides. The meshwork of the latter ceases at the broadest part of the egg, and the filaments continuous with it pass upwards side by side almost to the opposite (narrow) end of the egg, but do not actually meet there.

In fresh specimens treated with picro-carmine the process of attachment takes the carmine stain more rapidly than any other part, the granulosa taking it slowly, if at all. In smaller eggs, *i. e.* half the size of the foregoing, the process of attachment is not seen, but minute, deeply staining dots are visible at the broad end of the egg, and probably represent its earliest appearance. The larger stained eggs show an intimate connexion between the process and the zona for a short distance around the micropyle, being the area which afterwards becomes the pedicle. The apertures are comparatively more elongated in this region, with finer interstitial matter (closely applied to the zona), which suddenly thickens at the margin of the pedicle. I could detect no layer between the zona and

* [Mr. Holt left within a few hours for the trawling expedition on the west coast of Ireland.—W. C. M.]

the granulosa, nor, I think, is this possible without the aid of the microtome.

EXPLANATION OF PLATE II.

Fig. 1. Process of attachment of ovum attributed to *Gobius minutus*; the filaments are mostly curtailed. *fil*=filament; *p*=pedicle of attachment; *sp*=apertures in process of attachment; *z. r.*=zona radiata. (Zeiss D, Oc. 4.)

Fig. 2 Group of ova *in situ*. × 3.

Fig. 3. Detached ova highly magnified. *a. p.*=process of attachment; *e*=embryo; *y*=yolk.

Figs. 4, 5. Ova of *Gobius niger* from glycerine-preparations, enlarged under lens.

Fig. 6. Larval *Gobius* of 14th May, 1890; length 3·57 millim. *a. b.*=air-bladder; *h*=heart; *n*=notochord; *y*=yolk. Magnified.

IV.—*Notes on Radiolaria from the Lower Palæozoic Rocks (Llandeilo-Caradoc) of the South of Scotland.* By George Jennings Hinde, Ph.D.

[Plates III. & IV.]

The Radiolaria described in this paper are contained in specimens of chert collected from several different localities in the Southern Uplands of Scotland, and sent to me for examination by the Geological Survey of Scotland through B. N. Peach, Esq., F.G.S. From the most promising pieces of this chert a number of microscopic sections have been prepared, and from these the forms have been studied. I may premise that the occurrence of these minute organisms in this chert was first announced by my friend Prof. H. Alleyne Nicholson, M.D.*, of Aberdeen; but the specimens which he examined did not show the structure sufficiently well to allow of positive determination as to their real nature.

The chert containing the Radiolaria occurs in beds and intercalated nodular masses in a portion of the well-known series of Ordovician or Lower-Silurian strata forming the Southern Uplands of Scotland; and it is more particularly developed in the counties of Lanarkshire, Peeblesshire, and Edinburghshire. Mr. B. N. Peach †, who has lately been resurveying the district, informs me that he has traced a defi-

* Trans. Edinb. Geol. Soc. vol. vi. pt. i. p. 56 (1890).

† A full description by Mr. Peach of the geological and stratigraphical relations of these rocks will appear in a forthcoming Geological Survey Memoir on Sheet 16.

nite zone of this Radiolarian chert over a considerable area. The zone is bounded below by a thin band of black shale containing Glenkiln graptolites of Llandeilo facies, and above it there is another mass of black shale with Lower Hartfell fossils, having a Caradoc facies. The zone included between these two beds of graptolitic shale consists, from below upwards, of nodular red and green cherts and red and green mudstones, followed by massive grey mudstones and cherts, mudstones and shales, succeeded above by black flints and shale, with a few Glenkiln graptolites. This Radiolarian zone of Mr. Peach thus corresponds with the Lower and part of the Middle Division of the Moffat Terrane of Prof. Lapworth (Geol. Mag. dec. iii. vol. vi. (1889) p. 66). Hitherto in this series of rocks the graptolitic zones have been chiefly studied and the intermediate beds of chert, regarded as unfossiliferous, have been neglected; but it is now certain that these latter are of organic origin equally as much as the former.

The Radiolarian chert is a very hard compact rock, with the usual hackly fracture; when unweathered it is for the most part of a steely-blue tint, but sometimes of a dull to a bright red; less frequently it has a greenish tint, and some pieces are even of a bright green. The rock is traversed in all directions by microscopic cracks and fissures, these latter now filled with crystalline quartz, and not unfrequently it is stained in irregular patches by a dark brown or blackish substance, which often follows the course of the microscopic cracks, so that they appear in sections like an intricate web of dark threads crossing a clear field. The mudstones accompanying the chert are greenish or reddish in tint and very fine-grained; in some cases they become siliceous and pass gradually into chert; in these transition-beds casts of Radiolaria are present in the rock.

In thin sections under the microscope the unstained portion of the chert is nearly transparent; it has a faint cloudy appearance, due to the presence of extremely minute irregularly-shaped mineral particles and small crystalline rods ranging from ·002 to ·06 millim. in length, with which it is filled. The nature of these minute particles cannot well be ascertained; but Mr. J. J. H. Teall, F.R.S., who has examined the sections, thinks that some may be flakes of mica, whilst the rods are suggestive of rutile. In polarized light, between crossed Nicols, this chert has a mottled appearance, more like that of flint than of ordinary chert.

Even with the aid of an ordinary hand-lens the fractured surface of the chert is seen to be filled with countless numbers of the Radiolaria, which appear as minute, clear, circular specks; in thin sections of the unstained rock under the microscope they look like larger and smaller shadowy circles filled with a somewhat lighter material than the surrounding matrix; but in this condition no structure has been preserved. In sections of the red or jaspery chert the outlines of the Radiolaria are more clearly defined; the inner tests are occasionally shown as small red globes in the centres of larger, nearly transparent spheres, and not unfrequently the radiating spines are also indicated. In the red jaspery chert the enormous number of these organisms in the rock can be clearly seen, for the entire area of the section is occupied by their small circular outlines, which range from ·01 to ·25 millim. in diameter.

In the unstained and reddish chert just referred to the Radiolaria are only represented by casts, their tests having been dissolved or otherwise rendered undistinguishable; but where the chert has been stained by the darker substance mentioned above, which may be either due to carbon or iron, the tests themselves have been preserved in this material, which has replaced the original silica. In this condition the delicate lattice-like structure of many of them is now represented by a more or less dark meshwork, which, though as regards clearness of outline cannot be compared with the tests of recent or Tertiary fossil Radiolaria, is yet sufficient to show that the structure of these Palæozoic forms is essentially of the same character as that of their modern descendants. In these stained portions, which, as already noticed, occur as irregular patches in the generally transparent rock, fairly perfect specimens of Radiolaria showing one or more concentric spheres, and spines projecting from their surfaces, are intermingled with fragments of the meshwork, and entire and broken spines of other individuals, much in the same way as the entire forms and the fragmentary débris of these organisms occur in the unconsolidated Radiolarian earth from Barbados.

It is, however, often very difficult to ascertain with precision in the sections those particular features which form the basis of most of the family and generic characters in Hæckel's classification of these organisms. The tests are usually so filled with the dark staining material that they are either entirely opaque or present a blurred appearance. In these cases it is impracticable to determine definitely whether the structure was originally "lattice-like" or of an irregularly reticulate or "spongy" character, or whether an inner medullary test is present or not. The specimens available for study are limited to those shown in the sections of the chert, and consequently very few in comparison with the numbers which may be obtained from a recent ooze or from loose fossil material.

With two or three doubtful exceptions the forms which I have been able to determine in this chert may be all included in one of the four legions or subclasses into which Hæckel has divided the Radiolaria, viz. that of the Spumellaria or Peripylea. Within this subclass but two suborders, the Beloidea and the Sphæroidea, are represented. In the first of these there is no connected siliceous test; but the skeleton consists of numerous solid siliceous spicules irregularly scattered in the soft structures surrounding the central capsule. Spicules of similar form and proportions to those of the existing members of this group, represented in plates ii. and iv. of Hæckel's 'Challenger' Report, are abundant in the chert. Some of them with three- or four-pointed rays (woodcut, *a–f*, p. 56) are very similar in form to the spicules of Calcisponges; others, however, with a central rod giving off divergent rays from its extremities (woodcut, *g*) are quite distinct from any known type of sponge-spicule. These detached spicules are in the same condition as the lattice-like Radiolaria with which they are intermingled, and there can be no doubt that like these latter they were originally siliceous. Though now detached from their normal positions, the inevitable result of the decay of the soft structures, yet instances are not unfrequent in this chert where several of these Beloid spicules occur in close proximity to each other, forming small groups, much in the same way as we should expect to be the case if forms like the recent *Lampoxanthium pandora*, Hæckel *, and *Sphærozoum pandora*, H.†, were fossilized under favourable conditions.

The great majority of the Radiolaria in this chert, however, belong to the more normal types of the suborder Sphæroidea, in which the test consists of one or more rounded shells with a lattice-like or irregularly reticulate, so-called "spongy" structure. The simplest forms of these, in which the test is without spines or with only very minute secondary spines, are comparatively rare (Pl. III. figs. 1, 2). Tests in which there is a single large radial spine, with or without secondary spines, are abundant. In some the outer or cortical test consists of simple lattice-like structure with subcircular or irregular meshes (Pl. III. figs. 3, 4, 5, Pl. IV. fig. 3); in others the structure is "spongy" (Pl. III. fig. 7), whilst in another genus with the same structure there is a concentric inner or medullary test (Pl. III. figs. 8, 9). Shells with three or with

* Chall. Report, pl. ii. fig. 1.

† *Ibid.* pl. iv. fig. 6.

four primary radial spines, some with, some without an inner or medullary test, are also common (Pl. III. fig. 6, Pl. IV. figs. 2, 4–7, 9–11); the structure of these appears to be uniformly of the irregularly reticulate or spongy character. The spines in some of these shells are of unusual length (Pl. IV. figs. 2, 9), but it is very rare to meet with specimens in which they all remain intact. There are also a few specimens with lattice tests and numerous smaller spines (Pl. IV. fig. 1) included in the well-known recent genus *Acanthosphæra*, Ehrenberg, and others with larger spines (Pl. III. fig. 11, Pl. IV. fig. 8) which I have referred to *Haliomma*.

In addition to the above, mention may be made of some peculiar spicules (woodcut, p. 56, *i*, *k*, *l*) of the same general characters as the Beloid forms already referred to, which seem to correspond to the spicular skeletons of some existing Radiolaria, which are regarded by Hæckel as the simplest and most primitive types of the great primary division of the Nassellaria, in which they form the distinct suborder Plectoidea *. The spicules in question consist of a variable number of simple or branched arms or rays proceeding from a centre; the rays may be either free or connected by irregular fibres with each other. Spicules of this type are rare and not often entire, and their true position is not altogether free from doubt.

These Palæozoic Radiolaria, so far as can be judged from their present condition, do not differ in any striking respect from the existing forms of the group or from those numerous fossil ones which have been lately described by Dr. Rüst † and others from Jurassic and Cretaceous strata. Some of the more peculiar forms with one or with three primary radial spines bear a close resemblance to specimens figured by v. Dunikowski ‡ from the Lower Liassic strata of Schafberg, in the Tyrol. The detached spicules of the Beloidea have likewise been noticed by Rüst in the Radiolarian Jurassic strata of the continent. The quantity of this ancient chert which has as yet been examined is too small to permit of any general deductions as to the characters of the Radiolaria contained in it; but it is noticeable that so far, if we except the few spicules doubtfully referred to the Nassellarian Plectoidea, the forms belong to only two divisions of the Spumellaria, the Beloidea and the Sphæroidea; and there is an apparent absence not only of the discoidal and elliptical forms of the

* Chall. Report, pt. ii. p. 899, pl. xci.

† 'Palæontographica,' Bd. xxxi. (1885), Bd. xxxiv. (1888).

‡ Denkschr. d. k. Akad. d. Wiss. Wien, Bd. xlv. (1882), pp. 187, 188, Taf. v. figs. 53–55, 59.

other suborders of this legion, but also of the important Nassellarian Cystellaria, which are extremely abundant both in recent deposits and in all Tertiary and Mesozoic Radiolarian beds which have as yet been examined.

With the exception of the Radiolaria very few other organisms can be recognized in the sections of this chert-rock. There are one or two spicules of Hexactinellid sponges, readily distinguishable from the detached Beloid spicules by their larger size and distinctive forms, and I have met with a few minute toothed plates and detached denticles, which bear a certain resemblance to the radulæ of naked Molluscs; there are further numerous almond-shaped hollow bodies about ·1 millim. in length, with imperforate siliceous walls, of whose nature I am quite ignorant. This Ordovician chert may therefore be fairly considered to be due to the accumulation of the tests of Radiolaria, and is thus a *pure* Radiolarian rock, equally as much as the Tertiary beds of Barbados and the Nicobar Islands, which, according to Hæckel, correspond to the recent Radiolarian ooze, "and are certainly of deep-sea origin, having probably been deposited at depths greater than 2000 fathoms" *. If the same conclusion is applicable to this fossil chert, it represents, as Prof. H. A. Nicholson † has already pointed out, a true deep-sea deposit in the Palæozoic period, the existence of which in the geological series has of late been disputed. The beds of fine-grained red and green mudstones associated with this chert likewise favour the same view of its origin in deep water.

Hitherto only a single species of Radiolaria has been described from the entire Palæozoic series, and this was discovered by Dr. Rothpletz ‡ in siliceous shale of Upper Silurian age at Langenstriegis, in Saxony. This Radiolarian shale, like the Scotch chert, is accompanied by beds with graptolites. It is only since 1876 that Radiolaria were known in any rocks older than Tertiary by the discovery by v. Zittel § of a few forms in the Upper Chalk of Germany; since then the existence of an abundant and varied Radiolarian fauna in beds of chert and jasper of Lower Cretaceous and Jurassic age has been proved by Dr. Rüst ||, and v. Dunikowski ¶ has described numerous species in the Lower Lias of the Tyrol.

* Chall. Report, vol. xviii. pt. i. p. clxix.
† Trans. Edinb. Geol. Soc. vol. vi. pt. i. p. 56.
‡ Zeitschr. d. deutsch. geol. Gesellsch. Bd. xxxii. (1880) p. 447, pl. xxi.
§ *Ibid.* Bd. xxviii. (1876) pp. 75–86, pl. ii.
|| 'Palæontographica,' Bd. xxxi., xxxiv.
¶ *Op. cit.*

Lately Dr. Rüst* has announced the occurrence of Radiolaria in all the principal divisions of the Palæozoic series, but a detailed description of the forms has not yet appeared.

Very few Radiolaria have been as yet noticed from the rocks of this country. Mr. W. H. Shrubsole † has recorded three or four species from the London Clay of Sheppey; Dr. Rüst has discovered two species in the flints of the Upper Chalk ‡ and a few remains in coprolites from the Lias of Gloucester §; and Prof. Sollas ||, many years since, noted their occurrence in the Cambridge Greensand, but he has not yet described the species. The presence of Radiolaria in the Coal-measures of Lancashire ¶ and in the Carboniferous Limestone of North Wales** has been reported from time to time; but the minute spherical bodies in the Coal-measures known as *Traquairia* have been shown by Prof. W. C. Williamson †† to be vegetable structures, and the same author considers that the objects in the Carboniferous Limestones, presumed to be Radiolaria, are really composed of carbonate of lime, and he has named them *Calcisphæra* ‡‡. I have examined microscopic sections of limestones containing these organisms, and I agree with Prof. Williamson that there is no evidence to support the view that they were originally siliceous.

The apparent rarity of Radiolaria in the later Palæozoic and more recent strata in this country renders their occurrence in such great abundance in this Ordovician chert still more remarkable. Considerable attention has been paid lately to the nature of the chert and allied siliceous rocks of the different British sedimentary formations, but hitherto no other siliceous organisms than sponges have been found in them; and this Scotch chert is the first instance in which in our area this description of rock has been traced to the skeletons of other organisms than sponges. A large series of sections of chert from different formations has come under my own notice of late years, but in only one instance, that of a chert-bed in the Carboniferous Limestone of Flintshire, have I met with Radiolaria, and in this there were only a few individuals of a

* Jahresb. d. naturhistor. Gesellsch. zu Hannover, 1883–87 (1888), pp. 49–56.

† Quart. Journ. Geol. Soc. vol. xlv. (1889) p. 121.

‡ 'Palæontographica,' Bd. xxxiv. p. 185.

§ *Ibid.* Bd. xxxi. p. 278.

|| Quart. Journ. Geol. Soc. vol. xxix. 1873, p. 78.

¶ Brit. Assoc. Report, Brighton, 1872, p. 126.

** 'Nature,' March 1877, p. 461; Ann. Rep. Chester Soc. Nat. Hist. 1876–77, p. 10.

†† Phil. Trans. vol. clxxi. (1880) pt. ii. p. 511.

‡‡ *Ibid.* p. 520, pl. xx. figs. 67–81.

single species. The preservation of the Radiolaria in this Ordovician chert, which has evidently been subjected to considerable disturbance, is an indication that if these organisms had entered largely into the composition of other beds of chert in this country they would probably ere now have been recognized in them. The observations of Dr. Rüst * have led him to conclude that on the continent in the majority of cases chert and other siliceous rocks may be attributed to Radiolaria; but in this country, according to present experience, similar rocks are mainly derived from the remains of siliceous sponges and very exceptionally from those of Radiolaria.

Description of Species.

In attempting to classify these ancient Radiolaria I have followed as far as possible the latest system of Prof. Hæckel, contained in the 'Challenger' Report on this group. In this elaborate work the limits assigned to genera are extremely narrow and precise, and it is no wonder therefore that even with the greatest desire for comprehension it should be found impracticable to fit all these fossils into the divisions, numerous though they are, which have been already established, and I have therefore reluctantly been obliged to propose additional genera to include some of them.

Class *RADIOLARIA*, Müller.

Subclass **SPUMELLARIA**, Ehrenberg.

Order SPHÆRELLARIA, Hæckel.

Suborder SPHÆROIDEA, Hæckel.

Family **Liosphærida**, Hæckel.

Sphæroidea without radial spines on the surface of the spherical shell; living solitary (not associated in colonies). ('Challenger' Report, part i. p. 59.)

Genus STYPTOSPHÆRA, Hæckel.

Liosphærida forming a solid sphere of spongy framework, without enclosed medullary shell and without central cavity. (Chall. Rep. part i. p. 86.)

Styptosphæra antiqua, sp. n. (Pl. III. fig. 1.)

The irregularly reticulate or spongy framework appears to

* Jahresb. d. naturhist. Gesellsch. zu Hannover, 1883–87 (1888), p. 56.

be of an equally close character throughout the test, the interspaces are very minute, showing sometimes as minute circular pores about ·005 millim. in diameter, sometimes as sinuous apertures. Surface usually smooth and even, occasionally with minute spines. Diameter of test ranging from ·15 to ·24 millim.

*Distribution**. Abington, Lanarkshire; Broughton, Hartree Hill, Peeblesshire.

Genus Spongoplegma, Hæckel.

Liosphærida forming a sphere of spongy framework, which encloses in the centre one single latticed medullary shell. (Chall. Rep. part i. p. 89.)

Spongoplegma priscum, sp. n. (Pl. III. fig. 2.)

The surface of the cortical shell relatively smooth, with apparently regular apertures, the reticulate or spongy framework between the cortical and the medullary shell with circular or irregular apertures about ·01 millim. wide; the medullary shell well marked by its closer and denser structure. The specimen figured is shown in section. Diameter of cortical shell ·15 to ·2 millim., thickness of shell ·012 millim.; width of medullary shell ·075 millim.

Distribution.—Hartree Hill, Kilbucho, and Broughton Heights, near Broughton, Peeblesshire.

Genus Diploplegma, gen. nov.†

Liosphærida with a relatively large inner (cortical?) test of irregularly reticulate or spongy framework and an outer shell of the same structure, the two connected by radial bars. In this genus the inner test is sufficiently large to be regarded as an inner cortical shell, and in this respect it resembles *Liosphæra*, Hæckel ('Challenger' Report, pt. i. p. 76), which has two cortical shells. It differs from *Liosphæra*, however, in the irregularly reticulate or spongy nature of the tests.

Diploplegma cinctum, sp. n. (Pl. III. fig. 10.)

Surface of outer test uneven, but without definite spines. The inner test connected by numerous short radial bars with

* As all the specimens are from the same geological horizon (Llandeilo-Caradoc) referred to in the previous part of the paper, it is not necessary to indicate it in connexion with each species.

† διπλόος, double, πλέγμα, network.

the outer, so that in section the outer sphere has the appearance of an encircling ring. The framework of both outer and inner spheres apparently similar. No central medullary shell can be recognized. The minute structure of the meshwork is obscured by the dark infilling. Diameter of outer sphere ·25, of the inner ·15; length of radial beams ·015 millim. Rare.

Distribution. Abington, Lanarkshire; Hartree Hill, Peeblesshire.

Family **Staurosphærida**, Hæckel.

Sphæroidea with four radial spines on the surface of the spherical shell, forming a regular cross, being opposite in pairs in two axes perpendicular to one another. (Chall. Rep. pt. i. p. 151.)

Genus Staurodoras, Hæckel.

Staurosphærida with spongy spherical shell and four crossed simple spines. (Chall. Rep. pt. i. p. 168.)

Staurodoras gracilis, sp. n. (Pl. IV. fig. 7.)

The siliceous mesh apparently of a close irregular character, with apertures of about ·01 millim. wide. The radial spines slender, evenly tapering, about two thirds as long as the diameter of the shell. In the specimen figured one of the spines has been broken off. Diameter of the sphere ·11; length of spines 0·7, thickness at base ·01 millim. Another specimen has the spines stouter, measuring ·02 millim. at the base.

Three species of this genus have been described by Dunikowski * from the Lower Lias of Schafberg, near Salzburg; but in these the siliceous framework appears to be more regular and the spines stouter than in the present species.

Distribution. Abington, Lanarkshire; Hartree Hill, Peeblesshire.

Genus Stauroplegma, gen. nov.

Staurosphærida with solid, irregularly reticulate or spongy shell, a concentric medullary shell, and four simple spines approximately in the form of a cross. This genus differs from *Staurodoras* by the possession of an inner medullary test.

* Denkschr. d. k. Akad. d. Wiss. Wien, Bd. xlv. p. 188, pl. v. figs. 56, 57, 58.

Stauroplegma brevispina, sp. n. (Pl. IV. fig. 5.)

Surface of cortical shell smooth, the outer wall distinct from the interior meshwork, the medullary test now shown by its darker structure. Radial spines conical, shorter than the radius of the test. Diameter of shell ·16 millim., of medullary test ·06; length of spines ·04, basal thickness ·017.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

Stauroplegma compressum, sp. n. (Pl. IV. fig. 6.)

Test slightly elliptical, in part perhaps due to compression; surface uneven, with here and there circular pores ·015 millim. wide. The spines tapering, about two thirds as long as the diameter of the test, apparently unequal in length; they can be traced to the surface of the inner shell. Diameter of test ·16, of inner shell ·06; length of spines ·09 to ·12, width at base ·013 millim. In the specimen figured one spine has been broken off. Rare.

Distribution. Near Moorfoots, Edinburghshire.

Stauroplegma barbatum, sp. n. (Pl. III. fig. 6.)

Surface of cortical test rough, as if with minute spines. The medullary test indicated in the specimen figured by a partially clear subcentral space. Spines longer than the diameter of the sphere; they are not strictly in the form of a cross, but their present position may in part arise from subsequent misplacement. Diameter of sphere ·135; length of spines ·18, thickness at base ·02 millim. Rare.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

Stauroplegma diffusum, sp. n. (Pl. IV. fig. 4.)

Surface of cortical test irregular and uneven; an inner medullary shell is shown by a ring of darker structure, and within this is a central lighter space, which may perhaps indicate the presence of a second medullary test. The radial spines are shorter than the radius of the sphere, measuring from the surface. Diameter of sphere ·13, of outer medullary test ·07, of inner test (?) ·03 millim.; length of spines ·04, thickness at base ·012 millim.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

Family **Astrosphærida**, Hæckel.

Sphæroidea with numerous (8 to 12 or more, commonly between 20 and 60) radial spines on the surface of the spherical shell; living solitary. (Chall. Rep. pt. i. p. 206.)

Genus ACANTHOSPHÆRA, Ehrenberg.

Astrosphærida with one simple lattice sphere, covered with simple radial spines of the same kind. (Hæckel, Chall. Rep. pt. i. p. 209.)

Acanthosphæra antiqua, sp. n. (Pl. IV. fig. 1.)

Shell thin-walled, pores subcircular and wider than the inclosing framework. Spines short, conical, apparently numerous, though, owing to the way in which the specimen figured has been infilled with dark staining material, only those near the outer margin can be clearly seen. The missing part of the specimen figured has been cut off by a quartz-vein. Diameter of test ·16, of the pores ·015 to ·02; length of spines ·02, thickness at base ·01 millim. Rare.

Distribution. Hartree Hill, Kilbucho.

Genus HALIOMMA, Ehrenberg (in part).

Astrosphærida with one medullary (intracapsular) and one cortical (extracapsular) shell, which are connected by radial beams piercing the central capsule. Shell-surface covered with simple radial spines of the same kind. (Hæckel, Chall. Rep. pt. i. p. 220.)

Haliomma vetustum, sp. n. (Pl. III. fig. 11.)

Cortical test moderately thick, with small circular pores and relatively robust, short, conical spines, of which there are nine on the surface exposed. The specimen figured is partly a section; there are no traces of radial beams connecting the inner with the outer test; their apparent absence may be due to the fossilization. Diameter of sphere ·22, of the inner test ·08, pores ·013; length of spines ·06, thickness at base ·02 millim.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

Haliomma cornutum, sp. n. (Pl. IV. fig. 8.)

In the specimen figured the characters of the cortical test are obscured by the dark infilling, and the inner test is only indicated by a lighter area. There are at least seven equal, slender, tapering spines nearly as long as the diameter of the test. Diameter of sphere ·09, of inner test ·03; length of spines ·075, basal thickness ·01 millim.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

The genera described below, though embraced in the same suborder—Sphæroidea—as the preceding forms, do not find a place in any of the families of this group, as described by Hæckel in the 'Challenger' Report. They may possibly represent new families; but as their condition of preservation and mode of occurrence are very unfavourable for a thorough determination of their structural characters, I do not propose to define their position in Hæckel's system, but shall limit myself to giving generic and specific descriptions, so far as these can be ascertained.

Genus Dorysphæra *, gen. nov.

Sphæroidea with simple spherical lattice-shells and a single radial spine extending from the surface of the test. No medullary test.

Fossil forms of this genus have been already figured by v. Dunikowski from the Liassic strata of Schafberg, but no name was given to them, possibly under the idea that they were imperfect specimens of forms with normally two or four radial spines. In this Ordovician chert, however, specimens with but a single radial spine are not at all uncommon, and they may be regarded as being in their original condition. The genus *Lithapium* †, Hæckel, has a simple lattice-shell, with only a single radial spine; but it is ellipsoidal or pear-shaped, and thus is included in a different suborder.

Dorysphæra reticulata, sp. n.
(Pl. III. fig. 3, Pl. IV. fig. 3.)

The framework of the shell thin, of an open, subpolygonal, reticulate character, the meshes unequal in size, subcircular to subpolygonal. Radial spine short, styliform. Diameter of sphere ·18, meshes from ·005 to ·015 millim., thickness of framework about ·005 millim. Radial spine (probably imperfect) ·07, breadth of base ·01 to ·02 millim.

Distribution. Abington, Lanarkshire; Broughton Heights, Peeblesshire.

* *δόρυ*, a spear, *σφαῖρα*, sphere.
† 'Challenger' Rep. pt. i. p. 303.

Dorysphæra nucula, sp. n. (Pl. III. fig. 5.)

The shell smaller and the framework thicker than in the preceding form. Pores subcircular. Radial spine short, styliform. Diameter of shell ·13, pores ·01, intermediate spaces about ·007; spine ·03, thickness at base ·02 millim. Rare.

Distribution. Hartree Hill, Kilbucho, Peeblesshire.

Dorysphæra laxa, sp. n. (Pl. III. fig. 4.)

Framework of test thin, reticulate, the meshes subcircular, unequal, relatively large. Spine short, in the specimen figured it is seen projecting obliquely. Diameter of shell ·12, mesh-apertures from ·01 to ·025 millim. in width, intermediate framework about ·007, thickness of base of spine ·015 millim. This form differs from *D. reticulata* principally in the distinctly larger size of the mesh-apertures.

Distribution. Abington, Lanarkshire; Hartree Hill, Peeblesshire.

Genus Doryplegma *, gen. nov.

Sphæroidea with cortical shells of irregularly reticulate or spongy framework, inclosing a central medullary shell and with a single primary radial spine. Secondary or smaller spines occasionally present. The structure of the shell in this genus is the same as in *Spongoplegma*, Hæckel, but with the addition of a radial spine and sometimes of secondary spines. From *Dorysphæra* it is distinguished by the different character of the framework and the presence of a medullary shell.

Doryplegma nasutum, sp. n. (Pl. III. fig. 9.)

The wall of the sphere well marked and distinct from the reticulate structure of the space within. Radial spine conical, tapering, shorter than the diameter of the sphere; secondary spines small, acute, in some specimens none can be distinguished. The lower portion of the specimen figured has been displaced by a quartz-vein, and the interior structure is only partially shown. Diameter of sphere ·2, of medullary test ·08, thickness of cortical shell ·017; length of radial spine ·11, thickness at base ·02; length of secondary spines ·015 millim. Specimens not infrequent.

Distribution. Hartree Hill; Broughton Heights, Peeblesshire.

* δόρυ, a spear, πλέγμα, network.

Doryplegma gracile, sp. n. (Pl. III. fig. 8.)

The reticulate or spongy framework close, with small irregular apertures. Spine conical, tapering, about as long as the diameter of the shell. Smaller than the preceding form and with longer spine. Diameter of cortical shell ·13, of medullary test ·05; length of radial spine ·15, basal thickness ·015 millim.

Distribution. Hartree Hill, Peeblesshire.

Genus Dorydictyum *, gen. nov.

Sphæroidea with tests of irregularly reticulate or spongy framework and a simple radial spine, with or without secondary spines. The structure of the test corresponds with that of *Styptosphæra*, Hæckel, and it differs from this genus by the addition of a radial spine. It is distinguished from *Doryplegma* by the absence of a medullary test.

Dorydictyum simplex, sp. n. (Pl. III. fig. 7.)

The reticulate framework of the same character throughout, with very minute pores. Radial spine robust, styliform, nearly as long as the diameter of the shell. Occasional minute secondary spines. Diameter of the test ·15; length of radial spine ·12, basal thickness ·022 millim. Rare.

Distribution. Broughton Heights, Broughton, Peeblesshire.

Genus Triposphæra †, gen. nov.

Sphæroidea with an irregularly reticulate or spongy framework, a medullary shell, and three primary radial spines. Smaller secondary spines occasionally present.

Forms with spherical shells and three prominent radial spines, but without a medullary shell, have been described by Dunikowski ‡ from the Liassic strata of Schafberg, and placed by him in the genus *Spongechinus*, Hæckel; but in the 'Challenger' Report § one of them is regarded as discoidal and referred to the genus *Spongotripus*, H. Dr. Rüst has also described rounded *latticed* forms with three prominent spines from Jurassic and Cretaceous strata; they were originally placed in the new genus *Triactoma* (Palæontogr.

* *δόρυ*, a spear, *δίκτυον*, network.

† *τρίπους*, a tripod, *σφαῖρα*, sphere.

‡ Denkschr. d. k. Akad. der Wiss. Wien, Bd. xlv. p. 188, pl. v. figs. 54, 59.

§ Pt. i. p. 581.

Bd. xxxi. p. 289), but in a subsequent memoir they are considered as Discoidea under the modified name *Triactis* (Palæontogr. Bd. xxxiv. p. 197). Hæckel* has referred other discoidal three-spined forms to the genus *Triactiscus*. So far as I can ascertain no spherical "spongy" forms with a medullary shell and three radial spines, as in the proposed genus, have as yet been described. It is difficult to ascertain with absolute certainty now that these minute shells are imbedded in the solid chert whether particular specimens are discoidal or spherical; but their outlines are uniformly circular, and if discoidal shells had been present one would have expected to meet with lenticular or elliptical forms in the rock-sections.

Triposphæra Peachii, sp. n. (Pl. IV. fig. 9.)

Shell approximately spherical, the reticulate framework close. The radial spines nearly twice as long as the diameter of the test, straight or curved, tapering gradually, inequidistant from each other. In no specimen are all the spines intact, but they appear to have been equal in length originally. The medullary test is not shown in the specimen figured owing to the dark infilling, but it is present in others. Diameter of shell ·18, of medullary test ·05; length of spines ·42, basal thickness ·02 millim. This species is named after B. N. Peach, Esq., F.G.S., of the Geological Survey of Scotland, to whom I am indebted for the opportunity of studying these fossils.

Distribution. Abington, Lanarkshire; Broughton Heights, Peeblesshire.

Triposphæra hastata, sp. n. (Pl. IV. fig. 2.)

Shell of close framework, with minute pores; surface uneven and rough, as if with minute blunt spines. The medullary test in the specimen figured is indicated by a light central space. Spines straight, robust, nearly twice as long as the diameter of the sphere, inequidistant from each other. Only one is preserved intact in the specimen figured, the other two are indicated by their stumpy bases. Diameter of sphere ·27, of the medullary test ·055; length of spines ·5, basal thickness ·025 millim.

Distribution. Near Abington, Lanarkshire.

Triposphæra densa, sp. n. (Pl. IV. fig. 10.)

Surface of shell nearly even, the three radial spines slender,

* Chall. Rep. pt. i. p. 432.

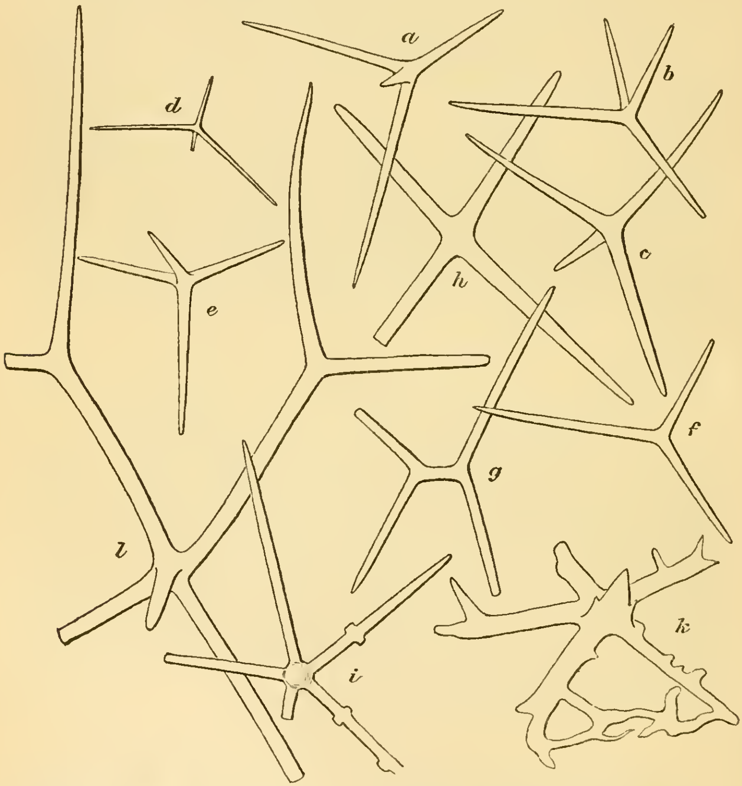
conical, nearly as long as the radius of the shell; they are inequidistant and do not seem to be all in the same plane. The specimen is so infiltrated with dark material that the medullary shell cannot be distinguished. Diameter of test ·18; length of spines ·06, basal thickness ·015 millim.

Distribution. Broughton Heights, Peeblesshire.

Triposphæra armata, sp. n. (Pl. IV. fig. 11.)

The primary radial spines stout, styliform, nearly equidistant from each other, about as long as the radius of the shell; surface with numerous minute secondary spines. Diameter of cortical test ·15, of medullary test ·065; length of primary spines ·08, thickness at base ·016; length of secondary spines ·01 to ·035 millim.

Distribution. Abington, Lanarkshire.



Detached spicules of Radiolaria.—*a–f.* Three- and four-rayed spicules of *Sphærozoum priscum*, sp. n. *g, h. Sphærozoum patulum*, sp. n.: *g*, geminate, *h*, cruciform spicule. *i, k, l*, spicules of Plectoid Radiolaria. All enlarged to the scale of 200 diameters.

Order COLLODARIA, Hæckel.

Suborder BELOIDEA, Hæckel.

Spumellaria with an imperfect skeleton composed of numerous solid needles or spicula, scattered irregularly in the calymma. (Chall. Rep. pt. i. p. 28.)

Genus SPHÆROZOUM, Meyen.

Beloidea socialia or "Sphærozoida with branched or radiate spicula of one kind." (Chall. Rep. pt. i. p. 38.)

Sphærozoum priscum, sp. n. (Woodcut, *a–f.*)

Under this name I propose to include spicules of various dimensions, mostly with four rays, more rarely with only three. The rays are usually straight, simple, apparently conical, gradually tapering from a common centre to a point. Three of the rays are either in a plane or form a low tripod, and the fourth ray is nearly vertical to the others. There is a close resemblance in form, and approximately in size, of these detached spicules to the spicules of recent species of this genus and of allied genera of the same group, as shown in the 'Challenger' Report, pls. ii. and iv. The spicules are very abundant, for the most part indiscriminately mingled with one another and with the ordinary spherical shells; sometimes several are now situated close together, as if resulting from the disintegration in position of individual Radiolaria. It is very probable that these spicules may represent more than one species, and they are grouped under one name simply for convenience of reference. In form they are very similar to the spicules of Calcisponges; but there is not the least ground for suspecting that they may have belonged to these organisms, since their condition of preservation is the same as that of the undoubted Radiolarian shells amongst which they occur, and they are associated with other spicules which as regards form have no counterparts amongst sponge-spicules.

Detached Radiolarian spicules, both three-rayed and other forms, have already been described by Dr. Rüst * from the Jurassic Strata of Western Switzerland and from the Neocomian of Gardenazza, and they are stated to be abundant in all Jurassic Radiolarian-bearing rocks.

The rays of the spicules range from ·04 to ·14 millim. in length and from ·005 to ·015 millim. in thickness.

* 'Palæontographica,' Bd. xxxi. p. 284, pl. xxxi., Bd. xxxiv. p. 190.

Distribution. Abington, Lanarkshire; Broughton, Hartree Hill, Kilbucho, Peeblesshire; Moorfoots, Edinburghshire.

Sphærozoum patulum, sp. n.
(Pl. IV. fig. 12; woodcut, *g*, *h*.)

The spicules included under this term are geminate and cruciform. In the geminate forms there is a short central rod, from both ends of which two simple, subcylindrical, divergent rays are given off, approximately in the same plane (Pl. IV. fig. 12; woodcut, *g*). The rays are similar in the cruciform spicules, but the median rod is reduced to a slight central expansion (woodcut, *h*). Both kinds of spicules are present in recent species of the genus *, and they have been likewise noted from Jurassic strata. The geminate spicules differ from any known kind of sponge-spicules.

The central rod of these spicules is from ·015 to ·03 millim. in length, and the rays are from ·03 to ·13 millim. in length.

Distribution. Broughton, Hartree Hill, Peeblesshire.

Subclass **NASSELLARIA**, Ehrenberg.

Order PLECTELLARIA, Hæckel.

Suborder PLECTOIDEA, Hæckel.

Nassellaria with a rudimentary, originally tripodal, skeleton, composed of radial spines arising from one common central point or central rod. (Chall. Rep. pt. ii. p. 898.)

There are a few forms in the chert which appear to belong to the above suborder, but they cannot be included in any of the known genera referred thereto by Hæckel; and it seems undesirable, since the specimens are rare and not perfect, to propose three new genera for them. In one specimen (woodcut, *i*) there are five straight, nearly cylindrical rays proceeding from a minute rounded centre; three of the rays are in one plane and one above and the other below this plane. On two of the rays are small spines or processes. The rays, when entire, are ·15 millim. in length. In another specimen (woodcut, *k*) there are five basal rays, with a stout ray rising from the centre. The rays are spinous, and there are traces of irregular tissue connecting them, as in the recent Plectanida (Chall. Rep. pt. ii. p. 919, pl. xcvii.). In the third specimen (woodcut, *l*), which is of unusual size, there are four basal rays radiating from a centre, from which also an upright ray springs. The rays are cylindrical and smooth and bifurcate,

* 'Challenger' Report, pt. i. pp. 40–45, pl. iv.

the secondary rays tapering to an acute point. The entire length of one of the rays is ·37 millim. I have only seen a single imperfect specimen of this form in the chert from Hartree Hill.

EXPLANATION OF THE PLATES.

Plate III.

Fig. 1. *Styptosphæra antiqua*, sp. n.
Fig. 2. *Spongoplegma priscum*, sp. n. The inner medullary sphere is shown by the dark central portion.
Fig. 3. *Dorysphæra reticulata*, sp. n. The radial spine in this specimen has been partially dislocated, and some of the mesh-apertures are infilled with the dark staining material.
Fig. 4. *Dorysphæra laxa*, sp. n. In this specimen the radial spine is viewed obliquely.
Fig. 5. *Dorysphæra nucula*, sp. n.
Fig. 6. *Stauroplegma barbatum*, sp. n. The medullary sphere in this specimen is indicated by the partially clear central space.
Fig. 7. *Dorydictyum simplex*, sp. n.
Fig. 8. *Doryplegma gracile*, sp. n.
Fig. 9. *Doryplegma nasutum*, sp. n. The lower portion of this specimen has been displaced by a quartz-vein. The inner or medullary sphere is indicated by the darker central area.
Fig. 10. *Diploplegma cinctum*, sp. n.
Fig. 11. *Haliomma vetustum*, sp. n. The mesh-apertures in the specimen are indistinct, owing to the dark infilling.

Plate IV.

Fig. 1. *Acanthosphæra antiqua*, sp. n. The specimen is imperfect, a portion to the right having been cut off by a quartz-vein.
Fig. 2. *Triposphæra hastata*, sp. n. In this specimen only one of the three radial spines is preserved entire, the bases only of the other two remain. The inner sphere is partially clear and has not been infilled with the opaque material like the outer sphere.
Fig. 3. *Dorysphæra reticulata*, sp. n.
Fig. 4. *Stauroplegma diffusum*, sp. n. A quartz-vein traverses the right-hand portion of the specimen.
Fig. 5. *Stauroplegma brevispina*, sp. n. The upper portion has been displaced by a quartz-vein.
Fig. 6. *Stauroplegma compressum*, sp. n.
Fig. 7. *Staurodoras gracilis*, sp. n. Only the base of the lower spine remains. A quartz-vein traverses the specimen.
Fig. 8. *Haliomma cornutum*, sp. n.
Fig. 9. *Triposphæra Peachii*, sp. n.
Fig. 10. *Triposphæra densa*, sp. n.
Fig. 11. *Triposphæra armata*, sp. n.
Fig. 12. *Sphærozoum patulum*, sp. n. A geminate spicule, the rays imperfect, referred to this species.

The figures have been drawn by transmitted light from microscopic sections of the chert-rock in which the Radiolaria are imbedded; they are all enlarged to the same scale of 200 diameters. The specimens are all from the same zone in the Ordovician or Lower Silurian strata of the Southern Uplands of Scotland; the particular localities are given in the text.

V.—*Revision of British Mollusca.* By the Rev. Canon A. M. Norman, M.A., D.C.L., F.R.S., F.L.S., &c.

[Continued from vol. v. p. 484.]

Class II. GASTROPODA.

Subclass I. ANISOPLEURA.

Superorder I. *EUTHYNEURA.*

Order I. PTEROPODA.

Suborder I. GYMNOSOMATA.

Fam. 1. Clionidæ.

Genus Clione, Phipps.

21. *Clione limacina*, Phipps.

Clio limacina, Phipps, Voyage North Pole (1773), p. 195.
Clione borealis, Pallas, Spicilegia Zoologica, fasc. x. (1774), p. 28, pl. i. figs. 18, 19.
Clione limacina, G. O. Sars, Moll. Regionis Arcticæ Norvegiæ, p. 322, pl. xxix. fig. 4 *a–c*.

Mr. T. Scott (Report Fishery Board Scotland, 1889, p. 325) has procured a specimen of this species in the towing-net off Inchkeith in the Firth of Forth, which he kept alive for two days; and Professor M'Intosh records that on April 11 and 12, 1887, and during a week or two afterwards, a considerable number of the species were captured near shore at St. Andrews.

Pelseneer ('Challenger' Report) says, "There is in the collection of the Muséum d'Histoire Naturelle of Paris a specimen from Falmouth presented by Leach." Leach certainly procured it living off the coast of Mull in 1811 (*vide* Forbes and Hanley, 'British Mollusca,' vol. iv. p. 292).

It is the *Clio retusa* of O. F. Müller, *Clione papilionacea* of authors, *Clio miquelonensis* of Rang, *Clione elegantissima* of Dall, and *Clione Dalli* of Krause.

Very abundant in the Arctic seas. The British localities are its most southern limit in the Eastern Atlantic, while in the Western Atlantic it was found in 1833 as far south as New York. It has been taken in Finmark, but is not known to reach the Norwegian coast.

Suborder II. THECOSOMATA.

Fam. 2. **Limacinidæ.**

Genus 1. Limacina.

22. *Limacina retroversa* (Fleming) = *Spirialis retroversa*, Jeffreys.

Var. 1. *Macandrei*, F. & H.

A produced form, of which several specimens were dredged by MacAndrew 15 miles south of Mizen Head, south of Ireland. The form approaches that of *L. bulimoides*, d'Orb., but the shell is smaller and more delicate than in that species and the suture more deeply cut.

[Var. 2. *Jeffreysii*, F. & H.

Only a single "very young shell" was found. Stated by Jeffreys himself to be only the young.]

23. *Limacina helicoides*, Jeffreys.

Limacina helicoides, Jeffreys, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. (1877), p. 338.
Limacina helicoides, Pelseneer, Report 'Challenger' Pteropoda, pt. 2 (1888), Thecosomata, p. 23, pl. i. fig. 1.

'Porcupine' expedition, 1869, off the west of Ireland, Stat. 28, lat. 56° 44′ N., long. 12° 52′ W., dead at bottom. It was also procured in the North Atlantic in the 'Valorous' expedition, by the 'Challenger' off the Azores, and by the 'Travailleur' in the Bay of Biscay.

[*Limacina bulimoides* (d'Orbigny).

Atlanta bulimoides, d'Orbigny, Voy. dans l'Amér. mérid. vol. v. (1836), p. 179, pl. xiii. figs. 36–38.
Limacina bulimoides, Boas, Spolia Atlantica, Bidrag til Pterodernes (1886), p. 47, pl. iii. figs. 36, 37.

Pelseneer ('Challenger' Report) records this species, which occurs in all the oceans except the Arctic and Antarctic, as "found by the first 'Porcupine' expedition, 1869." I do not know whence he procured the information, as I have no remembrance that Jeffreys has recorded it. It may be that specimens are preserved in the British Museum. It depends upon the station at which it was found whether it can be included in our lists.]

Genus 2. Peracle, Forbes.

24. *Peracle diversa,* Monterosato.

Spirialis diversa, Monterosato, Nuova Revista delle Conchiglie Mediterranee (1875), p. 50.
Peracle diversa, Monterosato, Bull. della Soc. Malacol. Ital. vol. vi. (1880), p. 80.
Peracle diversa, E. A. Smith, Ann. & Mag. Nat. Hist. ser. 6, vol. iv. (1889), p. 421.

Dead shells, doubtfully referred to this species, recorded by E. A. Smith as procured off the south of Ireland by the 'Flying Fox' in 1889.

Fam. 3. **Cavolinidæ.**

Genus 1. Clio, Linné.

25. *Clio pyramidata,* Linné.

Dr. Jeffreys and myself frequently dredged this species in the Shetland seas, but did not find it living. It was taken in many of the 'Porcupine' dredgings of 1869, and during the recent cruise of the 'Flying Fox' off the south of Ireland (1889) it is stated that "the surface waters teemed with Pteropods, *Cleodora lanceolata* [i. e. *Clio pyramidata*] being taken in abundance."

Genus 2. Cavolinia, Abildgaard.

26. *Cavolinia trispinosa* (Lesueur).

Hyalæa trispinosa, Lesueur, MSS. in de Blainville (*Hyale*), Dict. des Sci. Nat. (1821), vol. xxii. p. 82.
Hyalæa mucronata, Quoy and Gaimard, Ann. d. Sci. Nat. sér. i. vol. x. (1827), p. 231, pl. viii. B. figs. 1, 2.
Hyalæa trispinosa, Boas, Spolia Atlantica, Bidrag til Pterodernes (1886), p. 92, pl. i. fig. 3, pl. ii. fig. 14, pl. iv. fig. 52, pl. v. fig. 93.
Cavolinia trispinosa, Pelseneer, 'Challenger' Report, Pteropoda, pt. ii. (1888) p. 76.

A specimen was washed ashore at Youghal (Brit. Conch. v. p. 117) attached to a mast and found by Dr. Robert Ball in 1820. Dead shells from 250–1000 fathoms off the south of Ireland, 'Flying Fox,' 1889 (*E. A. Smith*). It was dredged also by the 'Porcupine,' 1869, Stat. 1, off Valentia.

It is a very common species in the more southern parts of the North Atlantic, and is found in the South Atlantic, Pacific, and Indian Oceans.

Order II. OPISTHOBRANCHIATA.

Suborder I. TECTIBRANCHIATA.

A. Cephalaspidea.

Fam. 1. **Actæonidæ.**

Genus Actæon, Montfort.

27. *Actæon tornatilis.*
 Var. 1. *subulata*, Searles Wood.
 Var. 2. *tenella*, Lovén.
 Var. 3. *bullæformis*, Jeffreys.

28. *Actæon exilis*, Jeffreys.

Actæon exilis, Jeffreys, Ann. & Mag. Nat. Hist. ser. 4, vol. vi. (1870), p. 21, and vol. xix. (1877), p. 335.
Auriculina insculpta, Verrill, Proc. U. S. Nat. Mus. vol. iii. (1880), p. 381.
Actæon nitidus, Verrill, Trans. Conn. Acad. vol. v. (1882), p. 540, pl. lviii. fig. 21.
Actæon exilis, Dall, Bull. Mus. Comp. Zool. vol. xviii. (1889), p. 38.

'Porcupine' expedition, 1869, in 1215 fathoms, off Ireland to the south-east of Rockall (Stat. 28).

It has been found also in the North Atlantic in 1450 fathoms, 'Valorous,' off the Lusitanian coasts, 227–994 fathoms, 'Porcupine,' 1870, and in the Mediterranean, 92–1456 fathoms. Off east coast of Florida, 150–200 fathoms, and Gulf of Mexico, 200 fathoms (*Dr. Rush*); off Martha's Vineyard, East America, 312–407 fathoms (*Verrill*).

Jeffreys states that it has been found by the late Prof. Seguenza fossil in the older Pliocene of Calabria.

Fam. 2. **Tornatinidæ.**

Genus 1. Tornatina, A. Adams, 1850 (= *Utriculus*, Brown, 1845, non Schumacher, 1817).

29. *Tornatina obtusa* (Montagu).
 Var. *Lajonkaireana* (Basterot).

30. *Tornatina mammillata* (Philippi).

31. *Tornatina truncatula* (Bruguière).
 Var. *pellucida* (Brown).

32. *Tornatina umbilicata* (Montagu).
 Var. *strigella* (Lovén).

33. *Tornatina nitidula* (Lovén).

34. *Tornatina ovata* (Jeffreys).

Bulla conulus, Searles Wood, Crag Mollusca, p. 173, pl. xxi. fig. 2 *a–c*.
Cylichna conulus, Forbes and Hanley, Brit. Moll. vol. iii. p. 517, pl. cxiv. c. fig. 7.
Cylichna umbilicata, var. *conulus*, Jeffreys, B. C. vol. iv. p. 156.
Cylichna ovata, Jeffreys, Proc. Roy. Soc. 1870, p. 156 (name only).
Utriculus conulus, G. O. Sars, *l. c.* p. 287, pl. xvii. fig. 17 *a, b*.
Cylichna ovata, Watson, Report 'Challenger' Gast. p. 664, pl. xlix. fig. 9.
Retusa (?) *ovata*, Dall, Bull. Mus. Comp. Zool. vol. xviii. p. 49.

Deal Voe, Shetland (*Jeffreys*); 'Triton' exped., 1882, St. 13, lat. 59° 51′ N., long. 8° 18′ W., 570 fathoms; 'Knight Errant,' 1880, St. 7, lat. 59° 37′ N., long. 7° 19′ W., 530 fathoms; off south of Ireland, 1000 fath., 'Flying Fox,' 1889 (*E. A. Smith*).

Its extra-Britannic range is 'Porcupine,' 1870, Stat. 16, off Portugal, 994 fathoms; 'Travailleur,' 1880, Bay of Biscay; 'Washington,' 1881, Mediterranean, 337–464 fathoms; 'Challenger,' 350–1000 fathoms, off the Azores; off Culebra Island, West Indies; off Pernambuco; by G. O. Sars off Lofoten Islands, 300 fathoms; Straits of Florida, 150-465 fathoms (*Dr. Rush*); east coast of North America, 124–400 fathoms (*Dall*).

It occurs fossil in the Coralline Crag of England.

Jeffreys says that it is not the *Bulla conulus* of Deshayes. I have no opportunity here of consulting that work. It is certainly not *Bulla striatula*, Forbes = *Bulla conulus*, Weinkauff = *B.* (*Cylichna*) *Hoernesi*, Weinkauff = *C. cuneata*, Tiberi, which I have from Algiers and Palermo. That is a larger shell, remarkably attenuated above, with deeply inverted spire, which is quite open above (the margin of the last whorl not projecting over the edges of the inversion as in *T. ovata*), and the shell strongly striated vertically, especially at the apex.

Nor is it *Diaphana conulus*, Brugnone, which Dall states is the *Cylichna obesiuscula*, Brugnone. It is to this last species moreover, according to him, that the shells found by Seguenza in the Italian Pliocene really belong, and not to *T. ovata*, to which they were referred by Jeffreys.

I have followed Sars in placing the species in the present genus as its characters come near to those of *T. umbilicata* and *T. nitidula*, which Sars has shown by examination of the masticatory apparatus are true *Tornatinæ*.

[In the Report 'Porcupine' Exped., 1869 (Proc. Royal Soc.), Jeffreys gives under St. 42 "*Cylichna pyramidata* (Norwegian and Mediterranean);" and in B. C. v. p. 223, under *Cylichna umbilicata*, he writes:—"Var. *conulus*, Loffoden I., 300 f. (Sars), not var. *conulus* of Weinkauff, which he has since named *C. Hoernesi*; this is *C. pyramidata* of A. Adams." It appears probable from the words "Norwegian and Mediterranean" in the first of these quotations that he there used *C. pyramidata* for the shell we now understand as *Tornatina ovata*, Jeffr., whereas in the second he makes *C. pyramidata* synonymous with the shell I have above spoken of as *Cylichna* (*Bulla*) *striatula*, Forbes = *C. Hoernesi*, Weink.]

Genus 2. VOLVULA, Adams.

35. *Volvula acuminata* (Bruguière).

Off Berwick (*R. Howse* in Newcastle Museum). This is the only instance of its occurrence off the east of England.

Fam. 3. **Scaphandridæ.**

Genus 1. CYLICHNA, Lovén.

36. *Cylichna cylindracea* (Pennant).
Var. *linearis*, Jeffreys.

37. *Cylichna alba* (Brown).

At the time when 'British Conchology' was published the only known British locality for this species was north-north-west of Unst, Shetland, where Jeffreys and myself dredged it on several occasions. It has since been found north-north-west from the Butt of Lewis in 189–530 fathoms ('Lightning,' Stats. 12, 13); off the west of Ireland in 430–1366 fathoms ('Porcupine,' 1869, Stat. 23 *a*, 19); near the same ground as by the 'Lightning,' in 530 fathoms ('Knight Errant,' Stat. 7).

Genus 2. DIAPHANA, Brown, 1833
= *Amphisphyra*, Lovén, 1846.

38. *Diaphana hyalina* (Turton).

39. *Diaphana expansa* (Jeffreys).

40. *Diaphana ventrosa* (Jeffreys).

41. *Diaphana globosa* (Lovén).

Utriculus globosus, Jeffreys, Brit. Conch. vol. v. p. 223, pl. cii. fig. 8.
Diaphana globosa, G. O. Sars, *l. c.* p. 290, pl. xviii. figs. 4 and 3 *c*.
Diaphana hyemalis, G. O. Sars, *l. c.* p. 291, pl. xviii. fig. 4.

The only British specimens of this shell I myself dredged in St. Magnus Bay, Shetland, in 60–80 fathoms, when my friend Jeffreys was not out with me. These were in his collection, and are among the many interesting specimens which have gone to America*.

I have frequently dredged it in the Norwegian west-coast fiords. A small specimen was taken by the 'Travailleur' in the Bay of Biscay (*Jeffreys*).

Genus 3. Scaphander, Montfort.

42. *Scaphander lignarius* (Linn.).
    Var. 1. *alba*, Jeffreys.
    Var. 2. *curta*, Jeffreys.

43. *Scaphander punctostriatus* (Mighels).

Bulla punctostriatus, Mighels, Bost. Soc. Nat. Hist. vol. i. (1841), p. 49.
Scaphander librarius, Lovén, Index Moll. Scand. 1846, p. 10.
Scaphander librarius, Jeffreys, B. C. vol. iii. p. 446, vol. v. p. 224.
Scaphander punctostriatus, G. O. Sars, *l. c.* p. 292, pl. xviii. fig. 6.

One small specimen off Shetland (see Jeffreys, Brit. Conch. vol. iii. p. 446); 'Lightning,' off Butt of Lewis, 189 fathoms (Stat. 13, lat. 59° 5′ N., long. 7° 29′ W.); 'Porcupine,' 1869, off the west of Ireland, 420–1380 fathoms (St. 23 *a* and 30); 'Triton,' St. 13, lat. 59° 31′ N., long. 8° 18′ W., 570 fathoms.

Its distribution includes Norway, where I have frequently dredged it; Iceland; Bay of Biscay, to 1054 fathoms; off Azores, 1000 fathoms, and off Culebra Island, West Indies, 390 fathoms ('*Challenger*'); Palermo (*Monterosato*); off east coast of United States (*Verrill*); Gulf of Mexico and near Barbadoes, 533 and 288 fathoms (*Dall*). Mediterranean, 'Washington,' 85–1536 fathoms, recorded by Jeffreys, who also states that Seguenza has found it fossil in the older Pliocene of Sicily.

Genus 4. Cryptaxis, Jeffreys.

44. *Cryptaxis crebripunctatus*, Jeffreys.

Cryptaxis crebripunctatus, Jeffreys, Proc. Zool. Soc. 1883 (June), p. 398, pl. xliv. figs. 11, 11 *a*–*c*.

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* In our many dredging expeditions the choicest of the Mollusca went to my friend's collection, while the animals belonging to other classes of the Invertebrata fell to my share. He was always most generous in this matter.

"Shell oval, thin, semitransparent, and glossy: *sculpture*, very numerous and regular fine spiral or revolving striæ, which are closely punctured; they are stronger at the base than at the crown: *colour* white: *spire* deeply sunken, and for the most part concealed in a small cavity in the centre of the crown; but the bulb-shaped apex is visible at the bottom of the cavity: *mouth* semioblong, contracted above and expanding below: *outer lip* slightly raised above the crown and channelled, curved in the middle and at the base: *inner lip* inconspicuous: *pillar* straight on the upper half and incurved below. L. 0·2, B. 0·1."

Three specimens from 'Triton' exped., Stat. 13, lat. 50° 51′ N., long. 8° 18′ W., 570 fathoms (*Jeffreys*), and I have a small specimen (L. 0·1) which I found in ooze from the same station.

As far as the above description goes the shell might be a *Tornatina*; but the figure represents a shell nearly allied in form to *Scaphander* and with sculpture somewhat like that of *S. punctostriatus*. Compared with my smallest example of the latter species, less than 0·2 long, my little *Cryptaxis* differs in its more equal breadth throughout, the lip being more expanded below and the apex at the other extremity being broader, and the small *S. punctostriatus* shows no more sign of perforated apex than does the adult. I have likewise compared it with *Cylichna insculpta*, Totten, which shell is more broadly ovate and has the apex closed.

Fam. 4. **Bullidæ.**

Genus 1. Bulla, Klein.

45. *Bulla utriculus*, Brocchi.
    Var. *a. oblonga*, Jeffreys.

46. *Bulla semilevis*, Seguenza.

Bulla semilevis, Seguenza, Form. terz. della Provincia di Reggio (Calabria), 1879, p. 241, pl. xvi. fig. 5.
Bulla semilevis, Jeffreys, Report 'Travailleur' Dredgings, Brit. Assoc. Rep. 1880, p. 10 (name only).
Bulla (?) *eburnea*, Dall, Bull. Mus. Comp. Zool. ix. (1881), p. 98; ib. xviii. (1889), p. 55, pl. xvii. fig. 6: Bull. U. S. Nat. Mus. no. 37 (1889), p. 88, pl. xvii. fig. 6.
Bulla Guernei, Dautzenberg, Résult des Camp. scient. par Prince de Monaco, Contrib. à la Faune malacol. des Açores, 1889, p. 24, pl. i. figs. 5 *a–d*.

Off the south of Ireland, 1000 fathoms, 'Flying Fox,' 1889 (*E. A. Smith*).

Distribution. Bay of Biscay, 'Travailleur' (*Jeffreys*)); off Azores, 450–1000 fathoms, 'Challenger' (*Watson*); Azores, 1287 metres (*Dautzenberg*); 'Blake,' Stat. 43, lat. 24° 8′ N., long. 82° 51′ W., 339 fathoms (*Dall*).

Fossil. Middle Pliocene of Calabria (*Seguenza*).

Mr. E. A. Smith has kindly, at my request, compared the specimens of this species which are in the British Museum with the figures and description of *B. Guernei*, Dautzenberg, and has confirmed my expectation that the latter cannot be regarded as specifically distinct from *B. semilevis*. It is clear also, I think, that *B. eburnea*, Dall, is the same thing.

Genus 2. HAMINEA, Leach.

47. *Haminea hydatis* (Linn.).
Var. *globosa*, Jeffreys.

Genus 3. ACERA, Müller.

48. *Acera bullata*, Müller.
Var. 1. *nana*, Jeffreys. Length $\frac{3}{20}$ inch.
Var. 2. *Farrani*, Norman. Length $1\frac{3}{4}$ inch.

Akera bullata, var. *gigantea*, Norman, Museum Normanianum, iv. Mollusca, 1888, no. 101.

The variation in size in this species is most extraordinary, and perhaps the forms here treated as varieties should rather be regarded as entitled to rank as species. The full size of ordinary specimens may be taken as an inch; but no specimens of var. *nana*, which was dredged by Jeffreys and myself in shallow water at Balta Sound, Shetland, exceed three twentieths of an inch. On the other hand Dr. Farran found many years ago (see Nat. Hist. Review, vol. iv. (1857) p. 74) the gigantic variety which I here name after him. The specimens were dredged near Birterbuy Bay, Ireland: the animal measured 3 inches long and $2\frac{1}{2}$ wide, and weighed $2\frac{1}{2}$ ounces. The shell of one of these giants, now in my collection, measures $1\frac{3}{4}$ inch long and an inch wide; hundreds of specimens of var. *nana* might be placed in it as in a box! In 1876, in company with my friend Mr. David Robertson, I dredged diligently the spot carefully described by Farran, but without again meeting with this form; but Mr. A. G. More informed me that the year before that just mentioned he had found a similar-sized specimen in a lough nearer Galway.

Fam. 5. **Philinidæ.**

Genus PHILINE, Ascanius.

49. *Philine aperta* (Linné).
    Var. *patula*, Jeffreys.
50. *Philine nitida*, Jeffreys.
51. *Philine scabra* (Müller).
52. *Philine catena* (Montagu).
    Var. *zona*, Jeffreys.
53. *Philine angulata*, Jeffreys.
54. *Philine quadrata* (Searles Wood).
55. *Philine punctata* (Clark).
56. *Philine pruinosa* (Clark).
    Var. *dilatata*, Jeffreys.

B. ANASPIDEA.

Fam. 6. **Aplysiidæ.**

Genus APLYSIA, Linné.

57. *Aplysia depilans* (Linné).

Major A. R. Hunt took many examples of this fine species in Torbay in 1875 and 1877 (see Trans. Devon Assoc. Advanc. Sci. Liter. and Art, 1877 and 1888); the larger specimens weighed from 19 to 40 ounces. Major Hunt remarks that these large specimens did not discharge any purple, but some pink dye. One of the shells of these large specimens which he kindly sent me measures $2\frac{1}{2}$ inches long and $1\frac{3}{4}$ inch wide, and exactly corresponds in its characters with Mediterranean examples of the same species and size in my collection.

58. *Aplysia punctata*, Cuvier.

C. NOTASPIDEA.

Fam. 7. **Pleurobranchidæ.**

Genus PLEUROBRANCHUS, Cuvier.

59. *Pleurobranchus membranaceus* (Montagu).

Off Cumbrae, Firth of Clyde (*A. M. N.*).

60. *Pleurobranchus plumula* (Montagu).

Fam. 8. **Runcinidæ.**

Genus RUNCINA, Forbes, 1853,
=*Pelta*, Quatrefages, 1844, nec Beck, 1838.

61. *Runcina coronata* (Quatrefages).

Pelta coronata, Quatrefages, Mémoire sur les Gastéropodes phlébenteres, Ann. des Sci. Nat. 3e sér. i. (1844).
Pelta sp., Alder and Hancock, Ann. & Mag. Nat. Hist. xviii. 1846, p. 289, pl. iv. figs. 1–7 (figuræ optimæ).
Runcina Hancocki, Forbes, in Forbes and Hanley, Brit. Moll. iii. (1853), p. 612, pl. ccc. fig. 2.
Pelta coronata, Vayssière, Ann. des Sci. Nat. 6e sér. xv. (1883), p. 6, pls. i., ii. figs. 1–24.

Isle of Cumbrae (*A. M. N.*).
Distribution. Brittany (*Quatrefages*), Marseilles (*Vayssière*).

Order III. NUDIBRANCHIATA.

Suborder I. HOLOHEPATICA, Bergh.

A. ANTHOBRANCHIATA.

Fam. 1. **Dorididæ.**

Genus DORIS, Linné.

Subgenus 1. ARCHIDORIS, Bergh.

62. *Doris tuberculata*, Cuvier.

Distribution. Mediterranean (*Vayssière &c.*), Adriatic (*Sandri &c.*), Western France (*Fischer*), Denmark (*Mörch*), Sweden (*Lovén*), Norway and Finmark (*G. O. Sars*), Faroe (*Mörch*).

It is *D. argo*, Penn., *D. pseudoargus*, Rapp, and perhaps *D. Delle Chiajii* (Verany) and *D. Leuckarti*, Del. Ch., *D. areolata*, Stuvitz, *D. britannica* and *Montagui*, Leach, and *D. mera*, Ald. & Hanc.

63. *Doris flammea*, Ald. & Hanc.

Cumbrae (*A. M. N.*), Plymouth (*Garstang*, in litt.) *.

* Species thus recorded—" (Garstang, *in litt.*)"—are from a list supplied me by Mr. Garstang, of those which he has found at the Biological Laboratory, Plymouth, since the publication of his list (" Report on the Nudibranchiate Mollusca of Plymouth Sound," Journal Marine Biological Assoc. of United Kingdom, vol. i. Oct. 1889, p. 173).

Subgenus 2. JORUNNA, Bergh.

64. *Doris Johnstoni*, Ald. & Hanc.

St. Andrews (*M'Intosh*), Liverpool district (*Herdman*), Plymouth (*Garstang*), Shetland (*A. M. N.*); Moray Firth (*Gordon*).

Distribution. Adriatic (*Graeffe*), S.W. France (*Fischer*), Denmark (*Mörch*), Christiania Fiord and W. Norway (*G. O. Sars*).

This is perhaps *D. tomentosa* of Cuvier, and it is *D. obvelata* of Johnston.

Subgenus 3. ADDISA, Bergh.

65. *Doris testudinaria*, Risso = *D. planata*, Ald. & Hanc.

Plymouth (*Garstang*), Arran, N.B. (*Herdman*).

Distribution. Western France (*Fischer*).

66. *Doris zetlandica*, Ald. & Hanc.

Distribution. W. Norway and Lofoten Islands (*G. O Sars*).

67. *Doris millegrana*, Ald. & Hanc. ? An *Addisa*.

Subgenus 4. CALDINA, Bergh.

68. *Doris repanda*, Ald. & Hanc.

St. Andrews, abundant (*M'Intosh*), Firth of Forth (*Leslie & Herdman*), Shetland (*A. M. N.*).

Distribution. Palermo (*Schultz*), Adriatic (*Tiberi*), Denmark, Sweden (*Mörch*), Norway, Finmark, and Spitsbergen (*G. O. Sars*), N.E. America.

This may be *D. lævis* of Fleming. It is *D. obvelata* of Lovén and perhaps of Müller, but not of Fabricius, Johnston, &c. *D. planulata*, Stimpson.

Subgenus 5. ROSTAGNA, Bergh.

69. *Doris coccinea*, Ald. & Hanc.

Plymouth (*Garstang*).

Distribution. Ægean (*Forbes*), Adriatic (*Graeffe &c.*), whole of Western France (*Fischer*), Denmark (*Mörch*), W. Norway (*G. O. Sars*), Faroe (*Mörch*).

Fam. 2. **Polyceridæ.**

Genus 1. Acanthodoris, Gray.

70. *Acanthodoris pilosa* (Müll.).

Firth of Forth (*Leslie & Herdman*), Liverpool district (*Byerley*), Plymouth (*Garstang*), off Lowestoft, 16 fath. (*Meyer*), Shetland (*A. M. N.*), Moray Firth (*Gordon*), Arran, N.B. (*Herdman*).

Distribution. Ægean (*Forbes*), whole of Western France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Mörch*), all coasts of Norway and Finmark (*G. O. Sars*), Sweden (*Lovén*), Faroe and Iceland (*Mörch*), N.E. America (*Gould*), Heligoland (*Meyer*).

Synonyms are *D. stellata*, Gmelin, *D. sublævis*, Thompson, *D. fusca*, Lovén, *D. rosinela*, Leach; and of the black variety, *D. nigricans*, Fleming, and *D. Flemingii*, Forbes. It is also *D. similis*, Ald. & Hanc.

71. *Acanthodoris subquadrata*, Ald. & Hanc.

Doris quadrangulata, Jeffreys, B. C. v. p. 93.

Liverpool district (*Byerley*).

Genus 2. Lamellidoris, Ald. & Hanc.

72. *Lamellidoris aspera*, Ald. & Hanc.

St. Andrews (*M'Intosh*), Plymouth (*Garstang*), Moray Firth (*Gordon*).

Distribution. Coast of Finistère (*Crouan*), Kiel (*Meyer & Möbius*), Denmark, Greenland (*Mörch*), N.E. America (*Stimpson*).

Synonyms. *D. pallida* (Agassiz), Stimpson, *D. fusca*, Müll., *D. muricata*, Mey. & Möb. (non Müll.).

73. *Lamellidoris muricata* (Müll.).

Distribution. Denmark (*Mörch*), Sweden (*Lovén*), Norway and Finmark (*G. O. Sars*).

74. *Lamellidoris ulidiana* (Thompson).

75. *Lamellidoris diaphana*, Ald. & Hanc.

76. *Lamellidoris bilamellata* (Linné).

Firth of Clyde and Northumberland coast (*A. M. N.*), Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Cheshire coast (*Byerley*), Plymouth (*Garstang*).

Distribution. Western France (*Fischer*), Denmark (*Mörch*), West Norway and Finmark (*G. O. Sars*), Iceland and Greenland (*Mörch*), N.E. America (*Agassiz &c.*).

Synonyms. D. verrucosa of Pennant and Fleming, *D. Elfortiana*, Blainv., *D. vulgaris*, Leach, *D. tuberculata*, Eckhoff, *D. liturata*, Möller, *D. obvelata*, Bouch.-Chant., *D. Leachii*, Blainv., *D. affinis*, Thompson, *D. coronata*, Agassiz.

77. *Lamellidoris depressa*, Ald. & Hanc.

Hilbre Island, Cheshire (*Byerley*), Moray Firth (*Gordon*). This is perhaps *Villersia scutigera*, d'Orbigny.

78. *Lamellidoris inconspicua*, Ald. & Hanc.

Distribution. Denmark (*Mörch*), who also records it with doubt from Iceland and Greenland; Arcachon (*Fischer*).

79. *Lamellidoris pusilla*, Ald. & Hanc.

Moray Firth (*Gordon*).

Distribution. Recorded from Christiania Fiord and West Norway by G. O. Sars, who places it in a genus *Onchidoris*.

80. *Lamellidoris sparsa*, Ald. & Hanc.

Plymouth, 15 fath. (*Garstang*).

Distribution. Faroe (*Mörch*).

81. *Lamellidoris oblonga*, Ald. & Hanc.

Subgenus Adalaria, Bergh.

82. *Lamellidoris proxima*, Ald. & Hanc.

St. Andrews (*M'Intosh*), Liverpool district (*Byerley*).

Distribution. Kiel (*Meyer & Möbius*), Denmark (*Mörch*), West Norway and Lofoten (*G. O. Sars*).

83. *Lamellidoris Lovéni*, Ald. & Hanc.

The only known British example of this was taken by me in Bantry Bay between tide-marks in 1858.

Distribution. Sweden (*Lovén*), Christiania Fiord and West Norway (*G. O. Sars*); recorded with a ? from Faroe (*Mörch*).

Genus 3. Goniodoris, Forbes.

84. *Goniodoris nodosa* (Montagu).

Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Arran, N.B., and Firth of Forth (*Herdman*), Penmaen Ros and Llandrillo Bay, North Wales (*Price*), Plymouth (*Garstang*), Puffin Island, Anglesea (*Herdman*).

Distribution. Western France (*Fischer*), Denmark (*Kröyer*), Sweden (*Lovén*), West Norway (*G. O. Sars*).

It is *Doris barvicensis*, Johnston, and probably *Doris emarginata*, Forbes, and *Doris elongata*, Thompson.

85. *Goniodoris castanea*, Ald. & Hanc.

Isle of Man and Arran, N.B., 25 fath. (*Herdman*), Plymouth (*Garstang*).

Distribution. Genoa (*Verany*), Trieste (*Graeffe*).

It is *Doris Paretii*, Verany.

Genus 4. Idalina, nom. nov. (=*Idalia*, Leuckart, 1828, nec *Idalia*, Hübner, 1816, nec *Idalia*, Savigny, 1820, nec *Idalia*, Muls., 1846).

86. *Idalina elegans* (Leuckart).

Distribution. Cette (*Leuckart*), Marseilles, Genoa, and Naples (*Bergh*), Trieste (*Staz. Zool.*, fide *Carus*), Western France (*Fischer*), Denmark (*Mörch*).

It is *I. laciniosa*, Philippi.

87. *Idalina Leachii* (Ald. & Hanc.).

Shetland, deep water (*A. M. N.*).

Subgenus Idaliella, Bergh.

88. *Idalina inæqualis* (Forbes).

89. *Idalina aspersa*, Ald. & Hanc.

Plymouth (*Garstang*), off the Bass Rock, 24 fath. (*Meyer*).

Distribution. Sweden (*Lovén*, as *I. cirrigera*, Phil.), West and S.W. France (*Fischer*).

90. *Idalina quadricornis* (Montagu).

91. *Idalina pulchella* (Ald. & Hanc.).

Distribution. West Norway and Lofoten (*G. O. Sars*).

Genus 5. Ancula, Lovén.

92. *Ancula cristata* (Alder).

Shetland (*A. M. N.*), Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Plymouth (*Garstang*).

Taken abundantly at Hilbre Island, Cheshire, by Prof. Herdman, who found one specimen "entirely of a hyaline transparent white colour, without any yellow markings on the dorsal papillæ, and with no opaque white pigment on any part of the body." Arran, N.B., and Firth of Forth (*Herdman*).

Distribution. Boulogne (*Bouch.-Chant.*), Denmark (*Kröyer*), W. Norway (*G. O. Sars*), Kiel (*Meyer & Möbius*), Heligoland (*Frey & Leuckart*), Iceland (*Mörch*), Sweden (*Lovén*).

Genus 6. Thecacera, Fleming.

93. *Thecacera pennigera* (Montagu).

Off Lowestoft, 16 fath. (*Meyer*), 20 fath. off Rame Head, Plymouth (*Garstang*).

Distribution. Sicily (*Quatrefages*), N. and N.W. France (*Fischer*).

94. *Thecacera virescens*, Ald. & Hanc.

95. *Thecacera capitata*, Ald. & Hanc.

Genus 7. Crimora, Ald. & Hanc.

96. *Crimora papillata*, Ald. & Hanc.

The only two known specimens of this Nudibranch are those which I took at Guernsey, the one in 1858 the other in 1865. They occurred in shallow water.

Genus 8. Polycera, Cuvier.

97. *Polycera quadrilineata* (Müller).

Shetland and Cumbrae (*A. M. N.*); St. Andrews (*M'Intosh*), Plymouth (*Garstang*), Moray Firth (*Gordon*), Firth of Forth (*McBain*).

Distribution. Mediterranean (*Marion &c.*), Adriatic (*Bergh &c.*), Kiel (*Meyer & Möbius*), Denmark (*Kröyer &c.*), Western France (*Fischer*), Sweden (*Lovén*), S. and W. Norway (*G. O. Sars*), Heligoland, 5–6 fath. (*Meyer*).

Synonyms. Doris cornuta, Abildgaard, *D. flava*, Montagu, *D. varians*, M. Sars, *P. ornata*, d'Orbigny, *P. lineata*, Risso, *P. typica*, Thompson.

Subgenus Palio, Gray.

98. *Polycera Lessonii*, d'Orb.

Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Arran, N.B., 20 fath., and the Mersey (*Herdman*).

Var. *ocellata*, Ald. & Hanc.

Shetland (*A. M. N.*), Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Liverpool (*Byerley*), Plymouth (*Garstang*).

Distribution. The type: Northern and western coasts of France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Lütken &c.*), Bergen and Manger, Norway (*Friele & Hansen*), Iceland and Greenland (*Mörch*). Var. *ocellata* is recorded from the Adriatic (*Marenzeller*), W. France (*Fischer*), Denmark (*Mörch*), Sweden (*Lovén*), and N.E. America (*Gould*).

Synonyms of the type. *P. modesta*, Lovén, *Doris illuminata*, Gould; *P. citrina*, Ald. & Hanc., is the young. Another variety is probably *P. fusca*, Frey & Leuckart, which is the *P. dubia*, M. Sars.

Genus 9. Triopa, Johnston.

99. *Triopa clavigera* (Müll.).

Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Firth of Forth (*F. M. Balfour*), Cumbrae and Lamlash Bay, Arran (*A. M. N.*), Plymouth (*Garstang*).

Distribution. Sweden (*Lovén*), W. Norway, 5–20 fath. (*G. O. Sars*).

Synonyms. *Tergipes pulcher*, Johnston, *Euplocamus plumosus*, Thompson.

Genus 10. Ægirus, Lovén.

100. *Ægirus punctilucens* (d'Orbigny).

Shetland (*A. M. N.*), Firth of Forth (*Balfour*), Moray Firth (*Gordon*), St. Andrews (*M'Intosh*), Plymouth (*Garstang*).

Distribution. Mediterranean? (*Ihering*), Brest (*d'Orbigny*), W. Norway, 10–20 fath. (*G. O. Sars*).

It is *Doris maura* of Forbes.

Suborder II. CLADOHEPATICA, Bergh *.

B. INFEROBRANCHIATA.

Fam. 3. **Pleurophyllidiadæ.**

Genus PLEUROPHYLLIDIA, Meckel, 1816 (=*Diphyllidia*, Cuvier, 1817).

101. *Pleurophyllidia Lovéni*, Bergh.

Off Dunbar, N.B., 30 fath., in mud (*F. M. Balfour*), St. Andrews (*M'Intosh*, in litt.).

Distribution. Denmark (*Lyngbeye & Hörring*), Sweden (*Lovén*), Christiania Fiord, Norway (*G. O. Sars*).

It is the *Diphyllidia lineata* of Lovén and of Forbes and Hanley, but not of Otto. The latter is a Mediterranean species.

C. POLYBRANCHIATA.

Fam. 4. **Tritoniidæ.**

Genus TRITONIA, Cuvier.

102. *Tritonia Hombergi*, Cuvier.

Shetland (*A. M. N.*), St. Andrews (*M'Intosh*), Firth of Forth, 30 fath. (*Meyer*), Moray Firth (*Gordon*), Mersey and Isle of Man, 25 fath. (*Herdman*), Plymouth (*Garstang*).

Distribution. Marseilles (*Marion &c.*), W. France (*Fischer*), Denmark (*Mörch*), Sweden (*Lovén*), S. and W. Norway (*G. O. Sars*).

It is *Doris atrofusca*, MacGillivray, and *Sphærostoma Jamesonii*, MacGillivray.

103. *Tritonia alba*, Ald. & Hanc.

Subgenus CANDIELLA, Gray.

104. *Tritonia plebeia*, Johnston.

Moray Firth (*G. Murray*), Shetland (*A. M. N.*), St. Andrews (*M'Intosh*), Firth of Forth, Hilbre Island, Cheshire,

* The arrangement here followed is for the most part that of Bergh in his paper just published, "Die Cladohepatischen Nudibranchien," 1890. The most important difference is that I have retained *Pleurophyllidia* in a separate section Inferobranchiata.

and Puffin Island, Anglesea (*Herdman*), Mersey and Dee (*Collingwood*), Peterhead, 30 fath. (*Meyer*), Plymouth (*Garstang*).

Distribution. Smyrna (*Forbes*), Marseilles (*Marion*), West France (*Fischer*), Denmark (*Mörch*), South and West Norway, 10–30 fath. (*G. O. Sars*), Heligoland, 19 fath. (*Meyer*).

105. *Tritonia lineata*, Ald. & Hanc.

In 20 fath., Arran, N.B. (*Herdman*).

Distribution. W. France (*Fischer*), Denmark (*Mörch*), West Norway, 20–30 fath. (*G. O. Sars*).

Fam. 5. **Scyllæidæ.**

Genus Scyllæa, Linné.

106. *Scyllæa pelagica*, Linn.

Distribution. Mediterranean, Atlantic, Pacific, and Indian Oceans.

Bergh makes four varieties:—1. *marginata*, Bergh = *S. Grayæ*, Ad. = *Edwardsii*, Verrill; Atlantic Ocean. 2. *S. ghomfodensis*, Forskål; Red Sea. 3. *sinensis*, Bergh; China. 4. *orientalis*, Bergh = *S. ghomfodensis*, Q. & G.; Philippines.

Fam. 6. **Dendronotidæ.**

Genus Dendronotus, Ald. & Hanc.

107. *Dendronotus frondosus* (Ascanius).

Amphitrite frondosus, Ascanius, Kgl. Norske Vid. Selsk. Skrift. 5 Deel, 1774, S. 114, pl. v. fig. 2.
Doris frondosa, Müll. Zool. Dan. Prod. (1776), no. 2777.
Doris arborescens, id. ibid. no. 2776.
Tritonia lactea, Thompson, Nat. Hist. Ireland, iv. (1856), p. 276.
Dendronotus lacteus. Becher, Mollusker von Jan Mayen (1886), p. 14, pl. vi. fig. 8.
Dendronotus luteolus, Lafont, Note pour servir à la France de la Gironde, no. 11, pl. xvii. fig. 1.

Moray Firth (*G. Murray*), St. Andrews, where the white variety, var. *lactea*, Thompson, has occurred (*M'Intosh*), Firth of Forth (*Leslie & Herdman*), near Dogger Bank, 34 fath. (*Meyer*), off Great Orme's Head and Hilbre Island (*Herdman*), Plymouth, 25 fath. (*Garstang*).

Distribution. S.W. France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Lütken &c.*), all coasts of Norway and Finmark to 100 fath. (*G. O. Sars*), Sweden (*Lovén*), Faroe, Iceland, and Greenland (*Mörch*), Jan Mayen (*Becher*), Spitsbergen (*G. O. Sars*), N.E. America (*Couthouy &c.*), Arctic Pacific (*Bergh*), Behring Strait (*Aurivillius*).

It is *Tritonia Reynoldsii*, Couthouy, *Tritonia pulchella* and *Dendrotus arborescens*, Ald. & Hanc., and perhaps *Dendronotus elegans*, Verrill (Proc. U. S. Nat. Mus. 1880, p. 385).

Fam. 7. **Dotonidæ.**

Genus Doto, Cuvier.

108. *Doto fragilis* (Forbes).

Firth of Clyde and Shetland (*A. M. N.*), St. Andrews (*M'Intosh*), Norfolk coast, 12–16 fath. (*Meyer*), off Puffin Island, Anglesea (*Herdman*), Plymouth (*Garstang*).

Distribution. Adriatic (*Graeffe*), Christiania Fiord, Norway, 20 fath. (*G. O. Sars*).

Synonym. Melibœa pinnatifida, Johnston.

109. *Doto pennatifida* (Montagu).

110. *Doto coronata* (Gmelin).

Shetland (*A. M. N.*), Moray Firth (*G. Murray*), St. Andrews (*M'Intosh*), Arran, N.B., 10–20 fath., and Liverpool district, many places (*Herdman*), Plymouth (*Garstang*), Firth of Forth (*F. M. Balfour*).

Distribution. Mediterranean (*Verany &c.*), Adriatic (*Stossich*), S.W. France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Kröyer*), Sweden (*Lovén*), Norway and Finmark down to 10 fath. (*G. O. Sars*), N.E. America (*Stimpson &c.*).

It is *Scillæa punctata* (Bouch.-Chant.), *Melibœa ornata*, Ald. & Hanc., *Melibœa arbuscula*, Agassiz, and *Tergipes lacinulatus*, Delle Chiaje, and, according to Bergh, *Doto Forbesii*, Deshayes, *D. uncinata*, Hesse, *D. pinnigera*, Hesse, *D. armoricana*, Hesse, and *D. confluens*, Hesse.

111. *Doto cuspidata*, Ald. & Hanc.

Shetland (*A. M. N.*).

Genus Hancockia, Gosse, 1877 = *Govia*, Trinchese, 1886 *.

Bergh thus defines this interesting genus :—

" Margo frontalis utrinque digitatus ; rhinophoria quasi ut

* Trinchese, " Richerche anat. sul genere *Govia* " (Mem della R. Acc. delle Sc. dell' Instituto di Bologna, s. 5, vol. vii. pp. 183–191, pl.

in Tritoniadis, tentacula nulla. Papillæ dorsales cuculliformes (facie concava externa cnidocystis prædita); anus latero-dorsalis. Podarium antice truncatum.

"Margo masticatorius mandibulæ singula serie denticulorum armatus. Radula triseriata, quasi omnino illi Galvinarum similis. Otocysta cum otolitho. Penis inermis."

Trinchese has described two species from the Mediterranean.

112. *Hancockia eudactylota*, Gosse.

Hancockia eudactylota, Gosse, Ann. & Mag. Nat. Hist. ser. 4, xx. (1877) p. 316, pl. xi.
Govia dactylota, Bergh, Die Cladohepatischen Nudibranchien, 1890, p. 53.

Dredged by Mr. A. R. Hunt near Torquay, Aug. 10, 1877.

Fam. 8. **Lomanotidæ.**

Genus Lomanotus, Verany.

113. *Lomanotus marmoratus*, Ald. & Hanc.

Lomanotus varians, Garstang, Journ. Marine Biol. Assoc. of Great Britain (1889), p. 185.

Off Lowestoft, 25 fath. (*Meyer*), Shetland (*Peach*).

Distribution. West Norway, 10–20 fath.

Mr. Garstang has found three specimens of this genus at Plymouth, and it appearing to him that they were intermediate forms between so-called species described, he has proposed to group the whole under the name *L. varians*. Of course, however, if they are so united, the laws of nomenclature require that it should be under the earliest name, *L. marmoratus*. Further observations are desirable. It is very probable that Mr. Garstang's conclusions are correct.

114. *Lomanotus flavidus*, Ald. & Hanc.

115. *Lomanotus portlandicus*, W. Thompson (of Weymouth).

116. *Lomanotus Hancocki*, Norman.

Lomanotus Hancocki, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. (1877), p. 518.

Body elongated, of a very light pinkish-orange tinge, very transparent, so that the internal organs are clearly seen through the skin; below white, the front margin of the foot microscopically sprinkled with red specks. *Veil* with two tentacular processes on each side, overhanging the mouth; these processes are orange-coloured below, and above are microscopically sprinkled with red in the same manner as the margin of the foot. *Tentacles* terminating above in a calyx-like expansion, formed of five leaflet-like points, from the middle of which rises the small, conical, smooth termination of the tentacle; this conical process is of small size, not exceeding that of the divisions of the calyx. *Branchial processes* in the form of a waved raised curtain, surmounted by flat triangular papillæ, passing down each side of the back and uniting behind; the undulations of the curtain consist of three outwardly and four inwardly directed folds on each side; the fold which is nearest the head is the largest; the papillæ on this fold are 18 to 20 in number; the papillæ on all the folds vary considerably in size, but there appears to be always one larger than the rest; they are capable of contraction and dilatation, and are constantly changing their apparent dimensions while the animal is in motion; they are banded with deep dark orange, while the small points in which they terminate are pale orange. *Length* $2\frac{1}{4}$ inches.

I dredged a single specimen of this very fine Nudibranch off Berry Head, Torbay, June 25, 1875.

It approaches both *L. flavidus*, A. & H., and *L. portlandicus*, Thompson, but differs in many particulars, and especially in the form of the tentacles, which have a very marked character in the small size of their apical portion, which projects beyond the calyx-like sheath and is quite simple and shows no sign of ringing. The small size of these simple and non-laminated tentacles and their peculiar cut-edged sheath prevent my thinking that *L. marmoratus* is the young and *L. Hancocki* the adult of one species, as has been suggested by Mr. Garstang.

Fam. 9. **Æolididæ.**

Subfam 1. *ÆOLIDINÆ.*

Genus 1. ÆOLIS, Cuvier, 1798 = *Æolidia*, Cuvier, 1817.

Subgenus 1. ÆOLIS, Cuv. (sens. strict.).

117. *Æolis papillosa* (Linn.).

Cumbrae and Shetland (*A. M. N.*), Moray Firth (*G. Murray*), Hilbre Island (*Byerley*), North Wales and Isle of Man (*Herdman*), St. Andrews (*M'Intosh*), Plymouth (*Garstang*), Firth of Forth (*McBain &c.*).

Distribution. W. and S.W. France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Mörch*), Sweden (*Lovén*), Norway and

Finmark (*G. O. Sars*), Faroe and Iceland (*Mörch*), N.E. America (*Gould*).

It is *Doris bodoensis*, Gunner, *Doris vermigera*, Turton, *Eolis Cuvieri*, Lamarck, *Eolida zetlandica*, Forbes & Goodsir, *Eolis Murrayana* and *Lesliana*, MacGillivray, *Eolis rosea*, Ald. & Hanc., *Eolis obtusalis*, Ald. & Hanc., and *Eolis farinacea*, Gould.

Subgenus 2. *Æolidiella*, Bergh.

118. *Æolis glauca*, Ald. & Hanc.

North Wales (*Herdman*).

Distribution. Genoa (*Trinchese*), Adriatic (*Graeffe*), S.W. France (*Fischer*), Denmark (*Collin*).

119. *Æolis Alderi*, Cocks.

Plymouth (*Garstang*, in litt.).

Distribution. St. Malo (*Vaillant*).

120. *Æolis sanguinea*, Norman.

Eolis sanguinea, Norman, Ann. & Mag. Nat. Hist. ser. 4, xx. (1877) p. 517.

This is a very beautiful species, the type of which was taken August 26, 1874, at low water, spring tides, on the islet known as Innislacken, at the entrance of Roundstone Bay, Connemara. The radula of this species has not been examined.

Subfam. 2. *CratenINÆ.*

Genus 2. Cuthona, Ald. & Hanc.

121. *Cuthona nana*, Ald. & Hanc.

Hilbre Island, Cheshire, and Puffin Island, Anglesea (*Herdman*), Firth of Forth (*T. S. Wright*).

Distribution. Boulogne (*Bouch.-Chant.*).

122. *Cuthona* (?) *aurantiaca* (Ald. & Hanc.).

Shetland (*A. M. N.*), Liverpool district (*Price &c.*), Peterhead, 30 fath. (*Meyer*).

Distribution. Lofoten Islands (*G. O. Sars*), Sweden (*Lovén*).

It is *Eolis bellula*, Lovén.

Genus 3. CRATENA, Bergh
(= *Cavolina*, Cuvier, non Abildgaard).

123. *Cratena viridis* (Forbes).

Moray Firth (*G. Murray*), St. Andrews, abundant (*M'Intosh*), Arran, N.B., 20 fath., and Puffin Island, Anglesea (*Herdman*), Plymouth (*Garstang*, in litt.).

124. *Cratena amœna* (Ald. & Hanc.).

Arran, N.B., 20 fath.; off Port Erin, Isle of Man, 15 fath. (*Herdman*).

125. *Cratena olivacea*, Ald. & Hanc.

Shetland (*A. M. N.*), St. Andrews, not uncommon (*M'Intosh*), Moray Firth (*G. Murray*), Mersey (*Herdman*), the Dee (*Collingwood*), Plymouth (*Garstang*).
Distribution. West Norway, 5–10 fath. (*G. O. Sars*).

126. *Cratena pustulata* (Ald. & Hanc.).

127. *Cratena glottensis* (Ald. & Hanc.).

128. *Cratena arenicola* (Forbes).

North Wales (*Herdman*).

129. *Cratena concinna* (Ald. & Hanc.).

? *Eolis gymnota* (Couthouy), Gould, Invert. Mass. edit. Binney (1870), p. 249, pl. xvi. figs. 238–241.

Mersey, common (*Collingwood*).
Distribution. Christiania Fiord (*Asbjörnsen*), West Norway, 5–100 fath. (*G. O. Sars*).

130. *Cratena* (?) *Peachii* (Ald. & Hanc.).

131. *Cratena* (?) *stipata* (Ald. & Hanc.).

132. *Cratena* (?) *angulata* (Ald. & Hanc.).

Off the Bass Rock, 24 fath. (*Meyer*), Plymouth (*Garstang*), Moray Firth (*G. Murray*).
Distribution. Sweden (*Lovén*, fide Alder), Normandy (*Quatrefages*, as *Eolidina paradoxa*).

133. *Cratena* (?) *inornata* (Ald. & Hanc.).

134. *Cratena* (?) *Couchii* (Cocks).

135. *Cratena* (?) *northumbrica* (Ald. & Hanc.).

Subfam. 3. *Tergipedinæ.*

Genus 4. Tergipes, Cuvier.

136. *Tergipes despectus* (Johnston).

Arran, N.B., and Hilbre Island, Cheshire (*Herdman*), Firth of Forth (*Leslie & Herdman*), Mersey (*Collingwood*), Plymouth (*Garstang*).

Distribution. West Norway, 0–10 fath. (*G. O. Sars*), N.E. America (*Stimpson*).

Bergh suggests that *Tergipes claviger*, Menke, is a synonym.

Genus 5. Embletonia, Ald. & Hanc.

137. *Embletonia pulchra*, Ald. & Hanc.

Distribution. Mediterranean (*Ihering*), Brest (*Crouan*).

138. *Embletonia minuta* (Forbes & Good.).

139. *Embletonia pallida*, Ald. & Hanc.

Mersey (*Herdman*).

Distribution. Kiel (*Meyer & Möbius*), Denmark (*Mörch*), Bergen Fiord, Norway, 14 fath. (*Meyer*).

Var. *Grayi*, Saville Kent.

Embletonia pallida, Meyer and Möbius, Fauna der Kieler Bucht, 1865, p. 17, pl. figs. 1–3.
Embletonia Grayi, Saville Kent, Proc. Zool. Soc. 1869, p. 109, pl. viii.

Oral lobes highly developed. *Eyes* deeeply sunk beneath the integument and situated some distance apart, immediately behind the tentacles; they are, however, often scarcely discernible. *Branchial papillæ* in five transverse rows, two on each side; but in the adult generally three in each fasciculus of the second row, and rarely three in the first. In the form figured by Meyer and Möbius there are three papillæ in first and second fasciculus and four in the third; but the additional papillæ beyond the primary two are not one third the size of these. *Colour* transparent white, antero-dorsal region usually more or less sprinkled with minute ramifying pigment-cells of a blackish hue, which occasionally also extend over the papillæ. Length two tenths to three tenths of an inch.

Feeding on *Cordylophora lacustris*, which lives on the submerged timber-balks at the Victoria Docks, London, where the water contains about one third of the saline constituents of pure sea-water. Spawn masses of an irregular oval form.

Genus 6. AMPHORINA, Quatrefages.

140. *Amphorina cœrulea* (Mont.).

Distribution. Genoa (*Trinchese*), Adriatic (*Graeffe*), West France (*Fischer*).

141. *Amphorina* (?) *purpurascens* (Fleming).

A species doubtful in all respects.

142. *Amphorina molios* (Herdman).

Eolis molios, Herdman, Proc. Roy. Phys. Soc. Edinb. vol. vi. 1881, p. 28, pl. i. figs. 1–3.

"*Body* longish, tapering to a fine point posteriorly, and of a yellowish-green colour. *Oral tentacles* of the same colour as the body, very short. *Dorsal tentacles* also yellowish green, short and thick. *Branchial processes* stout but not large, dark blue, with large cadmium-yellow tips, encircled near the top by a narrow brown band; they are set in eight transverse rows, having five processes in each [there is some mistake in this number five, as according to the figure there must be double that number at least]; the three anterior rows are placed close together, the rest having greater intervals between them. *Radula* formed of overlapping plates, each of which has a central spine and five lateral denticulations, which decrease in size from the centre to the edge. Length 10 mm."

Two specimens dredged in about 10 fathoms, Arran, N.B., by Professor Herdman.

Genus 7. GALVINA, Ald. & Hanc.

143. *Galvina exigua*, Ald. & Hanc.

St. Andrews (*M'Intosh*), Mersey (*Collingwood*), North Wales (*Herdman*).

Distribution. Bergen Fiord, Norway, 14 fath. (*Meyer*), Adriatic (*M. Sars*), Kiel (*Meyer & Möbius*), Sweden (*Lovén*), Jugor Schar, 'Vega' exped. (*Aurivillius*); recorded with doubt from W. Norway (*Friele & Hansen*).

It is *Tergipes lacinulatus*, Lovén (nec Gmelin).

144. *Galvina tricolor* (Forbes).

Moray Firth (*G. Murray*).

Distribution. Brest (*Crouan*), Sweden (*Lovén*), Florö, Norway (*Friele & Hansen*), Arran, N.B. (*Herdman*).

It is *E. purpurea*, *E. amethystina*, and *E. violacea*, Ald. & Hanc.

145. *Galvina picta*, Ald. & Hanc.

Shetland (*A. M. N.*), Arran, N.B., 10–20 fath.; Liverpool district and off Port Erin, Isle of Man (*Herdman*), Moray Firth (*G. Murray*).

Distribution. Genoa (*Trinchese*), Adriatic (*Graeffe*), West Norway, 5–10 fath. (*G. O. Sars*).

146. *Galvina Farrani*, Ald. & Hanc.

St. Andrews (*M'Intosh*), Moray Firth (*G. Murray*). Mr. Garstang finds the species at Plymouth, and describes several interesting colour varieties (Journ. Marine Biol. Assoc. Gt. Brit. vol. i. 1889, p. 193).

Distribution. Mediterranean (*Ihering*), Bréhat, France (*Quatrefages*).

It is *Amphorina Alberti*, Quatrefages, and *Eolis andreapolis*, M'Intosh. The last is a variety with more or less purple colouring.

147. *Galvina adelaidæ* (W. Thompson).

Weymouth (*Thompson*), St. Andrews (*M'Intosh*).

This is *Eolis Robertianæ*, M'Intosh.

148. *Galvina vittata*, Ald. & Hanc.

149. *Galvina cingulata*, Ald. & Hanc.

It is also *Eolis hystrix*, Ald. & Hanc.

Subfam. 4. *Coryphellinæ*.

Genus 8. Coryphella, Gray.

150. *Coryphella rufibranchialis* (Johnst.).

Shetland (*A. M. N.*), Moray Firth (*G. Murray*), St. Andrews (*M'Intosh*), Hilbre Island (*Herdman*), near Plymouth, 20–25 fath. (*Garstang*), Arran, N.B. (*Herdman*).

Distribution. Mediterranean (*Bergh*), Denmark (*Mörch*), Bergen and Florö, Norway (*Friele & Hansen*), Kiel (*Meyer & Möbius*), N.E. America (*Stimpson*), Behring Sea (*Bergh*).

Synonyms. Eolidia Embletoni, Johnston, *Eolis mananensis*, Stimpson.

Trinchese regards the four *Coryphellæ* which next follow as only so many colour varieties of *C. rufibranchialis*.

151. *Coryphella gracilis*, Ald. & Hanc.

Off Puffin Island, Anglesea, 11-13 fath. (*Herdman*), Plymouth (*Garstang*, in litt.).
Distribution. Denmark (*Mörch*).

152. *Coryphella smaragdina*, Ald. & Hanc.

Moray Firth (*G. Murray*).

153. *Coryphella Landsburgii*, Ald. & Hanc.

Shetland and Cumbrae (*A. M. N.*), Firth of Forth (*McBain*), Moray Firth (*G. Murray*), Hilbre Island, Cheshire (*Herdman*).
Distribution. Mediterranean (*Trinchese*), S.W. France (*Fischer*), Florö, Norway (*Friele & Hansen*).

154. *Coryphella pellucida*, Ald. & Hanc.

Lamlash Bay, Firth of Clyde, 10 fath. (*Herdman*).
Distribution. Christiania Fiord and W. Norway, 10–20 fath. (*G. O. Sars*).

155. *Coryphella lineata* (Lovén).

Off Port Erin, Isle of Man, 15 fath. (*Herdman*).
Distribution. Mediterranean (*Verany*), Sweden (*Lovén*), W. Norway, 20–30 fath. (*G. O. Sars*).
It is *Æolis argento-lineata*, A. Costa, and *Eolidia Demartinii*, Verany.

Subfam. 5. *Favorinidæ.*

Genus 9. Favorinus, Gray.

156. *Favorinus albus*, Ald. & Hanc.

Favorinus albus, Trinchese, Atti della R. Acc. dei Lincei, ser. 3, vol. xi. (1882), p. 69, pls. xxxi., xxxii. fig. 2.

One variety figured by Trinchese has the branchiæ white, another green, another orange, a fourth brown.
Isle of Cumbrae and Shetland (*A. M. N.*), Moray Firth (*G. Murray*), Plymouth (*Garstang*, in litt.).
Distribution. Mediterranean (*Trinchese &c.*), Adriatic (*Graeffe*), S.W. France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Mörch*), Sweden (*Lovén*), W. Norway, 10–20 fath. (*G. O. Sars*).

157. *Favorinus carneus*, Ald. & Hanc.

Genus 10. FACELINA, Ald. & Hanc. (=*Acanthopsole*, Trinchese).

158 *Facelina Drummondii* (W. Thompson).

Facelina Drummondii, Trinchese, Atti della R. Acc. dei Lincei, ser. 3, vol. xi. (1881) p. 41, pl. x. fig. 3, pls. xii., xviii., xix., xxi., xxiv., xxv., xxvi., xxviii., xxix., xxx., xxxi.

Trinchese, as above, figures two very marked colour varieties, and goes very fully into the anatomy of the species.

Cumbrae, Arran, N.B., and Falmouth (*A. M. N.*), Firth of Forth (*McBain*), Mersey and Dee, very common (*Collingwood*).

Distribution. Mediterranean (*Costa &c.*), S.W. France (*Fischer*), Kiel (*Meyer & Möbius*), Denmark (*Mörch*), W. Norway, 0–10 fath. (*G. O. Sars*).

Synonyms. Æolis gigas, A. Costa, *Eolidia Janii* and *Pannizæ*, Verany, *Eolis Quatrefagesi*, Vayssière; and a British variety is *E. tenuibranchialis*, Ald. & Hanc.

159. *Facelina coronata* (Forbes).

Moray Firth (*G. Murray*), St. Andrews (*M'Intosh*), Cumbrae and Arran, N.B. (*A. M. N.*), Firth of Forth (*McBain*), Hilbre Island (*Herdman*), Plymouth (*Garstang*).

Distribution. Mediterranean (*Trinchese &c.*), W. France (*Fischer*), Denmark (*Mörch*), Florö, Norway (*Friele & Hansen*).

160. *Facelina punctata*, Ald. & Hanc.

Facelina punctata, Trinchese, Atti della R. Acc. dei Lincei, ser. 3, xi. (1882), p. 38, pls. ix., x. figs. 1, 2, pls. xi., xiv., xv., xvi., xvii., xxii. figs. 1, 2, pl. xxiii. figs. 3–5, pls. xxvii., xxx A. figs. 3–8.

One of the Mediterranean varieties figured by Trinchese has the branchiæ of a rich rose colour.

Plymouth (*Garstang*).

Distribution. Mediterranean (*Ihering &c.*), S.W. France (*Fischer*).

161. *Facelina elegans*, Ald. & Hanc.

Subfam. 6. *FLABELLININÆ.*

Genus 11. CALMA, Ald. & Hanc.

162. *Calma glaucoides*, Ald. & Hanc.

Subfam. 7. *Fionidæ.*

Genus 12. Fiona, Hancock & Embleton.

163. *Fiona marina* (Forskål).

Fiona nobilis, Ald. & Hanc. Brit. Nud. Moll. fam. iii. pl. xxxviii *a*.
Fiona atlantica, Bergh, Anatom. Unders. af *Fiona atlantica*, Vid. Medd. Natur. For. i Kjöbenhavn, 1857.
Fiona marina (Forskål), Bergh, Scient. Results Explor. Alaska, vol. i. (1879) p. 142.

Penmaenmawr, N. Wales (*Thompson*), Southport Pier (*Vicars*).

Distribution. Mediterranean (*Bergh &c.*), W. France (*Fischer*), North Pacific (*Bergh*).

Synonyms. Limax marinus, Forskål, *Æolis fasciculata*, Lamarck, *Eolis Cuvieri*, Del. Chi., *Hymenæolis elegantissima* (A. Costa).

Subfam. 8. *Antiopinæ.*

Genus 13. Antiopa, Ald. & Hanc. 1848 (=*Janus*, Verany, 1844, nec Stephens, 1835).

164. *Antiopa cristata* (Delle Chiaje).

Shetland, and Seaham Harbour, co. Durham (*A. M. N.*), River Dee (*Collingwood*), Mersey and N. Wales (*Herdman*), Plymouth (*Garstang*).

Distribution. Mediterranean (*Verany &c.*), Adriatic (*Graeffe*), Boulogne (*Bouch.-Chant.*).

Synonyms. Antiopa splendida, Ald. & Hanc., *Janus spinolæ*, Verany, and perhaps *Æolis carinata*, Costa.

165. *Antiopa hyalina*, Ald. & Hanc.

Hilbre Island, Cheshire (*Byerley &c.*).

Genus 14. Proctonotus, Ald. & Hanc.

166. *Proctonotus mucronifer*, Ald. & Hanc.

Arran, N.B., in 15 fathoms (*Herdman*).

Subfam 9. *Heroinæ.*

Genus 15. Hero, Lovén.

167. *Hero formosa*, Lovén.

Hero formosa, Herdman, Proc. Roy. Phys. Soc. Edin. vi. (1881) p. 15, pl. i. figs. 4–6.

Lamlash Bay, Arran, 10–20 fath., and off Salen, in the Isle of Man (*Herdman*).

Distribution. Denmark (*Mörch*), Christiania Fiord and Lofoten Islands, 15–100 fath. (*G. O. Sars*).

Synonyms. Clœlia trilineata, M. Sars, and *Tritonia velata*, Œrsted.

Fam. 10. **Hermæidæ.**

Genus 1. HERMÆA, Lovén.

168. *Hermœa bifida* (Montagu).

Plymouth (*Garstang*, in litt.).

Distribution. Naples (*Costa*), Genoa (*Trinchese*).

It is *H. Hancocki*, Trinchese, and perhaps *H. cruciatus*, Agassiz; it is also *Physopneumon carneum*, Costa.

169. *Hermœa dendritica*, Ald. & Hanc.

Distribution. Naples (*Costa*), Genoa (*Trinchese*), Trieste (*Graeffe*).

It is *H. brevicornis*, *lutescens*, and *orbicularis* of Costa.

Genus 2. ALDERIA, Allman.

170. *Alderia modesta* (Lovén).

Distribution. Sweden (*Lovén*).

It is *Alderia amphibia*, Allman.

D. PELLIBRANCHIATA.

Fam. 11. **Elysiidæ.**

Genus ELYSIA, Risso.

171. *Elysia viridis* (Montagu).

Cumbrae and Plymouth (*A. M. N.*).

Var. *olivacea*, Jeffreys.

Distribution. Mediterranean (*Marion &c.*), Adriatic (*Bergh &c.*), Ægean (*Forbes*), Kiel (*Meyer & Möbius*), Denmark (*Bergh*), Sweden (*Lovén*), Norway and Finmark, 0–10 fath. (*G. O. Sars*).

Fam. 12. **Limapontiidæ.**

Genus 1. LIMAPONTIA, Johnston.

172. *Limapontia capitata* (Müller) = *Fasciola capitata*, Müller = *Limapontia nigra*, Johnston.

Cumbrae (*A. M. N.*), St. Andrews (*M'Intosh*), Newhaven, in Firth of Forth (*T. Scott*), Plymouth (*Garstang*, in litt.).
Distribution. Denmark (*Müller &c.*), Sweden (*Lovén*).

173. *Limapontia depressa*, Ald. & Hanc.

Genus 2. CENIA, Ald. & Hanc.

174. *Cenia Cocksi*, Ald. & Hanc.

Moray Firth (*G. Murray*).

Genus 3. ACTÆONIA, Quatrefages.

175. *Actæonia corrugata*, Ald. & Hanc.

[To be continued.]

VI.—*Description of a new Snake of the Genus* Glauconia, *Gray* *, *obtained by Dr. Emin Pasha on the Victoria Nyanza.* By G. A. BOULENGER.

Glauconia Emini.

Snout rounded; supraocular large, nearly twice as broad as long, followed by a single large transverse shield; rostral a little broader than nasal, not extending quite to between the eyes; nasal completely divided; ocular bordering the lip, between two labials, the anterior of which equals the lower portion of the nasal in size; six lower labials. 14 scales round the body. Diameter of body 55 times in the total length, length of tail 9 times. Uniform blackish. Total length 110 millim.

Two specimens were obtained at Karagwe by Dr. Emin Pasha and presented by him to the British Museum.

* = *Stenostoma*, Wagler, nec Latreille.

The African species of *Glauconia* which, in my opinion, are entitled to recognition are thirteen in number, and may be distinguished as follows :—

A. Ocular bordering the lip, separated from the lower part of the nasal by a single labial.	
a. Snout hooked, the præoral portion flat or concave inferiorly.	
Diameter of body more than 100 times in the total length	*G. macrorhynchus*, Jan.
Diameter of body less than 100 times in the total length	*G. rostrata*, Bocage.
b. Snout rounded.	
a′. Supraocular nearly twice as broad as long, followed by a single transversely enlarged shield....................	*G. Emini*, Blgr.
b′. Supraocular small.	
a″. Rostral not extending to the level of the posterior border of the eyes.	
α. Diameter of body 40 to 57 times in the total length.	
First labial as large as lower part of nasal	*G. narirostris*, Ptrs.
First labial smaller than lower part of nasal; length of tail 25 to 30 times in total......	*G. brevicauda*, Bocage.
First labial smaller than lower part of nasal; length of tail 8 to 13 times in total	*G. nigricans*, Schleg.
β. Diameter of body 65 to 90 times in the total length.	
Nasal semidivided; length of tail 14 or 15 times in total	*G. Cairi*, D. & B.
Nasal completely divided; length of tail 9 times in total	*G. longicauda*, Ptrs.
b″. Rostral extending to the level of the posterior border of the eyes.	
Rostral not twice the width of the nasal......	*G. conjuncta*, Jan.
Rostral at least twice the width of the nasal ..	*G. scutifrons*, Ptrs.
B. Ocular bordering the lip, separated from the lower part of the rostral by two labials.	
Supraocular large, as broad as the shield following	*G. Sundevallii*, Jan.
Supraocular small	*G. bicolor*, Jan.
C. Ocular not reaching the lip	*G. dissimilis*, Bocage.

In addition to the above-described *Glauconia*, the following

Reptiles and Batrachians were sent to the British Museum by Dr. Emin Pasha :—

South Shore of Victoria Nyanza.—Nucras tessellata, Smith ; *Eremias Spekii*, Gthr. ; *Lygosoma modestum*, Gthr. (a single specimen, with 24 scales round the body and the nasal completely divided into two) ; *Dromophis angolensis*, Bocage ; *Psammophis biseriatus*, Ptrs. ; *Thelotornis Kirtlandii*, Hallow.

Ugogo.—Megalixalus Fornasinii, Bianconi.

VII.—*On a new Genus and some new Species of Shells from Lake Tanganyika.* By EDGAR A. SMITH.

MR. E. COODE HORE recently presented to the British Museum a few Tanganyikan shells preserved in spirit and containing the animals. Among them are two specimens of *Paramelania nassa*, var. *grandis* *.

This variety I now propose as the type of a new genus, which may be designated *Nassopsis*, distinguished from *Paramelania* † (henceforth reserved for *P. Damoni* and *P. crassigranulata*) partly on account of certain differences in the shell, but more especially as the operculum is of an entirely different type.

In *Paramelania* the aperture of the shell does not exhibit the sinuation or subtruncation of the columella which is so conspicuous in typical *Nassopsis*, and the anterior extremity of the last whorl has a slightly produced appearance ; the outer lip also is more thickened. The operculum in *Paramelania* is large, ovate, paucispiral at the nucleus, situated a little within the left margin and about equidistant from the ends, and subsequently displays a concentric style of growth. That of *Nassopsis* is small and somewhat paucispiral at the *almost terminal* nucleus.

Nassopsis nassa, var. *grandis*.

Animal with the foot small, broader in front than behind, with the anterior margin double ; sides of the foot and head blackish ; proboscis compressed, broad and truncate at the end ; tentacles also black, except at the tips, which are pale, very short, conical, swollen at the base on the outer side, probably denoting the position of the eyes ; free edge of the mantle dark-coloured and subdenticulate.

* Proc. Zool. Soc. 1881, p. 561, pl. xxxiv. fig. 26 *a*.

† *L. c.* p. 559 (= *Bourguignatia*, Giraud).

Radula with teeth in seven series (3. 1. 3), central smallest; recurved edge notched at each side, with a conspicuous cutting-edge; inner or first lateral obliquely subquadrate, much produced at the outer base into a rostrate extremity, with three denticles on the recurved cutting-edge; second lateral larger than the rest, oblique, incurved, margin tricuspidate; outer or third lateral narrow, more slender at the base than above, curved over towards the adjacent tooth, and with five or six unequal denticles on the edge.

Operculum rich brown, horny, narrow, striated externally with lines of growth from the paucispiral nucleus, which is nearly terminal; lower surface with a broad glossy band or thickening along the outer or right margin, occupying about half the surface; placed transversely across the dorsal part of the foot. Length (from a semiadult shell 20 millim. long) 7 millim., diameter $3\frac{1}{2}$.

Mr. Gwatkin, who has had much experience, kindly examined the radula of this genus, and informs me that he is inclined to believe that *Nassopsis* will find its nearest allies in the Cerithiidæ, and not amongst the Littorinoids as I had suggested. It also seems to me to bear considerable resemblance to *Planaxis*.

In general construction the operculum is very like that of many species of *Melania*, but the peculiar solidity of the shell and the slight notch at the base of the columella, besides certain differences in the radula, may be sufficient to separate this and allied species as a distinct group.

Syrnolopsis (*Anceya*) *Giraudi*, var.

A single specimen, kindly submitted to me for examination by Mr. S. I. Da Costa, agrees in most respects with M. Bourguignat's description. It differs, however, in colour, being of a red tint with a white zone around the middle of the whorls. It does not exhibit the palatal liræ in the aperture, but these may be too far within to be visible. In adult specimens of *Syrnolopsis lacustris* the liræ cannot be seen until the lip is broken away to some extent. As far as I can discover the only distinction separating *Anceya* from *Syrnolopsis* is one of sculpture. The type of *Syrnolopsis* has smooth whorls, whereas that of *Anceya* is *longitudinally* costate. If sculpture be admitted as a generic character there is no reason why *Syrnolopsis carinifera* should not be regarded as the type of a third genus characterized by *spiral* ridges. The general form of the aperture is the same in all three forms; it is slightly oblique and has an upper and basal broad sinus or slight canaliculation; the outer lip is faintly effuse and prominent, and the columellar folds are similar and in the same position in each.

Turbonilla? terebriformis.

Testa subulata, nitida, albo-grisea, superne pallide lilacea, oblique costata et striata; anfractus circiter 18, lente accrescentes, apicales — ?, sequentes 3–4 convexi, longitudinaliter tenuiter striati, circa medium biangulati, cæteri convexi (superioribus quam inferioribus convexioribus, fortissime costatis), costis obliquis, subacutis, distantibus, instructi, lineis incrementi tenuissimis oblique flexuosis striati; anfr. ultimus ad peripheriam rotunde subangulatus, costis inferne obsoletis; apertura longit. totius $\frac{1}{5}$ adæquans; columella rectiuscula, superne obsolete uniplicata.
Longit. 12 millim., diam. $2\frac{2}{3}$.

The costæ (about eight in number) on the upper whorls are stronger and further apart than on the lower ones, and are more convex in outline; on the last volution they number about twelve or thirteen. The aperture is somewhat broken away anteriorly, so that the generic position of this interesting species is not quite certain. The texture and costation somewhat recall the appearance of some species of *Terebra*.

Streptostele Horei.

Testa parva, elongata, anguste rimata, cerea; anfractus $7\frac{1}{2}$, apicales læves, cæteri convexiusculi, sutura profunda leviter obliqua sejuncti, costellis confertis, erectis, superne ad suturam denticulatis instructi, inter costellas nitidi; apertura mediocris, longitudinis totius $\frac{1}{4}$ subæquans; perist. incrassatum, album, anguste reflexum, margine externo prope suturam intus sinuato, columellari dilatato, rimam semiobtegente; columella indistincte contorta; paries anfr. ultimi prope extremitatem labri tuberculis duobis parvis munitus.
Longit. $6\frac{1}{2}$ millim., diam. 2; apertura $1\frac{1}{2}$ longa et lata.

This species is well distinguished by the fine longitudinal riblets, which at the upper extremities give a finely denticulate appearance to the deep suture. The single specimen under examination exhibits two denticles at the upper part of the aperture upon the wall of the body-whorl—one near the upper end of the upper lip, the other near it but further within the mouth. The labrum is conspicuously sinuated above near the suture and has a tubercular thickening within below the sinus.

Streptostele simplex.

Testa subulata, tenuis, imperforata, cereo-alba; anfractus 9, apicales læves, cæteri convexiusculi, sutura obliqua profunda discreti, longitudinaliter confertim striati; apex obtusus, globosus; apertura parva, longit. totius $\frac{1}{4}$ vix æquans, subquadrata; perist. haud incrassatum, antice leviter expansum; columella subrecta, reflexa. Longit. $8\frac{1}{2}$ millim., diam. 2; apertura 2 longa.

This species has rather convex whorls, is finely striated, and has a deepish suture. The outer lip is scarcely thickened and does not exhibit the sinus at the upper part which is characteristic of the genus. In form and general appearance, however, it agrees very well with the type of the group, *S. fastigiata*, Morelet. It also bears some resemblance to *S. Buchholzi* of Martens, from the Cameroons, but is considerably smaller, and has shorter and rather more convex whorls.

VIII.—*Notes on the Genus* Dyschorista, *Led., a small Group of Moths allied to* Orthosia. By A. G. BUTLER.

THE genus *Dyschorista* was founded for the reception of two European species, *D. suspecta*, Hübn., and *D. ypsilon*=*fissipuncta*, Hew. (see Lederer, Noct. p. 143, gen. 82).

Accepting *D. suspecta* as type of the genus, it will be necessary to include the bulk of the forms referred by M. Guénée to his previously characterized genus *Orthodes*.

Orthodes, Guénée, was described in the first volume of the 'Noctuélites,' p. 371, no type being indicated; but Guénée selected two of the species, *O. t-nigrum* and *O. curvirena* (both Brazilian), for illustration. In the description of the species of his second group Guénée pointed out that *O. curvirena* differed structurally from the remainder of the genus:—"L'une d'elles (*Curvirena*) a les palpes particulièrement ascendants et allongés." He thus restricted the identification of his type to *O. t-nigrum*, the first species of his first group.

In the Museum collection we have an example of *O. t-nigrum*, and, as may be seen from the figure in the 'Noctuélites,' it has no connexion whatever with the remainder of the species, but is in fact far more closely allied to *Leucania*; fortunately the remaining species correspond with *D. suspecta* in size, pattern, coloration, the ascending palpi, simple antennæ, and heavily tufted anal decorations of the male.

In his 'Check-list of North-American Moths' for 1882 Grote rightly reduced the number of M. Guénée's North-American species, *Orthodes nimia* and *candens* being sunk as synonyms of *O. cynica*, of which they are in fact slight varieties; *O. infirma*, however, is a Brazilian species, and must be expunged from the North-American fauna, the form described by M. Guénée as var. A being, as he supposed, a distinct species.

In typical *O. infirma* the secondaries of the male are creamy white—"Ailes infér. d'un blanc-jaunâtre"—whereas in the northern form they are of the same glossy brownish grey as in the female. In the Brazilian insect the inner line of the central area of primaries is more oblique and much more irregular and the outer line more distinctly sinuated between the nervures; both of these lines and the edges of the discoidal spots which they enclose are much less prominent than in the northern form; but, as M. Guénée says, the subterminal line is clearer, at any rate it is so in the female; the marginal spots are very indistinct, and are thus overlooked in the original description of the Brazilian form; but in that of var. A the pale zigzag line which shows them up in the northern form is noted:—"Un feston terminal clair très-marqué." I propose to give the North-American species the new designation of *Dyschorista crenulata*.

Four closely allied Brazilian species are in the collection, all differing more or less in the clothing of the under surface of the primaries, the tufting of the anal extremity in the males, or the palpi; one of these is typical *O. infirma*, a second may be *O. rubor*, but the discoidal spots are bordered by a pale line, whereas in Guénée's type (a female) they were not; a third I am unable to recognize from any of the descriptions; it is a male with closed anal claspers, giving it the aspect of a female; the costa of the primaries is distinctly arched towards the base; the under surface of these wings almost wholly covered with dense rough hair, which extends also to the basicostal area of secondaries; the coloration and general pattern is that of *Dyschorista crenulata*, but the "orbicular" spot is rhomboidal, the two outlines of the central area are indistinct and much more parallel, and the pale crenulated submarginal line is wanting; the pectus and femora are also much more hairy. I propose to call this *Dyschorista lanaris*. The fourth species of the same group is *O. curvirena*—a most remarkable insect, in which the palpi are curved upwards like those of a Deltoid and the anal tufts, when fully expanded, are seen to be enormously developed. The genus seems to abound in extraordinary ornamentation; in *D. melanogaster* M. Guénée says, "Abdomen noirâtre en dessus, garni latéralement de poils carnés, à l'extrémité d'une brosse jaunâtre," which calm description hardly prepares one for the large expanded rose-coloured brushes of the moth.

IX.—*Descriptions of two new Species of Scorpions brought by Emin Pasha from the inland parts of East Africa.* By R. I. Pocock, of the British Museum (Nat. Hist.).

[Plate I. figs. 1 and 2.]

Buthus Eminii, sp. n. (Pl. I. fig. 2.)

Colour.—Trunk ochraceo-fuscous; keels of tergites and of cephalothorax black; the ocular tubercle and the antero-lateral regions of the cephalothorax infuscate; a fuscous patch on each side of the tergites. Legs and palpi ochraceous beneath, the upper surface of humerus and brachium and anterior surface of the legs feebly infuscate; tail ochraceous above, the inferior keels irregularly blackened; vesicle clear ochraceous, aculeus black in its second half.

Cephalothorax slightly wider than long, its anterior border very lightly concave; the anterior keels well developed, marked by smooth and rounded granules which anteriorly become lost amongst the similar though smaller granules which adorn the antero-lateral parts of the cephalothorax; ocular tubercle deeply cleft, very finely granular, the sides of it, which are continuous with the anterior keels, are granular in front and behind, smooth in the middle; sides of cephalothorax beset with larger and smaller granules; running obliquely backwards and inwards from the direction of the lateral eyes there are about three subparallel series of large granules; the posterior keels well developed, granular, short and parallel, their anterior ends not connected with the very feebly developed external median keels and separated by a slight interval from the internal median keels, which are strong and granular; the areas defined by the anterior and by the internal median and posterior keels beset with larger and smaller granules.

Tergites.—The first six furnished with three strongly granular keels, which in the posterior half of the body project somewhat beyond the margin of the plate; finely granular throughout and furnished in addition between the keels and especially at the sides with many coarse granules; the seventh tergite furnished like the preceding with fine and coarse granules; the lateral keels well developed, strongly granular, complete behind, united in front; the median prominence elongate, granular, and subcarinate.

Sternites mostly smooth, sparsely punctured and hairy; the first finely granular antero-laterally; the last more coarsely granular at the sides, bearing four keels, the internal keels smooth, abbreviated in front, complete behind, the external granular and abbreviated in front and behind.

Tail powerful, parallel-sided, deeply excavated above; the anterior four segments furnished with ten granular keels, but the median lateral (supernumerary) keel becoming weaker posteriorly, is nearly obsolete on the fourth segment; the rest of the keels on these segments all well developed, complete and evenly granular throughout, the posterior granule only of the superior keels being the largest of the series and dentiform; the intercarinal spaces finely and closely granular; the upper surface of the first and second segments granular, the upper surface of the rest smooth; fifth segment excavated and smooth above, with compressed granular sides, the inferior lateral and median keels evenly granular throughout, the space between these keels coarsely and finely granular, the granules in the anterior half being arranged on each side in a distinct longitudinal series. *Vesicle* large and inflated, granular and hairy below; aculeus of average form.

Palpi.—*Humerus* thickly granular above, granular and tubercular in front, minutely granular beneath, hairy, especially in front, and furnished with the usual granular keels; *brachium* granular and granularly costate above, smooth and subcostate behind and beneath, granular and granularly costate in front; *manus* large, rounded, very finely and closely granular, hairy and somewhat deeply punctured, much wider than the brachium; *dactyli* short, not in contact at the base, each furnished with a lobe, the lobe on the movable dactylus being smaller than and fitting behind the lobe on the immovable dactylus.

Legs granular and carinate; coxæ smooth.

Pectines long, projecting beyond the fourth coxæ, furnished with 25 or 26 similar teeth.

Measurements in millimetres.—Total length 50; length of tail 30, of first segment 3, of second 4, of third 4·2, of fourth 5, of fifth 6, of vesicle 3·5; width of first segment 4, of third 4·2, of fifth (in front) 4, (behind) 3, of vesicle 3; cephalothorax, length 5·5, width 6; length of humerus 4·5; brachium, length 5, width 2·2; manus, width 3·3; length of "hand-back" 4, of movable dactylus 5·7.

A single male specimen taken on the south shore of Victoria Nyanza.

This interesting species belongs to the group of *Buthus* of which *hottentotta* is a good representative, and appears to lead from it to those constituting the subgenus *Prionurus*, of which *australis* is the type. Thus in the number and armature of the keels of the tail it closely resembles *hottentotta*, but the fifth segment of that organ is much more deeply excavated, and its sides are distinctly carinate, though not to such an extent as is seen in *australis*. Moreover, the manus is much larger than in *hottentotta* and the dactyli much shorter; in the form of these parts it calls to mind the male of *B. Philippsii*, Pocock, but with this species it cannot be confounded on account of the conformation of its caudal segments.

Scorpio viatoris, sp. n. (Pl. I. fig. 1.)

Colour.—Trunk above olivaceo-piceous, paler beneath; hands with reddish tinge; vesicle ochraceous; aculeus black in its hinder half.

Cephalothorax wider behind than long, with its anterior border deeply excised in the middle and denticulated at the sides; lateral depressed portions of cephalothorax finely and closely granular; the area behind the frontal lobes also finely granular, but very sparsely so; the rest of the upper surface smooth, bearing a few scattered setiferous pores; ocular tubercle cleft and situated just behind the middle of the cephalothorax.

Tergites granular, minutely and closely in front and at the sides, much more coarsely and less closely behind; the first six marked with a median smooth keel, the seventh with a sparsely granular median prominence, and one strongly granular keel on each side.

Sternites bisulcate in front, wholly smooth, all of them, but especially the last, furnished with a few setiferous pores.

Tail much less than four times as long as the cephalothorax; the first two segments slightly shorter than the cephalothorax; upper surface of tail almost wholly smooth; the superior and supero-lateral keels distinctly denticulate; the inferior keels on the first and second segments wholly smooth, on the third subdenticulate behind; on the fourth more denticulated than on the third, but less so than on the fifth; the median lateral keel present on the first segment, but much abbreviated anteriorly, represented on the second, third, and fourth segments by a few granules subserially arranged; the fifth segment furnished with seven denticulated keels; vesicle carinate and granular beneath; the aculeus somewhat abruptly curved in its posterior half.

Palpi.—*Humerus* smooth on its lower and upper surfaces, the latter defined behind and in front by a series of denticles and bearing two or three setiferous tubercles, its anterior surface strongly dentate; *brachium* subcostate behind, smooth, but marked with setiferous pores; smooth beneath and furnished with many setiferous pores along the hinder margin; anterior surface finely granular and sparsely denticulate; *manus* narrow, equalling in width the superior ridge of the "hand-back," with lightly convex but distinctly dentate and hairy inner margin, scarcely produced posteriorly; the upper surface ornamented with a reticulated pattern formed by the anastomosis of low smooth ridges; above the superior ridge of the "hand-back" the surface is subcostate; inferior surface mostly smooth, coarsely but sparsely granular in front, with two smooth keels; *dactyli* granular, costate and hairy; the movable dactylus slightly longer than the hand.

Legs.—The femora of the fourth pair feebly granular in front; for the rest the legs are almost entirely smooth and not costate; *coxæ*, especially of the anterior two pairs, punctured.

Pectines short, projecting as far as the end of the fourth coxæ; furnished with fourteen teeth.

Measurements in millimetres.—Total length 100·5; length of cephalothorax 15, width 15·5; length of tail 49, of first segment 6·5, of second 7·5, of third 8·2, of fourth 9·5, of fifth 12, of vesicle 6·5, of aculeus 4·5; width of first caudal segment 6·5, of fifth 4·5, of vesicle 4·5; length of humerus 13·7; brachium, length 14·5, width 5·3; width of hand 11; length of "hand-back" 10·5, of movable finger 16·5.

A single male specimen without special locality.

In the reticulated sculpturing of the hands this species resembles *Sc. indicus* (Linn.); but it is of much more slender build, with longer palpi, thinner hands, and longer tail. In the form of its palpi it approaches the male of *Sc. fulvipes*; but in this species the upperside of the hand is coarsely granular and subcostate.

X.—*On* Ebalia nux, *Milne-Edwards.* By R. I. Pocock.

My attention has just been called to a passage on p. 316 of the last number of the 'Journal of the Marine Biological Association,' in which I regret to see that Canon Norman has taken occasion to charge me by implication with lack of courtesy for not giving what he considers due acknowledgment to the name he applied to the above Crustacean; and since such an accusation is likely to carry weight from such a source and to leave a wrong impression on the minds of readers not acquainted with the facts of the case, I shall be glad to be permitted to say a few words on my own behalf to clear away any misapprehension that may have arisen.

When writing a report upon the Crustacea dredged by Mr. Green off the south-west coast of Ireland, I was naturally desirous of giving a reference to the original description of *Ebalia nux*—one of the species obtained. That the species had been described I did not at first for a moment doubt; for in more than one case I saw it quoted as *Ebalia nux*, Norman, without any insertion of the letters MS. Anyone, I think, who will take the trouble to "look up" the species in the 'Museum Normanianum,' in the Brachyura of the 'Challenger,' and in the first three of the works mentioned by Mr. Bourne in his useful list of the literature of the subject, will admit without hesitation that my conclusion was the obvious one to arrive at; for in every case it will be noticed that amongst several well-known species, to each of which is affixed its author's name, *Ebalia nux*, Norman, is mentioned —just as if this species rested upon as secure a basis as the others and had the same right to recognition.

Since, however, in none of these places was there a reference to the original source of the name, I decided, very naturally, to apply to the fountain-head for the information I required. I consequently wrote to Canon Norman asking if he could kindly help me out of the difficulty; but since I received no reply to this letter, although I retained my manuscript as long as was possible in the expectation of being favoured with one, I was obliged to have the paper printed as it now stands*. But whilst awaiting an answer from Canon Norman I had discovered that Prof. Carus, in his 'Prodromus,' mentions *Ebalia nux*, Norm., and that he inserts after the name the words "*species nondum descripta.*" This was the first intimation I had that the crab in question had been hitherto known by a manuscript name. Having learnt this, it seems to me that, in writing on the species, I adopted the only plan that common sense and common courtesy alike suggested, *i. e.* I described the species as new and gave Canon Norman the credit of it by retaining the name he proposed and by subjoining the words "*Ebalia nux*, Norman, MS." How by thus acting I overstepped the bounds of courtesy I confess my inability to see. It appears to me that I gave to his species all the acknowledgment Canon Norman could possibly expect, and that at the same time I represented the facts of the case in a perfectly courteous and intelligible

* Ann. & Mag. Nat. Hist. iv. pp. 425–431 (1889).

manner. This being so, I was not a little surprised to see Canon Norman's comment on the praiseworthy conduct of Messrs. Marion and Milne-Edwards and the reflection that it cast upon my own; nor, when I thought over the implied accusation against me of discourtesy, could I help feeling slightly amused as the recollection of my letter passed through my mind. But if I were to assume that Canon Norman received my letter and had not the—shall I say?—courtesy to answer it, and were to suggest that if my mode of dealing with his manuscript name was discourteous his treatment of my letter is deserving of a much harsher epithet, I think the assumption would be very unjust and the suggestion a very unmannerly one. I shall consequently make neither, but shall conclude that my letter never reached its destination; for seemingly this is the only conclusion that explains to Canon Norman's credit the fact that the sole reply received to my private letter was a public, though guarded, accusation of discourtesy.

XI.—*On some new Species of African* Lycænidæ *in the Collection of Philip Crowley, Esq.* By Emily Mary Sharpe.

Fam. **Lycænidæ.**

Genus Pseudaletis.

Pseudaletis trifasciata, sp. n.

Similar to *P. clymenus*, Druce, but differing in the extent of the black border on the fore wing, which reaches from the costa to the submedian nervure; this black portion of the wing is relieved by two white spots, one at the end of the discoidal cell, while the second is oval and extends from the first discoidal or radial nervule, then slanting slightly down to the third median nervule.

There is a white patch along the inner margin of the fore wing, extending a little above the submedian nervure.

The hind wing has a broad border of black along the margin to the internal nervure, with a broad black bar from the end of the costal nervure to the border.

The underside has this bar distinctly marked, with a second black bar from the base of the hind wing to the submedian nervure; there is a third bar which begins from the inner margin and joins the other two bars, making a large black patch between the first median nervure and the submedian nervure at the anal angle; this patch has a little yellow in which are two black spots.

On the underside of the fore wing there is an additional white spot near the apical portion of the wing.

Exp. 37 millim.

Hab. Sierra Leone.

Genus Zeritis.

Zeritis leonina, sp. n.

Similar to *C. harpax*, Fabr., but is a much paler yellow, with a very bread black border to the hind margin and costal margin, and very black at the base of the fore wing.

The hind wing has no black border, the wing being entirely yellow with the exception of black at the base and a black streak near the first subcostal nervule. There are two delicate tails.

The underside of the fore wing is a very pale yellow, changing to a pale brown near the apical portion and having the hind margin a deep reddish yellow. There is a row of six silver spots along the inner side of this red marginal border, two small silver spots near the base, a silver black and reddish-yellow-bordered streak across the wing rather before the middle, with a shorter similar streak on each side of it (the outer one interrupted), and a quadrate spot between this and the marginal series of spots. The costal margin is slightly touched with reddish yellow.

The hind wing is more or less suffused with deep reddish yellow, with bars and spots of silver enclosed by very fine black lines. There is a large black spot at the anal angle of the wing.

Exp. 28 millim.

Hab. Sierra Leone.

Zeritis fallax, sp. n.

The underside resembles that of *Z. latifimbriata*, but it has the ground-colour slightly darker rufous-brown; all the markings are silver, with thin black outlines; there is a complete row of spots on a dark hind marginal border.

The upperside is a deep purplish blue, with the costa, hind margin, and apical portion of the fore wing black.

The hind wing has some blue in the centre of the wing, with a black costa and fringe; from the first median nervule to the anal angle is a patch of rufous-brown, with two small tails.

Exp. 23 millim.

Hab. Sierra Leone.

Zeritis latifimbriata, sp. n.

Allied to *C. harpax*, Fabr., but differs in the greater extent of the reddish yellow on the fore wing, thus making the black border narrower; there is a black spot at the end of the discoidal cell. The base of both wings is suffused with black.

The hind wing has a narrow black line along the hind margin with a grey fringe; the costal portion is black. There are two tails, the last being very thick.

The underside is paler than in *Z. harpax*, with the silver lines more marked; between the two tails on the hind wing is a large spot of silver.

This may probably turn out to be the female of *Z. fallax*.

Exp. 30 millim.

Genus Aphnæus.

Aphnæus chalybeatus, sp. n.

Nearest to *A. orcas*, Drury, but is much smaller and the blue not so bright nor so distinctly marked on either of the wings.

The underside is a deep brownish red with spots of silver enclosed in black; from the end of the discoidal cell below the first median nervule is a silver streak on the fore wing.

The hind wing is similar to the fore wing, with the exception of two oblique silver lines between the submedian and internal nervures.

Exp. 29 millim.

Hab. Sierra Leone.

Genus Lycænesthes.

Lycænesthes voltæ, sp. n.

Entirely white, with the base, costa, apical portion, and hind margin of the fore wing light brown; there is a transverse line of brown at the end of the discoidal cell.

The hind wing has the hind marginal border brown, with three angulated lines between the second and first median nervules and one near the anal angle. The fringe on the hind wing is white, with three tails at the end of the second and first median nervules and submedian nervure.

The underside is white, with markings of pale brownish yellow over the wings; on the hind wing are two yellow spots situated one on the submedian nervure and the other between the second and first median nervures.

Exp. 33 millim.

Hab. Volta River.

Genus Epitola.

Epitola Crowleyi, sp. n.

♂. Nearest to *E. Dewitzi*, Kirby, but larger and with the blue of a much deeper colour, having more of a purple tint.

The blue patch on the fore wing extends a little into the discoidal cell, there being no spots of any kind on the upperside.

The hind wing resembles the fore wing in having the large blue patch and the black border round the hind margin.

The underside is different in having no spots near the discoidal cell of the fore wing; there is, however, an uneven row of white spots near the apical portion of the wing. The costal margin has a line of dull metallic golden colour.

The hind wing has a purple ground relieved by a number of white silver streaks and spots. There is a broad stripe of silver-white extending for some distance along the costa.

Exp. ♂ 50 millim.

Hab. Sierra Leone.

The female differs considerably from that of *E. Dewitzi* in having only a very faint indication of the pale blue patch on the fore wing. There are three white spots placed obliquely near the apex of the fore wing, a larger spot between the second and third median nervules, with a faint blue spot nearly at the end of the first median nervule.

The hind wing has the blue paler, but it is strongly marked between the lower radial and the first median nervule, leaving the margin and the base of the wing black.

The underside differs in having the four white spots from the costal margin to the discoidal nervules, and another large white spot between the second and third median nervules of the fore wing.

The hind wing is entirely silver-white, with the spots and streaks of purple-bronze. The silver-white near the costa is very large and spreads almost to the subcostal nervure.

Exp. ♀ 52 millim.

Hab. Sierra Leone.

XII.—*On some Eastern Equatorial African Coleoptera collected by Emin Pasha, with Descriptions of two new Longicornia.* By CHARLES O. WATERHOUSE.

[Plate I. fig. 3.]

THE British Museum has lately received a series of insects from Eastern Africa, collected by Emin Pasha. Among them there is a mixture of East- and West-African species, as observed in my former paper (Proc. Zool. Soc. Lond. 1888, p. 86) on the Coleoptera from the same source. Among the Longicorns the following may be noticed:—*Anoplostetha lactator*, F., *Lophoptera asperula*, White, Natal species; *Xystrocera nigrita*, Serv., *Phryneta obscura*, Ol., and *Mœcha hecate*, Chevr., West-African species.

Cerambicidæ.

Plocœderus Emini, sp. n. (Pl. I. fig. 3.)

Piceo-niger, parum nitidus, pube flavo-grisea vestitus. Epistomo sat profunde emarginato; antennis corpore longioribus, articulo basali crasso, rugoso, latitudine duplo longiore, basi vix angustato; thorace sat brevi, disco depresso, oblique plicato; elytris rufo-piceis, basi, sutura margineque laterali reflexo nigrescentibus, ad apicem truncatis, angulo suturali acute spinoso, angulo externo obtuse angulato. ♂.

Long. 20 lin.

This fine species is nearest to *P. fucatus*, Dej., but is larger and less convex, and differs from that and all its allies in the colour of the elytra. The antennæ have the basal joint very large, not quite twice as long as broad, with an obtuse ridge in front, extending to the middle of the joint. The third to sixth joints are swollen at the apex, with an acute angular projection; the swelling at the apex of the seventh joint is less and the angular projection less acute. The thorax has the disk much flatter than in *P. fucatus*, clothed with pale sandy pubescence; with a fine longitudinal carina in front, and a fine transverse straight carina at the middle (angulated in its middle), and a longitudinal smooth space behind the middle; the rest of the surface is marked by some undulating more or less oblique pleats. The elytra are less convex than in *P. fucatus*, very closely and very finely and evenly punctured, with larger punctures interspersed. The prosternal process has its apical portion almost parallel and very distinctly bituberculate.

Lamiidæ.

Ceroplesis signata, sp. n.

Niger, brevissime pubescens: thorace disco foveato-punctato; elytris fortiter sat crebre punctatis, fascia rufa ante medium ad suturam paullo interrupta ornatis.

Long. 9½ lin.

Hab. E. Africa.

This species is very close to *C. æthiops*, but is relatively narrower and has the elytra a little more acuminate at their apex. The thorax has a strongly marked, impressed, transverse line in front of and behind the disk, so that the disk is more convex than in *C. æthiops*, somewhat shining, with a median impressed line; the sides of the disk with some rather large deep punctures. The elytra are clothed with short pubescence, but the rather coarse and moderately close punctuation is nevertheless visible, especially at the base; just before the middle there is a bright red fascia, nearly rectilinear posteriorly, but obliquely narrowed anteriorly near the suture, where there is a slight interruption.

XIII.—*On the Organization of the Cyprides.* By Prof. Carl Claus *.

Since the publication of Zenker's well-known Monograph (1854), although the number of forms described as species and the division of the old Müllerian genus *Cypris* into subgenera and new genera have advanced considerably, our knowledge of the organization of the freshwater "Ostracoda" has made no particular progress. With the exception of my little treatise on the developmental history of *Cypris*, published twenty-two years ago, and the recently issued memoirs of some pupils of Weismann's (Stuhlmann, Nortquist) on the so-called mucous glands, recognized as an ejaculatory apparatus, of the male Cyprides, we stand essentially on the platform of Zenker's Monograph, and for information on the details of organization are compelled to go to that work, which, notwithstanding the imperfect methods of investigation prevalent at the time of its publication, furnished many important results. Nevertheless it does not come up to the present level

* Translated from the Anzeiger d. kaiserl. Akad. d. Wiss. in Wien, March 20, 1890, pp. 1-6.

ot our knowledge of the organization of the Crustacea, and it was easy to foresee that with the extraordinarily perfected methods of recent times, and especially the preparation of serial sections from hardened and stained objects, numerous gaps in our knowledge of these organisms would be filled up without much difficulty. Consequently I only supplied a pressing desideratum when I again took up the investigation of *Cypris*. The results obtained are briefly summarized here.

1. The *nervous system* consists, besides the brain clothed with a thick ganglionic covering, of an elongated ventral cord containing five pairs of ganglia. The anterior section of the brain, representing the prosencephalon of the Arthropod brain, gives forth the nerves to the tripartite frontal eye and possesses a particularly strong coating of ganglion-cells, in which the centre of projection of the highest rank is probably to be sought. The meseneephalon gives off the nerves to the anterior antennæ, into which, however, fibres from the prosencephalon also enter; at the sides of the metencephalon represented by the exceedingly elongated commissures, which only unite far above the œsophagus, the nerves of the second pair of antennæ originate. The ventral chain of ganglia extends throughout the length of the body to the sexual apparatus, and in its anterior, broader portion passes beneath the projecting cariniform pectoral plate on the side of which the maxillæ and maxillipeds (second pair of maxillæ) originate. This section contains the closely approximated ganglia of the mandibles, maxillæ, and maxillipeds, the muscles of which are supplied by the nerves issuing from them. Beyond the pectoral plate commences the narrower and more elongated division of the ventral cord, the two ganglia of which give off the nerves to the pairs of legs. At the posterior of these terminates the cell-layer, which quite continuously coats the concentrated ventral cord, and the longitudinal fibres of the central mass are continued in two long median stems nearly touching each other, which ramify among the muscles of the abdomen.

2. The *frontal eye*, as in all groups of Crustacea, is tripartite and receives for each of its three divisions a nerve which is rooted in the median layer of the prosencephalon. Each of the three closely connected pigment-cups is occupied by some sixteen to twenty cells, into which the fibres of the nerve enter from the outside beneath a nearly spherical lens. Thus the eye, like the lensless median eye of the Cypridinæ and Phyllopoda (*Branchipus*), is an inverse cup-eye. I have found no cuticular divisions such as occur

in the form of bacilli on the visual cells of *Cypridina*, which are turned towards the pigment, but within, turned towards the pigment, I have found a second layer of narrow elongated nuclei, which must belong to a special form of cells. The rounded nuclei of the nerve-cells are placed peripherally, turned towards the entering nerves and the overlying secretion-lens, which is clothed by the delicate integument. In *Notodromus* the three divisions of the frontal eye are separated from each other, and here, as in the *Pontellæ* and *Oniscidiæ* among the Copepoda, we have an anterior, ventral, cup-shaped eye and two separated lateral eyes, which are easily distinguished from the composite lateral eyes.

3. *Endoskeleton.*—Beneath the œsophagus, between the stomach and the anterior ganglionic mass of the ventral cord, in front of the transversely placed sinew of the shell-muscle, there is a broad, indistinctly bipartite, chitinous plate, upon which, in agreement with the endoskeleton of the Phyllopoda and other Crustacea, as also with the so-called *endostomite* of the Arachnoidea, pairs of muscles for all the limbs of the trunk, including the second pair of antennæ, are attached. On its anterior margin originate numerous muscular threads, which pass to the lower wall of the œsophagus, and two slender, long, muscular bundles, which pass through the space between the mandibular and maxillary ganglia to the labium.

4. The *alimentary apparatus* commences by a rather narrow atrium, bounded by the labrum and labium, into which the toothed biting edge of the mandibles enters from the right and left. Zenker's "rake-like masticating organs" are situated at the bottom of it, and belong, as a sort of hypopharynx, to the labium. In the bottom of the atrium beneath the labrum commences the buccal intestine, ascending at first nearly perpendicularly and then somewhat obliquely backwards to the stomach. The shorter anterior part of it (œsophagus), which is about equal in length to the atrium, appears to be nearly cylindrical, but with a more strongly arched ventral wall, into which the pair of muscles springing from the endoskeleton and acting as dilaters enter. More numerous and larger muscles pass from the integument of the labrum to the flattened dorsal surface of the œsophagus, and draw up its very thick wall, the convex surface of which projects like a valve into the lumen, and thus, in conjunction with the dilaters of the lower œsophageal wall, enlarge the lumen, which is horseshoe-shaped in transverse section. The following larger division of the œsophagus (gizzard) appears to be essentially altered in form; it was described by Zenker as a very complicated triturant organ, resembling the human

larynx. It is, however, by no means free, as supposed by that author, but has its larger, hinder portion united with the intestine. Only the smaller, anterior part, embraced laterally by powerful muscular bands and ventrally attached by muscular threads to the endoskeletal plate, lies free in front of the intestine, and is drawn forward by a large pair of muscles originating at the summit of the labrum and running beneath the brain and obliquely over the œsophagus, and backward by a second group of muscles acting in the opposite direction. This forward and backward displacement, which reminds us of the motory mechanism of the gizzard in the Decapoda, affects only the dorsal wall, the strong convexity of which projects into the lumen, beset with rows of pointed teeth, and acts like a rasp against the concave ventral wall, also densely armed with points. It corresponds with Zenker's "Reibzeug," while the part described by that author as "Ringknorpel" represents the bottom and the lateral wall of the œsophagus. The middle intestine is divided by a deep constriction into two sections, of which the anterior surrounds the throat-like opening of the gizzard and gives off the two hepato-pancreatic tubes into the interspace of the duplicature of the shell. It contains a very deep glandular epithelium, and must, as the stomach, have the function of digesting albuminous bodies. The second, far longer but equally wide section of the intestinal tube, the chyle-intestine, appears chiefly to effect the absorption of the nutritive materials. No muscular rectal section in Zenker's sense is present; the anal aperture is a narrow fissure concealed by a valve and placed dorsally from the furcal joints.

5. *Secretory organs.*—Both the antennal gland and the gland of the second pair of maxillæ are well developed in *Cypris*, but it is the former which is removed into the shell-cavity and therefore must be characterized as the *shell-gland.* Its position and form I have already represented correctly in my memoir on the development of *Cypris* (1868), but without tracing the finer structure. It commences above the entrance of the hepato-pancreatic tube into the cavity of the carapace and allows a terminal saccule to be distinguished from the gland-duct, which is somewhat tortuous, but not folded into convolutions. The cells of the former contain small nuclei and are very intensely stained by reagents. Excretory products are often deposited in its lumen. The gland-duct consists only of a series of perforated cells, the nuclei of which are of extraordinary size and emit digitiform branches above and below, each representing only a single perforated cell. The

efferent duct passing towards the antennæ commences near the terminal saccule and is exceedingly difficult to trace.

The *maxillary gland* is situated ventrally to the shell-muscle and appears to consist principally of the terminal saccule divided into several diverticula, from which the efferent duct runs into the shaft of the maxilliped (second maxilla). Besides these excretory organs, characteristic of the Crustacea and representing the nephridia of the Annelida, there are two glands in the labrum, and further some very large gland-like cells in the basal joints of the limbs, and also under the back, and particularly numerous within the carapace attached to the hypodermis of the inner lamella.

6. *Sexual apparatus.*—Like the copulatory apparatus of the males of *Cypridina* and *Halocypris* the complicated penis of the *Cytherides* and *Cyprides* represents a transformed (8) pair of limbs. But the external sexual parts of the female (still erroneously characterized as the *vagina*), which are arched like a capsule, perforated by the sexual aperture, and sometimes furnished with leg-like appendages, are also probably to be interpreted as the basal joints of a pair of limbs, while the two abdominal appendages, which still constantly figure as "Rami abdominales" (caudal rami) or as caudal spines, as also the so-called "postabdomen" of the Cypridinæ and Halocyprides, represent the two *furcal joints* of the Entomostracan body.

The long, fissure-like, sexual aperture, which is surrounded by a chitinous band, receives the oviduct in its posterior section, which is susceptible of dilatation by the action of powerful muscles; and the oviduct runs with many convolutions by the sides of the intestine, and by means of its glandular epithelium secretes the shell-membranes of the contained ova in the same way as the ovarian tube of the Insecta. The genital cleft in its anterior angle, where it is dilated, surrounds the aperture for the reception of the seminal filaments, which are of peculiar form and enclosed by a chitinous loop. A complicated apparatus follows on this copulatory aperture (which is dilatable by a special group of muscles), and consists in the first place of a saccule formed by a chitinous wall, then of a much convoluted glandular tube and a chitinous tube originating from the saccule, leading into the duct of the receptaculum, which is spirally twisted like a watch-spring.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 12, 1890.—J. W. Hulke, Esq., F.R.S., Vice-President, in the Chair.

The following communications were read :—

1. "On a Crocodilian Jaw from the Oxford Clay of Peterborough." By R. Lydekker, Esq., B.A., F.G.S., &c.

The symphysis of the mandible of a Thecodont Reptile obtained by Mr. Leeds from the Oxford Clay near Peterborough was described by the Author, and reasons were given for referring it to the Crocodilia rather than to the Sauropterygia. An imperfect skull found by Mr. Leeds in the same formation at Peterborough appears to belong to the same form as the mandible, and shows that the latter cannot be referred to *Machimosaurus.*

After reviewing the whole of the evidence, the Author concluded that he was dealing with a Crocodilian allied to *Metriorhynchus,* but forming the type of a new genus, to which he gave the name of *Suchodus*, adding the specific name of *durobrivensis.*

2. "On two new Species of Labyrinthodonts." By R. Lydekker, Esq., B.A., F.G.S., &c.

The right ramus of the lower jaw of a Labyrinthodont, from the Lower Carboniferous of Gilmerton, near Edinburgh, is regarded as referable to the Permian genus *Macromerium*, and it is proposed to describe it as *M. scoticum.*

Another mandible, from the Karoo system of South Africa, is referred to the American Permian genus *Eryops* under the name *E. Oweni.*

March 26, 1890.—J. W. Hulke, Esq., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. "On a new Species of *Cyphaspis* from the Carboniferous rocks of Yorkshire." By Miss Coignou, Cambridge. (Communicated by Professor T. McK. Hughes, M.A., F.R.S., F.G.S.)

The Author describes a fairly perfect head of a Trilobite found in the Pendleside limestone of Butterhaw, near Cracoe, which appears to belong to the genus *Cyphaspis,* though it differs from the typical species of that genus in possessing two pairs of glabellar lobes. The name *Cyphaspis acanthine* is proposed for this form.

2. "A Monograph of the Bryozoa (Polyzoa) of the Hunstanton Red Chalk." By George Robert Vine, Esq. (Communicated by Prof. P. Martin Duncan, F.R.S., F.G.S.)

The fossils examined occurred on tests of Echinoderms and on the shells of *Terebratula biplicata*, *T. capillata*, Oysters, *Inocerami*, *Nautili*, and Ammonites. The best of the forms of *Diastopora* and *Proboscina* are found on *Inocerami* and Ammonites, but the most abundant individuals are *Stomatoporæ*, chiefly on *Terebratula biplicata*. Species of *Entalophora*, *Idmonea*, and "*Ceriopora*" are very rare or badly preserved, and Chilostomatous forms are also very rare.

In the present monograph the Author felt obliged to limit or re-define the generic terms employed, and proceeded to describe in detail the forms which he has examined from the Hunstanton Red Chalk and other Cretaceous deposits, including the following new forms:—*Proboscina irregularis*, *P. uberta*, *P. gracilis*?, var. *Reussi*, *P. claviformis*, *P. hunstantonensis*, and var. *ampliata*, *P. Jessoni*, *P. gigantopora*, *P. dilatata*, var. *cantabrigiensis*, *Diastopora hunstantonensis*, *D. fœcunda*, *D. Jessoni*, and *Membranipora gaultina*.

April 16, 1890.—J. W. Hulke, Esq., F.R.S., Vice-President, in the Chair.

The following communication was read:—

"On Ornithosaurian Remains from the Oxford Clay of Northampton." By R. Lydekker, Esq., B.A., F.G.S.

Seven vertebræ, portions of the ilia and ischia, one femur, and the distal portion of that of the opposite side, part of a bone, probably from the shaft of the tibia, and two undetermined fragments, all associated, indicate the existence in England during the Oxford-Clay period of the species of *Rhamphorhynchus* provisionally referred to *R. Jessoni*, though not definitely distinguished from *R. Gemmingi*.

Amongst the noticeable features of the specimens are the presence of a distinct rib-facet at the lateral border of the inferior surface of the centrum of the cervical vertebræ, proving the existence of cervical ribs, and the character of the neural spine of a dorsal vertebra, which strikingly recalls that of a bird.

May 14, 1890.—Dr. A. Geikie, F.R.S., President, in the Chair.

The following communications were read:—

1. "On some new Mammals from the Red and Norwich Crags." By E. T. Newton, Esq., F.G.S.

This paper contains descriptions of mammalian remains from the English Pliocene belonging to eight species, nearly all being new to the Crags, and four of them new to science. A remarkable low-crowned, but broad, lower carnassial tooth from the Norwich Crag of Bramerton is referred to the genus *Lutra*, and named specifically *L. Reevei*. All the other specimens noticed below are from the nodule-bed at the base of the Suffolk Red Crag, and the first four of them are in the possession of Mr. E. C. Moor, of Great Bealings. A right ramus of a lutrine lower jaw, differing from the common Otter in having the hinder fangs of the premolars much larger than the front ones, and agreeing in this particular with the *Lutra dubia* of DeBlainville, is referred to the latter species. A humerus of a Seal, most nearly resembling that of *Phoca vitulina*, but of smaller size and more slender proportions, is called *Phoca Moori*. Another Seal's humerus, having a peculiarly triangular shaft, is thought to belong to the *Phocanella minor* of Van Beneden. A maxilla with three teeth, evidently belonging to the genus *Trogontherium*, but of smaller size than the *Trogontherium Cuvieri*, is believed to represent another species, and is named *T. minor*. The ziphioid rostrum in the Ipswich Museum, which received from the Rev. H. Canham the MS. name of *Mesoplodon Floweri*, is for the first time described; and another rostrum in the Museum of Practical Geology, characterized by being very short and with a deep boat-like anterior extremity, is named *Mesoplodon scaphoides*. The peculiar species *Ailurus anglicus*, hitherto known only by a piece of a lower jaw with a carnassial tooth, is now further illustrated by a fine upper molar recently presented to the Museum of Practical Geology.

2. "On Burrows and Tracks of Invertebrate Animals in Palæozoic Rocks, and other Markings." By Sir J. William Dawson, LL.D., F.R.S., F.G.S.

This paper, which is illustrated by photographs and drawings, indicates some new facts in connexion with the markings produced by the burrows and tracks of animals and by other causes. *Rusichnites* and *Cruziana* are regarded, like *Climactichnites* and *Protichnites*, as representing probable burrows of Crustaceans and Chætopod worms. *Scolithus canadensis* is shown to be a cylindrical burrow, with accumulations of earthy castings at its mouth. The relation of these burrows to the forms known as *Scotolithus*, *Asterophycus*, *Monocraterion*, and *Astropolithon* is pointed out.

Under the new generic name of *Sabellarites* the Author describes certain tubes, composed of shelly and other fragments cemented by organic matter, found in the Trenton Black-river Limestone. They resemble the burrows or tubes formerly described by the Author from the Hastings and Quebec Groups, and appear to be the tubes of worms allied to the recent *Sabellariæ*: but they are liable to be mistaken for Algæ of the genera *Palæophycus* and *Buthotrephis*.

Some large cylindrical bodies from the Potsdam Sandstone are described as having been supposed to be trunks of trees; but the Author regards them as probably concretions formed around slender stems, like some now forming in the alluvial mud of the St. Lawrence.

Some curious combinations of worm-tracks with ripple-marks and shrinkage-tracks are described; as also branching or radiating worm-trails, which present some resemblance to branching Fucoids. Finally, the Author describes the formation of rill-marks on the mud-banks of the tidal estuaries of the Bay of Fundy, and indicates their identity with some impressions in slabs of rock which have been described as Fucoids under several generic names.

May 21, 1890.—Dr. A. Geikie, F.R.S., President, in the Chair.

The following communications were read:—

1. "On some Devonian and Silurian Ostracoda from North America, France, and the Bosphorus." By Prof. T. Rupert Jones, F.R.S., F.G.S.

Of the Devonian species herein figured and described, six species and one variety (four being new) from the decomposed Chert of the Corniferous Limestone of Ontario County, in the State of New York, and new species from the Hamilton Group of Clarke Co., Indiana, have been sent by Mr. J. M. Clarke, of Albany, N. Y., as mentioned in the February number of the Quart. Journ. Geol. Soc. p. 14. From Eighteen-mile Creek, Lake Erie, N. Y., there are two new Devonian species among specimens supplied by Dr. Hinde (*op. cit.* p. 28), and two new *Primitiæ* from Thedford. Altogether five genera (*Bollia*, J. & H., *Moorea*, J. & K., *Octonaria*, J., *Eurychilina*, Ulrich, and *Ulrichia*, gen. nov.) are hereby added to the list of "Hamilton" fossils.

The Devonian *Beyrichia* collected some years ago by M. Dumont at the Bosphorus, and noticed by Dr. Ferd. Römer in the 'Neues Jahrbuch' for 1863, having been kindly lent by M. Dewalque for examination, is figured and described in detail. It appears to be the same as *B. devonica*, Jones, lately described from Devonshire.

Nine new species from Anticosti, in Dr. Hinde's collection, alluded to above, are here figured and described. They are from Mr. Billings's "Anticosti Group" (Divisions 3, 2, 1, and the lowest). The lowest and Div. 1 are both now regarded as of Lower Silurian age, and Divs. 2 and 3 are either Middle or Upper Silurian. A series of Silurian Ostracoda from Canada, submitted by Mr. Whiteaves, F.G.S., and Mr. Ami, F.G.S., have been examined, and critical notes on them are here given.

The Lower-Silurian *Beyricha Guilleri*, named and compared with other species by M. G. de Tromelin at Nantes in 1875, who found it at Domfront and elsewhere in Brittany, is also figured and described in detail.

2. "On a new species of *Coccodus* (*C. Lindströmi*, Davis)." By J. W. Davis, Esq., F.G.S.

A description is given of a small fossil fish from the hard chalk of Hakel in Mount Lebanon ; it is nearly related to *Coccodus armatus*, Pictet, but is smaller than that species, does not show an equivalent of the pectoral spine (unless the posterior extension of the scapular arch should be so considered), and the posterior basal extension of the dorsal spine is very different in the two forms. Further, the dorsal spine is nearer to the occipital region in the new form than in *C. armatus*, and is, compared with the size of the fish, a larger fin.

The arrangement of the fins shown in the specimen now described is quite different to that of the Siluroids (*Synodontis* and *Pimelodus*), and the great resemblance of the teeth of *Coccodus* to those of the Pycnodonts, and the cartilaginous character of the vertebræ, indicate a relationship with the Ganoids; but its exact relationship in that group must remain still problematical.

The Author proposes to name the new form *Coccodus Lindströmi.*

June 4, 1890.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The President referred to the sad loss which the Society had sustained through the death of Mr. Dallas, and read the following resolution, which had been passed by the Council and ordered to be entered upon its Minutes.—

> "The Council desires to record on its Minutes an expression of its deep regret at the death of the Assistant-Secretary, Mr. Dallas, which took place on the 29th ultimo, and of its sense of the loss inflicted on the Council and Society by the removal of one who, for the long period of twenty-two years, had done them invaluable service, and who, by his courtesy, kindliness, and helpfulness had endeared himself as a personal friend to the Fellows."

The following communication was read:—

"North-Italian Bryozoa." By A. W. Waters, Esq., F.G.S.

The Chilostomatous Bryozoa dealt with in the paper are, for the most part, from known Vicentine localities, together with some from two new localities,—Monte Baldo in the Veronese and Ronzo in the Tyrol. Reuss described a number from the Vicentine, but at a time when the chief attention was given to the shape of the zoarium, and the oral aperture, avicularia, and ovicells did not receive the attention now given to them. The attempt is therefore made to bring our knowledge of these beds, which are the richest and most important known in the Lower Tertiaries, more nearly up to present ideas, so that more exact comparisons may be made between Tertiary and living forms.

Several cases are mentioned in which there is great difference of zoarial shape, and also some in which there is great range in the zooecial characters.

The discovery of *Catenicella* in these beds is of considerable importance, which is enhanced by one of the species having both short beads and longer internodes.

Porina coronata and *Lepralia syringopora* both have a closure, formed by a plate with a tubule in the centre, a structure supposed to be exclusively characteristic of the Cyclostomata.

The position of the beds has been established by Suess, Bayan, Hébert, and Munier-Chalmas, of Bartonian age, and may therefore be called Upper Eocene.

MISCELLANEOUS.

William Sweetland Dallas.

It is with deep regret, which we are sure will be shared by our readers, that the name of one who has for so many years taken a most active part in the conducting of this Magazine disappears from the titlepage. Our dear friend became one of the Editors in 1868; but long before this he had rendered the greatest service in bringing to the knowledge of British Naturalists the most important researches of Foreign investigators.

For some time past his health had been failing, and on the 29th of May he passed away, to the sad grief of his family and a large circle of friends. William Francis.

Description of a new Cottoid Fish.
By Tarleton H. Bean, Ichthyologist, U. S. Fish Commission.

On the 27th of September, 1888, the U. S. Fish Commission steamer 'Albatross' obtained in Barclay Sound, British Columbia, a remarkable little fish whose affinities are with the *Cottidæ*, but differing from all the other members of the family in characters of such importance as to necessitate the formation of a new subfamily to receive it. The description is given herewith.

Subfamily Synchirinæ.

Cottidæ with ventral fins thoracic, but remote from the gill-opening and consisting of a rudimentary spine and several rays; with a short and well-developed spinous dorsal, which is separated by a deep notch from the soft portion; the spines slender; the branchial apertures wide and the gill-membrane free from the isthmus; gills $3\frac{1}{2}$, apparently with no slit behind the last; the pectoral fins continuous around the breast, the rays supported all around by actinosts; the genital papilla of males capable of being received into a pit in front of the anal fin.

SYNCHIRUS, gen. nov.

Body slender and moderately elongate, resembling that of *Triglops*; covered with thin, tough skin. Lateral line armed with spiny tubercles. Spiny scales in a series along the dorsal base. Head subconical, with moderately pointed snout. Mouth small, very slightly oblique; the rami of the mandible a little concave beneath. Premaxillaries protractile. Jaws with slender, villiform teeth in bands. Teeth on vomer and palatines. Pseudo-branchiæ present. Gills $3\frac{1}{2}$, no slit behind the last. Gill-openings wide, extending above the median line, the membrane free from the isthmus. Suborbital connected by a bony stay with the preopercle, which bears a strong bifid spine at its angle. Pectorals completely united around the breast, all the rays supported by actinosts, the membrane free at its margin. Ventrals distant from the gill-opening, the pubic bones being remarkably long, the fins diverging widely and consisting of a rudimentary spine and three rays. Dorsal long, the spinous portion low, with slender spines, and the soft portion twice as long as the spinous. Anal long. Caudal moderately elongate, its middle rays somewhat produced.

Synchirus Gilli, sp. nov.

B. VI; D. VIII–IX, 19–21; A. 20; V. 1, 3; P. 22.

U. S. National Museum number 41820.

The eye is about as long as the snout and $\frac{1}{4}$ the length of the head, which is $\frac{2}{7}$ of the total length to caudal base. The depth is contained $5\frac{1}{2}$ times in the total length. The maxilla extends to about below the middle of the eye. The interorbital space is not quite equal to the length of the eye. There is a pair of strong nasal spines. The preopercle has a short and very sharp bifid spine. The lateral line contains about 41 spiny tubercles, and most of the specimens have a single series of spiny scales along the dorsal base. The pectorals are nearly as long as the head, and extend to about below the fourth ray of the soft dorsal. The ventrals are nearly under the middle of the pectorals and their length varies greatly. In some specimens they are scarcely $\frac{1}{2}$ as long as the head; in others they are as long as the postorbital part of the head. In some males the anal papilla is $\frac{2}{3}$ as long as the ventral fin of the same individual. This papilla can be received into a pit in front of the anal fin.

The spinous dorsal begins over the axil of the pectoral; the length of its base is a little greater than the postorbital part of the head. None of its spines are much longer than the eye.

The distance of the anal origin from the head is about $\frac{2}{3}$ the length of the head. The rays of the soft dorsal and the anal are not much longer than the dorsal spines.

The caudal is about $\frac{2}{3}$ as long as the head, and its middle rays are somewhat the longest.

The colour in spirits is a pale yellowish brown. The sides show traces of several small pale blotches, and the caudal and pectoral have a few very small dark blotches, those on the caudal forming interrupted bands. Across the back are faint indications of about five pale cross bands.

The species is dedicated to Dr. Theodore Gill, in appreciation of his researches upon the mail-cheeked fishes.

Three individuals have been taken as the types of the species. The largest is 46 and the smallest 38 millimetres in length.—*Proceedings National Museum*, vol. xii. No. 787. Advance sheet communicated by the Author.

Model of the "British Marine Area."
By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

Since writing my notes on the "British Marine Area," which appeared in the 'Annals' for May (pp. 345–353), I have learned that a model of sea around the British Islands had been executed by Mr. James B. Jordan, of the Mineral Statistics Branch, Home Office, and was in the South Kensington Museum of Science and Art. That model I have now had the pleasure of seeing. It has been carefully and well executed, and cannot but prove very instructive to those who examine it. At the same time it necessarily leaves much to be desired. The executor has unavoidably been obliged to draw on his imagination in filling in many details, where no soundings had been taken from which to work his model. The most important place which thus lacks accuracy is the district to the west of the north of Ireland and south of Scotland, and thence to the Rockall Bank. Now the hydrographer in his chart has not ventured to define the 1000-fathom boundary even roughly at this part; the dotted line which indicates that depth stops abruptly opposite Donegal Bay, and no attempt is made to trace it further to the north. The modeller could not thus stop, and has been obliged to supply the deficiency as well as he could. It is just in this part that we have one of the most interesting features in the outline of submarine Europe, where a tongue of the great abyss approaches nearest to our shores. The exact form of this tongue and of the slopes which surround it should be accurately surveyed. But while this is the most important district which awaits elucidation, it is at the same time much to be wished that a far more extensive series of soundings should be taken in 500 to 1500 fathoms all round the western coast.

May 27, 1890.

Preliminary Account of a new Australian Peripatus.
By Arthur Dendy, M.Sc., F.L.S.*

A few months ago I had the pleasure of reading before the Field Naturalists' Club a short account of a trip to Walhalla †, in which I described some of the Land-Planarians met with. As a result of this paper one of our members, Mr. H. R. Hogg, began to collect Planarians for me at Macedon. I requested him to look out also for *Peripatus*, and, with a view to so doing, he carefully examined some of my specimens of *P. Leuckartii.* Mr. Hogg has not been long in meeting with success in his researches into the cryptozoic fauna of Macedon, and a short time ago he kindly brought me a number of beautiful Planarians, all alive, and five specimens of *Peripatus*, two alive and three in spirits.

The Planarians I hope to describe at a future date; the *Peripatus* I propose to deal with in the present communication. Although all small, the specimens proved of the greatest interest, for they undoubtedly belong to a new species. The only Australian species of *Peripatus* hitherto described is *P. Leuckartii*, Sænger, which ranges through Queensland, New South Wales, and Victoria, and for details as to which I must refer the reader to my paper in the 'Proceedings of the Royal Society of Victoria' ‡. The only other Australasian species hitherto known is *P. novæ-zealandiæ,* Hutton, from New Zealand. Mr. Hogg's specimens differ in important particulars from both these species. The most important difference is in the number of pairs of legs, *P. Leuckartii* and *P. novæ-zealandiæ* having each constantly 15 pairs, while the new species has only 14. The new species differs from *P. Leuckartii*—to which it might be expected to be most nearly related—also in the structure of the jaws and in the pattern of the skin. The distinctness of the new species may be expressed by the statement that it differs more from either of the two previously known Australasian species than these do from one another.

On the present occasion I shall describe only the external characters, but I hope in due course to be able to give a complete anatomical account of both the Australian species.

Peripatus insignis §, sp. nov.

Colour and Markings.—(*a*) *Dorsal Surface.*—The general appearance to the naked eye is dark, sometimes almost black, speckled with pale orange or yellow. Microscopical examination by reflected light shows that the skin is, as usual in the genus,

* Reprinted from the 'Victorian Naturalist,' April 1890.

† "Zoological Notes on a Trip to Walhalla," 'Victorian Naturalist,' December 1889.

‡ "Observations on the Australian Species of *Peripatus*," part 1, Proceedings Royal Society of Victoria, July 1889.

§ *Insignis,* distinguished by a mark.

divided into a very great number of narrow transverse ridges by very fine grooves of a pale yellow colour. Down the mid-dorsal line runs a narrow dark stripe with a very fine white, or almost white, line running down the middle of it as in *P. Leuckartii.*

The general ground-colour is dark indigo-blue, often almost black, and this is checkered by more or less regularly arranged patches of pale dull orange or yellow. The typical arrangement of these patches appears to be as follows:—There is a squarish patch just over the base of each leg, more distinct than any of the others. Between the legs of each pair, in the mid-dorsal line, is a similar patch, interrupted by the median longitudinal stripe already mentioned, and separated from the patch over the leg on either side by a space of about the same width as itself. Thus there is a transverse row of three patches between the legs of each pair, and with these rows alternate other rows of only two patches each, in such a manner that a kind of chessboard pattern is produced. Besides these patches there are on each side of the mid-dorsal line several longitudinal rows (the typical number appears to be four on each side) of more or less regularly arranged dull orange or yellow papillæ. Sometimes the chessboard pattern is almost obliterated, leaving the longitudinal rows of papillæ scattered over a nearly uniform dark background. The dorsal surface of the legs is dark indigo-blue, with two or three orange or yellow papillæ.

(*b*) *Ventral Surface.*—The ground-colour is pale yellowish. Over this are scattered a number of papillæ, mostly of an indigo-blue colour, but some dull orange; the papillæ are arranged in transverse rows, one row on each ridge of skin. The blue papillæ are most numerous along an imaginary line joining the bases of the legs of each side. In the mid-ventral line, between the legs of each pair except the last, is an unusually pale area of skin, devoid of papillæ, and sometimes presenting clear indications of a longitudinal slit-like aperture in its centre. I have described similar pale areas in *P. Leuckartii*, and cannot help thinking that they must have some important morphological significance. I hope to find out later on, when working out the anatomy, what this significance may be.

(*c*) *The Antennæ.*—These are of a dark indigo-blue colour.

I have attempted above to describe the characteristic pattern of the skin as deduced from five specimens, but it must be remembered that considerable individual variations are sure to occur, though probably, as in *P. Leuckartii*, all the variations will be found to be readily derivable from a typical pattern. This typical pattern is quite different in the two Australian species, as will be seen on comparing my descriptions of *P. Leuckartii* (*loc. cit.*).

Size.—The five specimens at present to hand are all very small, the largest being only about eleven millimetres in length (excluding the antennæ), and one millimetre in greatest breadth, after preservation in spirits.

Legs.—These are fourteen in number on each side of the body. They have three spinous pads on the ventral surface, as described by Sedgwick* for the other Australian species. The feet closely agree with those of *P. novæ-zealandiæ*, as figured by Sedgwick (*loc. cit.*), being provided with a dorso-median papilla above the claws and a lateral one on each side.

Jaws.—The outer blade of the jaw is simple, as in *P. novæ-zealandiæ*, and not provided with an accessory tooth as in *P. Leuckartii.*

Genital Aperture.—The genital aperture is situated between the legs of the last pair. In some specimens it is a very prominent white papilla; these are probably females. The other specimens, in which it is less prominent, may be young females or males, but I have found no white papilla on the base of the last leg, such as exists in the males of *P. Leuckartii.*

Habitat.—Macedon, Victoria. In and upon rotten wood.

On the Compound Eyes of Arthropods.

'Studies from the Biological Laboratory of Johns Hopkins University,' vol. iv. no. 6, contains a paper "On the Morphology of the Compound Eyes of Arthropods," by Mr. Sho Watase, which is of interest owing to its bearing on the origin of the compound eyes of insects.

The principal subject of the paper is the eye of *Limulus*; but types of the three great groups of Arthropods—Insecta, Crustacea, and Arachnids—were studied, and the results are included in the generalizations at the close of the paper.

The primitive type of the *ommatidium*, or visual unit, is traced into a simple open ectodermic pit, from which he believes the compound eyes of Arthropods to have developed by a vegetative repetition of similar structures, not unlike what is supposed to have taken place in the formation of certain compound organs in other animals, such as the kidney in Vertebrates or the respiratory organs in Lamellibranchs.

Taking the number of facets as given by Lubbock, the compound eye of the house-fly (*Musca*) would represent about 4000 invaginations of the skin, and of the dragon-fly (*Æschna*) about 20,000, while an ocellus would represent a single pit.

In an appendix the compound eye of the starfish is briefly considered, and is found to be morphologically strikingly similar to that of an Arthropod. Six lithographic plates accompany the paper and admirably illustrate the author's studies.—*Insect Life*, vol. ii. no. 10, April 1890, p. 293.

* "Monograph of the Species and Distribution of the Genus *Peripatus* (Guilding)," Quarterly Journal of Microscopical Science, April 1888.

Variations in Bulimus exilis.

Dr. Benjamin Sharp called attention to two varieties of *Bulimus exilis* which he had found on the islands of Guadeloupe and Dominica. One variety was characterized by broad dark brown bands which run parallel with the coil of the shell, while the other was peculiar in possessing small and very faint bands, which in many specimens were entirely absent. The banded variety was found to be common in Guadeloupe, while the bandless one was rare. In Dominica, which is separated from Guadeloupe by a channel of only twenty-three miles, the banded variety was very rare, while the light or bandless one was comparatively common, although individuals were by no means so common in Dominica as in Guadeloupe. He spoke of the probable cause of the variation, and suggested that it was due to some environmental action. The island of Dominica being wholly of volcanic origin would produce a different kind of food from the Grande Terre portion of Guadeloupe, which in formation is purely coral. It was on this portion of Guadeloupe that the specimens of *B. exilis* were collected. It is known that Dominica has many species and some genera of plants that are peculiar to the island, and this difference of food may in some way account for the differences in this species of land-snail. Dr. Sharp said that it is probable that the dearth of land-shells on the volcanic islands and their comparative plenty on the coral and continental islands of the Caribbean group is due to the absence of carbonate of lime in the former and its presence in the latter.

Remarks on the Exuviæ of Snakes.

Dr. Benjamin Sharp further spoke on the exuviæ of two snakes, which were shed in the laboratory of the Academy two days previously. These snakes, *Eutanœia sirtalis*, B. & G., had been presented to the Academy on the 19th of March, 1890, and had been captured the day before in New Jersey. The whole process of shedding the skin had been observed. One of the snakes was in the water when first seen, and, coming out upon the sod, it shrugged and shook itself for a moment; then, getting between the glass of the vivarium and the box containing the earth, the skin parted at the jaws and the animal crawled out, leaving the exuvia. The cerebral portion being fixed, the animal passed through the opening, so that the discarded skin, as is always the case, was turned wrong side out. One of the specimens was interesting as it was entirely perfect, without the slightest rent and not a scale missing. The other was perfect, but there was a considerable rent on each side of the jaw. The operation took less than one minute. The snake was startled about the middle of the process. It crawled away from the exuvia very rapidly.—*Proc. Acad. Nat. Sci. Philad.*, April 15, 1890, pp. 148 and 149.

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XIV.—*The Inconsistencies of Utilitarianism as the Exclusive Theory of Organic Evolution.* By Rev. John T. Gulick *.

Natural Selection an Exclusive Theory with some Biologists.

In a previous article entitled "Divergent Evolution and the Darwinian Theory" † I dwelt chiefly on the need of a bionomic theory that should explain polytypic as well as monotypic evolution. One of the chief deficiencies in Darwin's discussion of the 'Origin of Species' is that he does not distinguish with sufficient clearness the conditions that are necessary for the transformation of an original species into a new species, when the former disappears in the process, leaving the latter to occupy its place, and the conditions that are necessary for the production of two or more species from one original species. In this paper it may be instructive to examine a vigorous attempt that has been made so to expound the theory of natural selection (which Darwin considered as inadequate to cover all the forms of monotypic evolution), that it shall serve as the full explanation of both monotypic and polytypic evolution in all organisms lower than man. By

* From the 'American Journal of Science,' July 1890, pp. 1-14.

† Amer. Journ. Sci. vol. xxxix. pp. 21-30; Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 156.

confining our attention to Mr. Wallace's very interesting and suggestive volume on 'Darwinism' we shall be better able to judge of the possibility of producing a self-consistent theory on this basis; but we should bear in mind that the same view is maintained by many naturalists, and that parallel statements abound in their writings. Mr. Wallace's volume not only embodies the mature reflections of one of the joint authors of the theory of natural selection, but it fairly represents that phase of biological theory which considers diversity of natural selection through exposure to different environments the only cause of divergence. The following passage will show the exclusive nature of his theory:—"A great body of facts on the one hand and some weighty arguments on the other alike prove that specific characters have been and could only have been developed and fixed by natural selection because of their utility. We may admit that among the great number of variations and sports which continually arise many are altogether useless without being hurtful; but no cause or influence has been adduced adequate to render such characters fixed and constant throughout the vast number of individuals which constitute any of the more dominant species" ('Darwinism,' p. 142). This is in strong contrast with the following passage from the close of the Introduction of the sixth edition of the 'Origin of Species,' which is the last one that received the revision of the author:—"I am fully convinced that species are not immutable, but those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore I am convinced that Natural Selection has been the most important, but not the exclusive, means of modification." On page 421 of the same edition Darwin calls attention to the fact that this passage has "been placed in a most conspicuous position" in the different editions of his work, and complains of the writers who misrepresent his conclusions on this point.

Facts that are neglected or denied.

Though Darwin maintains that besides the inherited effects of use and disuse and the direct action of the external conditions there are other forms of variation leading to permanent modifications of structure independently of natural selection ('Origin of Species,' 6th London ed. p. 421), he does not attempt to explain how these divergences arise. Neither Darwin nor Wallace appears to have observed that, as in domestication, the isolated breeding of other than average forms, in whatever way it is secured, is the one necessary and always effective cause of divergence, so, in nature, wherever there arises the isolated breeding of other than average forms, there divergence will be produced ; or that, as exposure to different environments is only one of the causes that lead isolated bands of men to desire and select different types of variation in the same species of animal, so exposure of wild species to different environments is only one of several classes of causes that may subject isolated portions of one of these species to different forms of selection, producing divergence ; or, again, that as differences in the uses to which men put an animal are not necessarily useful differences, so the differences in the uses which isolated portions of a species make of the environment, though they produce diversity of natural selection, leading to permanent divergence, are not necessarily useful differences. These, with other allied doctrines, which were presented in my paper on "Divergent Evolution through Cumulative Segregation," have received adverse criticism from Mr. Wallace in the work mentioned above. He says :— "In Mr. Gulick's last paper (Journ. of Linn. Soc., Zoology, vol. xx. pp. 189–274) he discusses the various forms of isolation above referred to under no less than thirty-eight different divisions, with an elaborate terminology, and he argues that these will frequently bring about divergent evolution without any change in the environment or any action of natural selection. The discussion of the problem here given will, I believe, sufficiently expose the fallacy of his contention; but his illustrations of the varied and often recondite modes by which practical isolation may be brought about may help to remove one of the popular difficulties in the way of the action of natural selection in the origination of species" (note on p. 150).

In this passage Mr. Wallace seems to take issue with each and all of my propositions; but after a careful study of his whole discussion one cannot but be in doubt whether he fully dissents from any of them. This uncertainty arises either from his failing to recognize distinctions which I have made, or from ambiguities and inconsistencies in his own statements.

Extending the meaning of Natural Selection does not save the Theory.

He represents me as contending that divergent groups are frequently found in which the action of natural selection is wanting. He here fails to distinguish between the absence of diversity in the action of natural selection and the absence of any action of the same principle. I have never maintained that any species can long escape the action of natural selection; but I have that natural selection cannot produce transformation of a race unless it secures the propagation of other than average forms of that race; that it cannot be a cause of divergence unless to this condition is added the independent generation (*i. e.* isolation) of groups that are subjected to some diversity in its action; and that, in isolated groups, some of the divergent characters may be due to other causes of transformation. In the passage I have quoted from p. 142 he expresses great confidence in the proof that all specific characters are developed and fixed by natural selection; but in the discussion that follows concerning the influence of natural selection he claims as belonging to this principle sets of influences which are usually included under sexual selection and which he cannot regard as due to the reactions between the species and its environment (see 'Darwinism,' pp. 282–285), and even then it is found too narrow to cover all the facts of specific divergence; for when he comes to consider the origin and development of accessory plumes he has to abandon the theory to which he has clung through the greater part of the book. Speaking of the enormously lengthened plumes of the "bird of paradise and of the peacock," he says, on page 293, "The fact that they have been developed to so great an extent in a few species is an indication of such perfect adaptation to the conditions of existence, such complete success in the battle of life, that there is, in the adult male at all events, a *surplus of strength, vitality, and growth-power, which is able to expand itself in this way without injury.* That such is the case is shown by the great abundance of most of the species which possess *these wonderful superfluities* of plumage. . . . *Why, in allied species, the development of accessory plumes has taken different forms, we are unable to say, except that it may be due to* that *individual variability* which has served as the starting-point for so much of what seems to us to be strange in form or fantastic in colour, both in the animal and vegetable world." (The italics are mine.) According to the theory he has elsewhere maintained, *these superfluities* of form and colour which are not controlled by natural selection should present "a series of inconstant varieties mingled together, not a distinct segregation of forms" (p. 148); but in this passage he teaches that they have assumed different forms in allied species. On p. 141 he maintains that characters which are neither beneficial nor injurious are from their very nature unstable and cannot become specific, while here he offers a suggestion as to how they have become specific. There is, then, a problem that presses for solution, namely the explanation of permanent divergence in characters that are useless without being hurtful (p. 142), unless he considers his suggestion "that it may be due to individual variability" an adequate explanation; and I presume he does not. On page 142 he says of characters that are "useless without being hurtful." "No cause or influence has been adduced adequate to render such characters fixed and constant;" but in speaking of "the delicate tints of spring foliage and the intense hues of autumn" he says, "As colours they are unadaptive and appear to have no more relation to the well-being of the plants themselves than do the colours of gems and minerals. We may also include in the same category those algæ and fungi which have bright colours—the red snow of the Arctic regions, the red, green, or purple seaweeds, the brilliant scarlet, yellow, white, or black Agarics, and other fungi. All these colours are probably the direct results of chemical composition or molecular structure, and being thus normal products of the vegetable organism need no special explanation from our present point of view; and the same remark will apply to the varied tints of the bark of trunks, branches, and twigs, which are often of various shades of brown and green, or even vivid reds or yellows" (p. 302). He here seems to admit that instead of useless specific characters being unknown they are so common and so easily explained by "the chemical constitution of the organism" that they claim no special attention.

Inconsistency in extending the meaning of Environment.

If Mr. Wallace accepts the definition of natural selection which makes it the survival of those members of a species which are best fitted to its environment (and this is the scope he seems to assign to it in the earlier half of Chapter V., where the matter is under special discussion), then he ought to admit that changes in a species produced by the action of the members of the species on each other although they are adaptive are not due to natural selection. If, on the other hand, natural selection is made to include the actions and reactions of the species on itself (and this he does on pages 282–285), then certainly he ought to admit that there may be changes in the action of natural selection without any change in the relations of the species to the environment. One way to escape this dilemma is to extend the definition of the environment, so as to include every influence that affects the species, whether it is within the species or external to it; but this reduces his doctrine that without change in the environment there is no change in the organism to the fruitless truism that without some cause there is no change in the organism. An example of Mr. Wallace's extending the meaning of the environment so as to include the action of the members of a species on each other is found on page 149. After mentioning several arguments intended to show the impossibility that isolated portions of a species should diverge while exposed to the same environment, he remarks, "It is impossible that the environment of the isolated portion can be exactly like that of the bulk of the species. It cannot be so physically, since no two separated areas can be exactly alike in climate and soil; and, even if they are the same, the geographical features, size, contour, and relation to winds, seas, and rivers would certainly differ. Biologically the differences are sure to be considerable. The isolated portion of a species will almost always be in a much smaller area than that occupied by the species as a whole, hence it is *at once in a different position as regards its own kind.*" He then enumerates several differences in the biological environment that are liable to occur; but the point I wish now to note is that he mentions as one of the differences in the environment the "*different position as regards its own kind.*" This is exactly the difference which, in so far as it is the prevention of intercrossing and the consequent unification of endowments and habits, constitutes isolation; and unless he is able to show that this difference is incapable of producing any divergence, his contention is unsustained. But he here yields the point at issue by mentioning this amongst the effective differences. The only way to escape the force of his concession is to claim, as he virtually does here, that isolation, being the separation of the isolated fragment from the influence of the original stock, is in itself a difference in the environment. By taking this position, however, he involves himself in another contradiction, for, if isolation is a difference in the environment, why does he deny that it has a direct influence in producing change in the organism?

Diversity of Natural Selection during exposure to the same Environment.

Another discrepancy in Mr. Wallace's theory is that, while he rightly assigns great importance to diversity of natural selection arising from divergent habits in appropriating the resources of the same environment, exhibited by different sections of the same species occupying the same area, he nevertheless insists that the representatives of a species, isolated in different areas of the same environment, will be necessarily subjected to the same influences from natural selection, and will inevitably maintain the same characters and, of course, the same habits. That he believes divergent habits may arise, when the divergent groups are occupying the *same area*, and are prevented from crossing simply by the divergence of habits, will be seen by the case of the varieties of wolves mentioned on p. 105 and by some of the cases mentioned on pp. 108 and 117; also by the statement, on p. 119, that "When one portion of a terrestrial species takes to a more arboreal or a more aquatic mode of life the change of habits itself leads to the isolation of each portion," and by a similar statement at the bottom of p. 145. That he believes there can be no change either of habits or structure when portions of the same species are isolated in *different areas* under the same environment appears from the statement on p. 149 that "If the average characters of the species are the expression of its exact adaptation to its whole environment, then, given a precisely similar environment, and the isolated portion will inevitably be brought back to the same average of characters." And this he maintains will be the case even "if we admit that, when one portion of a species is separated from the rest, there will necessarily be a slight difference in the average character of the two portions."

Does the difference in the Environment increase with each successive Mile?

If the divergences presented by the Sandwich-Island land-molluscs are wholly due to exposure to different environments, as Mr. Wallace argues on pages 147–150, then there must be completely occult influences in the environment that vary progressively with each successive mile. This is so violent an assumption that it throws doubt on any theory that requires such support. Of all the suggestions made by Mr. Wallace concerning possible and inevitable differences in the environments presented in the successive valleys, it seems to me not one meets the requirements of the case or throws any light on the subject. The one suggestion which is quite applicable as an explanation is the one already quoted, that "the isolated portion is at once in a different position as regards its own kind." This is, I believe, a most potent difference, which (as Mr. Wallace's language seems to indicate) is directly introduced by isolation, and (adhering to the meaning usually given to environment) is not at all due to difference in the environments presented in the different areas.

Unstable Adjustments disturbed by Isolation.

There is a sentence in another chapter of Mr. Wallace's book which attributes to isolation (though without recognizing the important results that must follow) just that kind of influence in introducing a certain class of physiological divergences, which I claim for it in introducing not only physiological, but also psychological and morphological divergences. I claim that there is in many species more or less variation with unstable adjustment in the habits which determine what forms of food it shall appropriate, and that, when a few individuals of such a species (the offspring perhaps of a single female) are isolated, this adjustment is often so disturbed by the failure of the few individuals to completely represent the average character of the species and by their being freed from competition and wide interbreeding with those of their own kind that divergent habits of feeding are formed. I further claim that for the production of this result it is not at all necessary that the environments presented in the isolated districts should differ in any respect. Indeed, if all but one pair of a variable species should be destroyed, the descendants of that pair, remaining in the same area and under the same environment, would probably differ more or less from the original stock. Those that breed together must have habits that enable them to do so; and the offspring of those that interbreed widely will for the most part inherit the powers and habits that enabled their ancestors to interbreed widely; but if the offspring of a single family are carried to an isolated area presenting the same environment, there will be nothing to ensure the perpetuation of exactly the original powers and habits, unless the power of heredity is such that each pair is sure to transmit the complete average character of the whole species; and this is not the condition of all species that pair, if of any. Within the limits of each freely interbreeding portion of a species a mutual harmony and adjustment of habits is preserved, because it is the condition of propagation within those limits; but between portions that are prevented from interbreeding there is nothing but heredity to prevent divergence in the kinds of adjustment; and in variable species the probability is that divergence will in time show itself more or less distinctly. Though Mr. Wallace considers this reasoning fallacious when applied to divergence in habits, he uses an exactly parallel reasoning in the portion of the following passage which I designate by italics:—"*It appears as if fertility depended on such a delicate adjustment of the male and female elements to each other that, unless constantly kept up by* *the preservation of the most fertile individuals, sterility is always liable to arise. . . . . So long as a species remains undivided and in occupation of a continuous area its fertility is kept up by natural selection; but the moment it becomes separated, either by geographical or selective isolation, or by diversity of station or of habits, while each portion must be kept fertile* inter se, *there is nothing to prevent infertility arising between the two separated portions.* As the two portions will necessarily exist under somewhat different conditions of life, and will usually have acquired some diversity of form and colour—both which circumstances we know to be either the cause of infertility or to be correlated with it—the fact of some degree of infertility usually appearing between closely allied but locally or physiologically segregated species is exactly what we should expect" (pp. 184–185). Notwithstanding this statement he does not seem to have grasped the idea that in the geographically isolated portions as well as in the others the "different conditions of life" of which he speaks may be the different relations to the environment into which the separated portions are brought by their divergent habits, without any reference to inevitable differences in the size and contours of the different areas, or in any other features of the environments, and that the divergence in the habits may be directly due to the prevention of interbreeding between separated portions which inevitably differ in average character, especially if they are very small portions.

Isolated portions differ in varying degrees from the average character of the Species.

The italicised portion of the passage last quoted attributes to isolation, in stronger language than I should be willing to use, a direct influence in producing divergence in the adjustments on which fertility in the different portions of the species depends. I should prefer to say that in *some species* the adjustments on which fertility depends are so delicate that adjustments producing perfect fertility within one intergenerating portion of the species will not produce fertility in another portion that has been long isolated. I do not make my statements so sweeping as his concerning the divergent influence of isolation on any one class of characters, but I include all classes of inheritable characters, in sexually producing organisms, as coming under its influence. I also insist that the direct influence of isolation in producing divergence is in proportion to the degree of segregation, which varies immensely in different forms of isolation which are equally complete as preventives of intercrossing. A very stable and homogeneous species may be divided by geological subsidence into two large sections, each represented by a vast number of individuals. In such a case the difference in the average character, and consequently the degree of segregation, of the two sections will be infinitesimally small, and the influence of the isolation thus produced will chiefly consist in its preserving in the different sections any diversities that may arise in the effects of natural selection or of other principles of transformation. The isolation between the land-animals of Ireland and Britain, which Mr. Wallace cites as adverse to my theory, is of this kind. Again, there may be transportation and isolation of very small fragments of a very variable species. In such a case separation may involve a degree of segregation that from the first produces perceptible divergence. Again, the process by which the isolation is produced may be in itself segregative, in that it brings together those endowed in some special way, causing them to breed together and preventing them from breeding with others. This is especially the case with Sexual, Social, and Prepotential Segregation, and in some degree with Industrial Segregation. Isolation thus produced is in its very nature segregative, and would result in divergence if diversity of natural selection did not arise in the different sections of the species. Segregation with divergence may also be produced by natural selection or some other principle of transformation cooperating with some form of isolation that of itself is not perceptibly segregative. As segregation of other than average forms always produces divergence, and without it there is no divergence, I claim that it is the fundamental principle of divergent or polytypic evolution. Natural selection, which is the exclusive propagation of those better adapted to the environment, when it results in the preservation of other than average forms, produces confluent or monotypic evolution; but it is never the cause of divergence, except when cooperating with some principle of isolation in such a way that the two principles produce segregation. Failure to recognize these distinctions prevents Mr. Wallace from understanding my theory, and leads him to represent me as claiming for isolation all that I claim for segregation.

Incompatibilities arise during Positive Segregation.

On pages 173–186 Mr. Wallace maintains that "Natural selection is, in some probable cases at all events, able to accumulate variations in infertility between incipient species"

(p. 174); but his reasoning does not seem to me conclusive. Even if we grant that the increase of this character occurs by the steps which he describes, it is not a process of accumulation by natural selection. In order to be a means of cumulative modification of varieties, races, or species, selection, whether artificial or adaptational, must preserve certain forms of an intergenerating stock, to the exclusion of other forms of the same stock. Progressive change in the size of the occupants of a poultry-yard may be secured by raising only bantams the first, only common fowls the second, and only Shanghai fowls the third year: but this is not the form of selection that has produced the different races of fowls. So in nature rats may drive out and supplant mice; but this kind of selection modifies neither rats nor mice. On the other hand, if certain variations of mice prevail over others through their superior success in escaping their pursuers, then modification begins. Now, turning to p. 175, we find that in the illustrative case introduced by Mr. Wallace the commencement of infertility between the incipient species is in relations to each other of two portions of a species that are locally segregated from the rest of the species, and partially segregated from each other by different modes of life. These two local varieties, by the terms of his supposition, being better adapted to the environment than the freely interbreeding forms in other parts of the general area, increase till they supplant these original forms. Then, in some limited portion of the general area, there arise two still more divergent forms, with greater mutual infertility and with increased adaptation to the environment, enabling them to prevail throughout the whole area. The process here described, if it takes place, is not modification by natural selection. The natural selection of which he speaks does not arise till, with each advancing step, a new and complicated adjustment (which introduces the two new forms, each with unabated fertility with its own kind, but with diminished fertility with the other kind) has been attained by some other process. That other process is the one described in the passage I have already quoted from pp. 184–185, where, according to my apprehension, the cause of divergence is more correctly stated than it is in the passage now under consideration. In the latter part of my paper on "Divergent Evolution through Cumulative Segregation" I have shown that the different kinds of incompatibility, preventing complete fertility between incipient species (and there called forms of Negative Segregation), cannot arise except as accompaniments of Positive Segregation in some form; but that, having once arisen in connexion with partial Positive Segregation, they increase from generation to generation by a law that is quite distinct from natural selection. It was also shown that endowments only partially segregative (as, for example, somewhat divergent habits of feeding), when not concurrent with any forms of cross incompatibility, are liable to be obliterated by crossing; but, when associated with segregate fertility and cross infertility, will increase from generation to generation, even if the mongrels are as well adapted to the environment as the pure forms. I at the same time called attention to the fact that, when associated with some form of partial positive segregation (as divergent habits of feeding or segregative sexual and social instincts), greater vigour of pure forms, as contrasted with the mongrels, would have the same effect as their greater fertility. In other words, Segregate Vigour would preserve a partially segregated variety as effectually as Segregate Fecundity.

Incompatibilities will disappear unless preserved by Positive Segregation.

Mr. Wallace has given a very instructive computation on pages 181–184; but it does not seem to me to prove, as he supposes, that infertility between the individuals of a species cannot increase "unless correlated with some useful variation," but that it cannot arise, except as a transitory variation, unless associated with some positively segregative principle, causing those to pair together which are fertile with each other. My contention is that, without some positive form of segregation, fecundity and cross sterility can never arise, and that, after it has arisen under segregation, no amount of correlation with useful variation will preserve it if the positive segregation is removed. If, for example, all the species of humming-birds were brought together in one country, and were deprived of all segregative habits and instincts, it certainly would not require many generations to reduce them to one species. If equally adapted to the environment, the species that would succeed in perpetuating itself would be the one represented by the largest number of individuals; or, if several species were entirely cross fertile and were in the aggregate represented by a larger number of individuals than any other similar group of species or than any single species, then the resulting species would be the hybrid descendants of this most numerous group. All the other species would become extinct through failing to mate with "physiological complements."

Why any need of distinctive Recognition Marks for those whose Ancestors had but one set of Marks?

An example of one of the effects of divergence being treated as if it were the primary cause of divergence is found on pages 217–228 and 284, where the need of distinctive characters for easy recognition is given as the chief cause of divergence in calls, odours, and colours. The importance of distinctive characters by which the members of a species may distinguish their mates from those of other species cannot be exaggerated; but how does it happen that the descendants of one stock which had originally but one set of such characters have become segregated into groups, needing distinctive marks? By confounding the problem of successive monotypic adaptation with that of coexistent polytypic adaptation the real causes of divergence have been obscured and misapprehended. The diversity of Sexual and Social Selection, which Mr. Wallace in these passages speaks of as natural selection, is due to diversity of sexual and social instincts, which in their turn have been produced by different forms of segregation. For a fuller exposition of this subject I would refer to my paper on "Divergent Evolution through Cumulative Segregation" (Journ. Linn. Soc., Zoology, vol. xx. pp. 234–238). The principles which I have called Sexual and Social Segregation Mr. Wallace has mentioned in several places under the name "selective association" or "selective isolation," but he does not recognize the fact that, whenever this principle segregates forms whose immediate ancestors were not segregated, it must be the direct cause of divergence; and that, when divergent forms that have arisen under Industrial and Local Segregation are brought together through increase of numbers, this principle is often the one cause preserving varieties that would otherwise be obliterated. With plants whose pollen is distributed by the wind, and probably with both vegetable and animal forms whose fertilizing elements are distributed by water, Prepotential Segregation plays the same *rôle* as the segregative instincts of higher animals. As this principle depends on the greater rapidity with which the male and female elements of the same variety or species combine, as contrasted with the elements of different varieties and species, we might call it isolation through selective impregnation, just as Mr. Wallace has called the instinctive segregation "isolation through selective association." Whatever names we give these two principles, they must be important factors in divergent evolution.

Segregation produces Domestic Races, why not Species?

Mr. Wallace seems to be opposed to the idea that some form of isolation is essential to divergence; but in his argument he yields so much that I cannot but think his opposition is largely due to his misinterpreting the theory. Mr. Romanes has mentioned eight or ten forms of isolation, and Mr. Wallace says I have discussed thirty-eight forms; but neither of us claim that these are the only possible forms, nor do we claim that any form of this principle is essential to the transformation of one species into another when the original one disappears in the process. The phrase "new species" as used by Mr. Wallace in the following passage is ambiguous; but the second sentence seems to indicate that he is here discussing divergence as well as simple transformation. He says:—"Most writers consider the isolation of a portion of a species a very important factor in the formation of new species, while others maintain it to be absolutely essential. This latter view has arisen from an exaggerated opinion as to the power of intercrossing to keep down any variety or incipient species and merge it in the parent stock. But it is evident that this can only occur with varieties that are not useful, or which, if useful, occur in very small numbers." . . . (p. 144). Near the end of the same chapter, after presenting arguments in favour of this position, and after reviewing some of the facts which I have presented concerning the divergences of Sandwich-Island land-molluscs, he remarks:—"We have, however, seen reason to believe that geographical or local isolation is by no means essential to the differentiation of species, because the same result is brought about by the incipient species acquiring different habits or frequently a different station, and also by the fact that different varieties of the same species are known to prefer to pair with their like, and thus to bring about a physiological isolation of the most effective kind" (p. 150). Except that he has used "physiological isolation" where I should have used psychological segregation, this last passage is as completely in accord with what I have presented in my paper on "Divergent Evolution" as it could have been if he had copied my statements. But how is this passage and one of similar import on page 185 to be reconciled with his own statement just quoted from page 144? On pages 217, 218, and 226, he bases his argument for the importance of different coloration in closely allied species on the obvious necessity for means "to secure the pairing together of individuals of the same species," if a new species is to be kept "separate from its nearest allies." He here assumes the fundamental fact on which the theory of segregation rests. All that is wanting is its recognition as a universal principle on which all permanent divergences, whether varietal or specific, necessarily depend. In the formation of domestic variations it is fully recognized; for he says, "It is only by isolation and pure breeding that any specially desired qualities can be increased by selection" (p. 99). If experimental biology shows this to be a constant law, is there any good reason for not applying it in the general theory of organic evolution? Seeing it is admitted that artificial selection, unaided by isolation, is of no avail in producing divergent races, how can it be claimed that natural selection, unaided by isolation, is of any avail in producing varieties and species? Again, as in domestication the segregate breeding of other than average forms always produces divergence, have we any reason to doubt that, when the same process takes place in the grouping of organisms in a natural state, the result will also be divergence?

The discrepancies to which I have referred are, it seems to me, due to deficiencies in the theory which Mr. Wallace maintains in common with many others. These problems that drive the exclusive utilitarian into various inconsistencies, can, I am convinced, be consistently explained by the theory of Divergence through Segregation.

26 Concession, Osaka, Japan.

XV.—*On a Viviparous Caddis-fly.* By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, Calcutta.

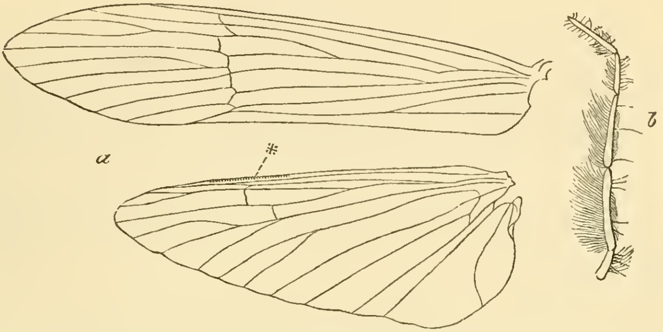
Some years ago, while studying a series of transverse sections through the body of a Trichopterous insect I had captured at the dinner-table lights, I noticed that the abdomen was crammed from end to end with partially developed ova. On the 25th October last I caught a second specimen of the same species, which also proved to be a gravid female. Remembering my former observation, and having often observed that gravid females of the viviparous forms of Muscidæ bring forth their young on falling accidentally into the spirit of the dissecting-dish, I threw the insect alive into a liqueur-glass of whiskey that happened to be ready at hand. The moment that the insect began to feel the effects of the alcohol there issued from the extremity of its abdomen in a dense cloud innumerable tiny living creatures, which wriggled convulsively in the fluid for some seconds before they died. These tiny creatures, on examination under the microscope, proved to be Trichopterous larvæ possessing all the characters, namely the slender and tapering body, the laterally-expanded and dorsally-humped first abdominal segment, but above all the disproportionately long and slender third pair of legs, of those of typical Leptoceridæ. They closely resemble the larva that forms the subject of De Geer's pl. xv. fig. 10 (Hist. des Ins. t. ii. pt. i.), which undoubtedly represents the larva of a species of the same family. They measure about ·75 millim. in length and about ·125 in breadth; they number no less than 460, according to my native artist, who measured and counted them for me. As is often, if not invariably, the case with Trichopterous larvæ of the first stage, no tracheal gills are present, at least none are to be detected.

No trace of the gelatinous secretion by which the eggs of the oviparous forms are bound together in masses was detectable either in the body of the mother or amongst the extruded brood.

The abdomen of the female still retains the distended condition it had before parturition, and presents itself as a thin and transparent membranous sac, the walls of which bear both on the dorsal and on the ventral side a longitudinal series of exceedingly short, transverse, brown bands, representing the more firmly chitinized terga and sterna of its constituent segments. The four penultimate of these segments appear to be extended and stretched, both in the longitudinal and in the transverse direction, to the limit of the extensibility of all their interarticular membranes, being separated from one another both above and below and at the sides by long and equal membranous intervals, while the four basal are stretched to little more than half the extent of their membranes in any part; so that the posterior half of the abdomen would seem to be that which gives lodgment to the main mass of the brood-pouch. The abdomen is in fact expanded for the accommodation of the developing brood much more after the fashion of that of the white-ant queen for her eggs than of those of the viviparous Coleoptera of the genera *Spirachtha* and *Corotoca* described by Schiödte.

The mother insect, which is of a dull golden-brown colour, has the antennæ equal to the anterior wings in length and is furnished with a retinaculum; it agrees in all essential particulars with McLachlan's diagnosis of the genus *Notanatolica*, to which it is here referred under the provisional name of *N. vivipara*, in allusion to its remarkable mode of reproduction.

The following are amongst the points upon which further information in regard to this interesting animal is desirable, and will, it is to be hoped, soon be forthcoming:—(1) The nature of the brood-pouch—whether this is a uterine dilatation of an oviduct or of the vagina, as in some viviparous Diptera, or whether it is an invagination into the cœlome of the soft roof of the genital sinus, as in the Orthopterous genus *Panesthia*; (2) the habits of the larvæ—whether these are aquatic, as in most other species of this order, or terrestrial, as in the single instance of the *Enoicylæ*; (3) the male; and (4) the form of the larva-case.



Notanatolica vivipara, ♀.—*a*, the wings of the left side, × 2·5, * the retinacular hooks; *b*, the maxillary palp of the right side, × 2·5.

XVI.—*A Short Account of a small Collection of Myriopoda obtained by Mr. Edward Whymper in the Andes of Ecuador*. By R. I. Pocock, of the British (Natural-History) Museum.

So little is known of the Myriopod fauna of Ecuador that any collection of these animals from that country is deserving of especial notice. But Mr. Whymper has added largely to the interest of his collection by devoting particular attention to the species found at great altitudes. This has been so rarely done by collectors that it is not yet possible to formulate any general laws with regard to the vertical range of the species of this much neglected group of animals; but, so far as any conclusion can be drawn from the small amount of material obtained by Mr. Whymper, the species found on the mountains do not for the most part differ from those of the lowlands. Of the seven species brought back two only are new. Both of these, since they belong to the rare and little-known genus *Newportia*, are of special interest, inasmuch as they throw fresh light upon the specific characters of the genus. The genus *Scolopocryptops*, too, has proved very troublesome to systematists, and all who are interested in the Chilopoda must feel grateful to Mr. Whymper for having preserved so large a number of individuals of *Sc. mexicanus*, for I have thereby been enabled to draw up with confidence the synonymy of this species as given below.

CHILOPODA.

Otostigma scabricauda (Humb. & Sauss.).

Branchiostoma scabricauda, Humb. & Sauss. Rev. et Mag. Zool. 1870, p. 203; Études Myr. p. 121, pl. vi. fig. 15 (1872); Kohlrausch, Arch. Nat. 1881, p. 75 (*Branchiotrema*).

Otostigma appendiculatum, Porath, Bih. Sv. Vet. Ak. Handl. iv. p. 23 (1876).

Mr. Whymper obtained specimens in the valley of Chillo, 8500 feet, Machachi, 9800 feet, and on Corazon at an altitude of 12,000 feet.

De Saussure and Porath have recorded this species from Rio Janeiro, and, in addition to specimens from this locality, Kohlrausch had others from Popayan, in Colombia. This author considered the remarkable appendage on the anal legs to be a monstrosity. It is in reality a sexual character belonging in all probability to the male.

Scolopocryptops mexicanus, Humb. & Sauss.

Scolopocryptops mexicanus, Humb. & Sauss. Rev. et Mag. Zool. 1869, p. 158; Études Myr. p. 135, pl. vi. fig. 18.

Scolopocryptops Miersii, Meinert, Proc. Am. Phil. Soc. 1886, p. 181 (not *Miersii*, Newport).

Scolopocryptops Meinerti, Pocock, Ann. & Mag. Nat. Hist. 1888, ii. p. 474.

? *Scolopocryptops bisulca*, Karsch, Abh. nat. Ver. Brem. ix. p. 66 (1884).

From the localities that Dr. Meinert gives this species is common in the West Indies and Brazil. It appears also to be common in Mexico. In Ecuador it is very abundant, specimens being obtained at Chiquipoquio, on Chimborazo, and on the south side of the mountain at an altitude of 12,000 to 13,000 feet, and on the east side at 11,700 feet; at Pichincha, 12,000 feet; at Machachi, 9800 feet; at the

Hacienda of Antisana, 13,300 feet; in the valley of Collanes, 12,540 feet; and on Corazon at an altitude of 12,000 feet.

Trusting to the accuracy of Dr. Kohlrausch's opinion on the question of the specific identity of *Sc. sexspinosus* and *Sc. mexicanus*, I was led into describing as new, under the name *Meinerti*, some specimens of a *Scolopocryptops* from Dominica which seemed identical with *Sc. Miersii* of Meinert, but which certainly were not *Sc. Miersii* of Newport. I now find that Dr. Kohlrausch was wrong in setting *Sc. mexicanus* as synonymous with *Sc. sexspinosus*, and that *Sc. mexicanus* was, apparently in consequence of that error, redescribed by Meinert as *Sc. Miersii*.

Newportia dentata, sp. n.

Colour ochraceous; head-plate and maxillary feet castaneous.

Head-plate somewhat quadrate; lateral margins nearly parallel, posterior margin lightly convex; marked with a relatively small number of large punctures and with very many minute close-set punctures; shortly hirsute and furnished behind with two abbreviated sulci. Antennæ pubescent, of moderate length, composed of seventeen segments; maxillary feet normally formed, internally hirsute; the anterior margin of the sternite almost straight and transverse, not dentate, but showing faint indications of a wide prosternal plate on each side; with a conspicuous seta on each side. First tergite marked behind the anterior margin with a conspicuous semicircular groove and on each side of the middle line there runs backwards from this groove to the hinder margin a single longitudinal sulcus. The rest of the tergites except the last marked as in *Cryptops* with two conspicuous, longitudinal, parallel sulci, and on each side with one posteriorly abbreviated oblique sulcus; all the tergites except the last without raised margins.

Anal tergite posteriorly impressed, hinder margin convexly produced in the middle; *sternite* wide, with rounded posterior angles and very slightly concave posterior margin; *pleuræ* marked with many large pores, produced behind into a long, straight, slender process, terminated by a sharp spine; *anal legs* short as compared with other members of the genus; the femur triangular in section, armed beneath with four enormously long and strong spines which progressively increase in length and strength from before backwards; the superior internal edge armed with a series of about six minute spinules; patella nearly cylindrical, very slightly longer than but as thick as the femur, its supero-internal edge armed with three minute spinules; the tibia cylindrical, as long as the patella, but more slender; the tarsus likewise cylindrical, a little shorter and distinctly more slender than the tibia; the metatarsus shorter and much slenderer than the tarsus, composed of four slender cylindrical segments, which increase in length from before backwards and are very distinctly defined from each other; the proximal segment also very clearly marked off from the distal end of the tarsus. Preanal legs long and strong, reaching when extended to the middle of the tibial segment of the anal pair, not armed with spinules; rest of the legs weaker, hairy, the distal end of the tibia, at all events in the middle and posterior end of the body, bearing a superior spinule; the inferior surface of the femur, patella, and tibia also armed with a distal spinule in most of the legs.

Sternites punctured and marked with a median sulcus.

Length 16 millim.

Hab. Chimborazo (east side, 12,000 feet).

From the form of its anal legs it is clear that this species is allied to both *N. longitarsis* (Newp.) and *N. azteca*, Saussure. From the latter it may be recognized by the form of the furrow on the first tergite and by the spine-armature of the anal legs; from the former, which is only known to me from Newport's figure and description, by the great difference in size that exists between the tarsal segment of the anal legs and the metatarsal; in *longitarsis* these segments are only slightly unequal.

Newportia monticola, sp. n.

This species in most of its features so closely resembles the preceding that a reference to the points of difference between the two will be the most intelligible way of describing it.

The anterior border of the maxillary sternite is not transverse and straight, but is strongly and convexly produced forwards in the middle line. The first tergite is marked before its anterior border with a strong furrow; but instead of being semicircular, the furrow is composed of a right and left portion, each of which runs obliquely backwards and inwards to the middle of the tergite, meeting its fellow of the opposite side in an angle of about 100°. The longitudinal sulci of this tergite converge in front and each anteriorly bifurcates: the outer branch running obliquely outwards and forwards meets the anterior furrow; the inner, shorter branch runs obliquely forwards and inwards and meets its fellow of the opposite side in a depression lying immediately behind the angle of the anterior furrow.

The median sulcus on the sternites is much less conspicuous and the anal sternite has the posterior margin more concave. In the anal legs the femur is more cylindrical and the inferior spines are not so large; the patella is armed on its inner surface with two stronger spinules. The femur, patella, and tibia are about equal in length, but the tarsus is much shorter than the tibia; the metatarsus is the longest segment of the legs and is composed of six or seven clearly defined segments. In the preanal legs there is a distinct metatarsal segment.

Length 18 millim.

Chimborazo (east side, 12,000 feet).

Specimens of this genus are very rare in collections, and there is consequently not much known of the specific characters of the group. I am inclined to think that in this case the only features to be relied upon for the separation of these two forms are those found in the shape of the sulci of the first tergite and of the anterior margin of the maxillary sternite. Those found in the anal legs are, I suspect, subject to individual or perhaps sexual variation.

This species differs from *azteca* and *longitarsis* in having the anterior border of the maxillary sternite produced forwards. It appears somewhat to resemble the former in the shape of the sulci on the first tergite.

A second specimen obtained by Mr. Whymper on La Dormida, at an altitude of 11,800 feet, differs from the type in having ten metatarsal segments on the anal legs. In this particular it approximates to *N. longitarsis*, but until the form of the sulci of the first tergite in this species is known it is impossible to refer any species to it with confidence.

DIPLOPODA.

Stenonia rufipes (C. Koch).

Platyrhacus rufipes, C. Koch, Die Myr. i. p. 96, pl. xliv. fig. 86.

A single specimen at Nanegal (3000–4000 feet).

C. Koch's specimen was described as doubtfully coming from Brazil. This example from Ecuador agrees very closely with C. Koch's figure of *rufipes*, except that the tergites are slightly smoother and the posterior series of granules smaller; the margins of the keels are in nearly every case quadridentate; the posterior tooth, however, is sometimes bifid.

? *Spirostreptus æquatorialis*, Porath.

? *Spirostreptus æquatorialis*, Porath, Ann. Soc. Ent. Belg. xxxii. pp. 215, 216 (1889).

One specimen at Milligalli and one at Guayaquil (sea-level). Since both these specimens are females it is impossible to identify them with certainty.

Spirobolus spinipodex, Karsch.

Spirobolus spinipodex, Karsch, Berl. ent. Zeitschr. xxxii. p. 29 (1888).

Pichincha, 12,000 feet; Chimborazo (east side 12,000 feet, south side 12,000 to 13,000 feet).

Dr. Karsch's specimens were from Ecuador (? Quito).

XVII.—*List of Land- and Freshwater-Shells collected by Dr. Emin Pasha in Central Africa, with Descriptions of new Species.* By Edgar A. Smith.

[Plates V. & VI.]

On the journey from the Albert Nyanza to Zanzibar in company with Mr. Stanley during the latter part of last year, Dr. Emin Pasha found time to make collections of various branches of natural history; and he has been good enough to send to the British Museum the shells he then obtained. Being from such remote and little-worked localities, it is not surprising that several of them are new to the National Collection, and a few new to science. The following is a complete list of the species with the exact localities which accompany them. Many of these places do not appear in maps which I have consulted, and consequently I am unable to point out their exact position. I therefore have merely copied the names as written by Dr. Emin himself.

The majority of the new species hereafter described were collected by the Rev. J. L. Last during his residence at Mamboia about six years ago, and a few were obtained by the late Bishop Hannington in 1883. All the species are in the British Museum.

I. List of Dr. Emin's Collection.

1. *Trochonanina mozambicensis*, Pfeiffer.

Hab. Hkata; var. from Illali.

2. *Trochonanina Jenynsi*, Pfr., var.

Hab. Kirassa.

The single specimen differs from the type in having the umbilicus a little larger and the spiral sculpture rather stronger. The keel at the periphery also is somewhat more pronounced.

3. *Bulimus* (*Rhachis*), sp.

Hab. Htoni Hiranza.

Two specimens in poor condition.

4. *Bulimus* (*Cerastus*) *ptychaxis*, Smith, var.

Hab. Huala.

The specimens from the above locality have the apical whorls somewhat larger than the type from Ujiji.

5. *Bulimus* (*Cerastus*) *Emini*, sp. n.

Hab. Kidete; also Htoni Heranza.

6. *Bulimus* (*Cerastus*) *kidetensis*, sp. n.

Hab. Kidete.

7. *Bulimus* (*Ena*?) *Hanningtoni*, Sowerby.

Hab. Kidete, Huala, and Hkata.

8. *Achatina*, sp.

Hab. Huini, Ussagara.

The two specimens may perhaps be a variety of *A. Craveni*, Smith; they differ in the spire being somewhat longer and the body-whorl shorter than in the type.

9. *Limicolaria Caillaudi*, Pfeiffer.

Hab. Hssanga, Ugogo; near Huala River; Kirassa.

10. *Limicolaria*, sp.

Hab. Lake Katuë, near Albert Edward Lake.

Three specimens in bad condition may belong to *L. rectistrigata*, Smith.

11. *Stenogyra* (*Subulina*) *usagarica*, sp. n.

Hab. Kidete.

12. *Ennea fortidentata*, sp. n.

Hab. Hkata.

13. *Ennea consanguinea*, sp. n.

Hab. Kidete.

14. *Ennea consociata*, sp. n.

Hab. Kidete.

15. *Ennea æquidentata*, sp. n.

Hab. Hkata.

16. *Cyclostoma* (*Rochebrunia*) *Delmaresi*, Bourguignat.

Hab. Hadako, Ugogo; Hkata and Longha (*Ferháni*) (*Emin*); Usagara (*Hannington*).

17. *Cyclostoma*, sp.

Hab. Longa (*Ferháni*); Hadako, Ugogo (*Emin*); Mamboia (*Last*); Usagara (*Hannington*).

This may possibly be a small variety of the preceding species.

18. *Cyclostoma anceps*, Martens?

Hab. Hlali, Htoni Hiranza, Hkata, Kirassa.

None of the specimens from the above localities are quite so large as the shell figured by Martens (Monatsb. Akad. Wiss. Berlin, 1878, pl. i. fig. 4). In other respects they appear to agree with the description. The largest specimen has a greatest diameter of 22 millim.

19. *Cyclostoma*, sp.

Hab. Kidete (*Emin*); Usagara (*Hannington*).

A small species, about 12 millim. in diameter, with a few liræ in the umbilicus and others upon the spire and upper part of the last whorl. Of about the same shape as the preceding species.

20. *Ampullaria gradata*, Smith.

Hab. —— ? (*Emin*); Lake Nyassa and between it and the east coast (*Thompson*).

The precise locality where this species was collected is not stated by Dr. Emin.

21. *Lanistes ovum* (Peters).

Hab. Bubu.

22. *Lanistes libycus* (Morelet).

Hab. Longa (*Ferháni*).
This is a well-known West-African form.

23. *Paludina*, sp.?

A series of fifteen specimens from Huala River might possibly be considered an extreme variety of *P. unicolor.*

24. *Paludina*, sp. n.

Hab. Victoria Nyanza, south shore (*Emin and Hannington*).
This species, which appears to be undescribed, has a very long spire and is remarkable also for the acute keel around the periphery, which revolves up the spire just above the suture.

25. *Melania tuberculata*, Müller.

Hab. Huala River.

26. *Cleopatra ferruginea*, Lea.

Hab. Longa (*Ferháni*).

27. *Cleopatra Guillemei*, Bourguignat.

Hab. Hadako, Ugogo.

28. *Physopsis Leroyi*, Grandidier.

Hab. Bubu.

29. *Corbicula radiata*, Parreyss.

Hab. Victoria Nyanza, south shore.

30. *Unio*, sp.

Hab. Hasvea.
A single specimen only, closely resembling *U. Edwardsianus*, Bourguignat, from the Victoria Nyanza.

31. *Spatha rubens*, Lamarck.

Hab. Njamagodjo, Victoria Nyanza; also Niangivira, Ugogo.

32. *Mutela Bourguignati*, Ancey.

Hab. Victoria Nyanza.

II. Descriptions of New Species.

Hyalinia Lasti. (Pl. V. figs. 1, 1 *a*.)

Testa minute perforata, orbiculata, subdepressa, nitens, fusco-cornea, tenuis; spira leviter elevata et convexa, ad apicem obtusa; anfract. 6, lente accrescentes, convexiusculi, leviter striatuli, striis prope suturam anguste marginatam subpliciformibus, ultimus ad peripheriam rotundatus, in exemplis juvenilibus obtuse angulatus, infra convexus, sed in medio, umbilicum versus, concave impressus, radiatim striatus, striisque concentricis tenuissimis fere obsoletis sculptus; apertura oblique semilunata, intus pallide vinosa; perist. tenue, margine columellari leviter incrassato et breviter reflexo.

Diam. maj. $15\frac{1}{2}$ millim., min. 13; alt. 9.

Hab. On the plains within a 50-miles radius of Mamboia (*Last*).

Var. *pellucida*. Testa subpellucida vel flavescenti-cornea.

Hab. Mamboia, at an elevation of from 4000 to 5000 feet (*Last*).

As is frequently the case in this difficult group of land-shells, there is no special feature which at once distinguishes this species. The perforation is very small and the superficial gloss on both the upper and lower surfaces is very brilliant. Three of four examples from the high altitude are quite pale in comparison with the typical form from the plains.

Hyalinia Eminiana. (Pl. V. fig. 2.)

Testa angustissime perforata, subgloboso-depressa, tenuis, nitida, semipellucida, flavo-cornea; anfract. $5\frac{1}{2}$, subceleriter accrescentes, convexiusculi, infra suturam anguste marginati, incrementi lineis striatuli, ultimus ad peripheriam rotundatus, infra convexiusculus, in medio concave impressus et perforatus; apertura mediocriter magna, obliqua, semilunata; perist. tenuissimum, margine columellari breviter reflexo, umbilicum semiobtegente.

Diam. maj. 11 millim., min. 10; alt. 8.

Hab. Mamboia, 4000 to 5000 feet altitude (*Last*).

A rather convex species, with a somewhat elevated conical spire with slightly convex outlines. The basal perforation is very small.

Hyalinia Hanningtoni.

Testa *H. Eminianæ* subsimilis, sed longe minor, magis aperte perforata, undique minutissime spiraliter striata; anfract. $4\frac{1}{2}$, ad suturam marginati, convexiusculi, incrementi lineis tenuibus, aliisque spiralibus microscopicis undique sculpti, ultimus in medio rotundatus; apertura lunata; perist. ad marginem columellarem leviter incrassatum, superne vix reflexum, sed leviter sinuatum.
Diam. maj. $6\frac{1}{2}$ millim., min. 6; alt. 4.

Hab. Same as *H. Eminiana.*

Although much resembling *H. Eminiana*, and at first sight liable to be taken for the young of that species, the present form is quite distinct. The umbilicus is larger, the columella is peculiarly sinuated or notched near its junction with the body-whorl, and scarcely at all reflexed, and the surface is everywhere above and below microscopically spirally striated.

Hyalinia depressior.

Testa *H. Hanningtoni* similis, sed magis compressa, columella superne breviter expansa et reflexa, apertura latior; superficies undique distinctius spiraliter striata; umbilicus angustior.
Diam. maj. $6\frac{1}{2}$ millim., min. 6; alt. 4.

Hab. Mamboia, altitude 4000 to 5000 feet (*Last*).

Although the measurements of this form and *H. Hanningtoni* are similar, still the two species are quite distinct. This can be seen at a glance when they are placed side by side, and the distinctness is confirmed by the differences referred to in the above description.

Trochonanina mamboiensis. (Pl. V. fig. 3.)

Testa acute conica, ad peripheriam carinata, tenuissima, anguste perforata, nitida, cornea, pallide fusco-olivacea; spira elevata, lateribus subrectis vel levissime concavis, ad apicem subobtusa; anfract. 6–7, mediocriter lente crescentes, supremi $2\frac{1}{2}$ convexi, minutissime et confertim spiraliter striati, cæteri planiusculi vel vix convexiusculi, infra ad suturam carinati, incrementi lineis obliquis striati, ultimus in medio acute carinatus, inferne leviter convexus, striisque tenuissimis, concentricis, sculptus, haud descendens; apertura parva, triangularis, longit. totius $\frac{1}{2}$ haud æquans; peristoma tenuissimum, margine columellari ad insertionem breviter reflexo, pallide vinoso, umbilicum semiobtegente.
Diam. maj. 11 millim., min. 10; longit. 10.

Hab. Mamboia, 4000 to 5000 feet (*Last*).

This is a very fragile shell and well distinguished by its conical form, very narrow perforation, and the minute spiral striation upon the apical whorls, which becomes obsolete on the few last. The acute keel at the periphery passes up the spire just above the suture, but does not reach beyond the fourth volution. The apical whorls are considerably convex and probably are not carinate at the middle. The three specimens at hand have a dirty appearance, through the presence of more or less blackish earth, which appears to be, as it were, gummed to the surface. This may possibly be a characteristic feature of the species.

Trochonanina episcopalis. (Pl. V. fig. 4.)

Testa anguste perforata, tenuis, breviter conoidea, ad peripheriam subangulata, vel obtuse carinata, pallide fusco-cornea, interdum linea angusta rufa supra angulum anfr. ultimi cincta; anfr. 6–7, apicales duo læves, politi, convexi, cæteri convexiusculi, regulariter accrescentes, striis obliquis curvatis aliisque concentricis microscopicis sculpti, quasi subsericati, inferne ad suturam anguste carinato-marginati, ultimus inferne magis politus, lineis concentricis, tenuibus, confertis, minute undulatis, ornatus, lineis incrementi radiantibus, tenuibus, sculptus, haud descendens; spira mediocriter elevata, superne submammiformis; apertura oblique semilunata; perist. tenuissimum, margine columellari ad rimam breviter expanso.

Diam. maj. $17\frac{1}{2}$ millim., min. $15\frac{1}{2}$; alt. 12.

Hab. Usagara.

This species is closely related to *T. Jenynsi* of Pfeiffer, but may be distinguished by its colour, the less acute periphery, and the finer spiral striæ on the upper surface. The typical form of *T. Jenynsi* is an opaque white shell with a brown zone above the periphery and distinctly spirally striated on both the upper and lower surfaces. *T. episcopalis* is more transparent, of a brownish horn-colour, and sculptured on the upper surface with excessively fine spiral striation.

This species was collected by Bishop Hannington, who lost his life a few years ago at the hands of some of the natives in East Africa.

Bulimus (*Rhachis*) *usagaricus.* (Pl. V. fig. 5.)

Testa ovato-conica, anguste perforata, tenuis, albida vel dilute flavescens, lineis spiralibus paucis fusco-nigris punctisque nigrescentibus sparsis picta; anfract. 6, convexiusculi, striis incrementi tenuibus obliquis, aliisque spiralibus minutis, sculpti, tres apicales plerumque fuscescentes, ultimus magnus, convexus; apertura longit. totius $\frac{1}{2}$ æquans; perist. tenue, margine columellari superne expanso et reflexo.

Longit. $16\frac{1}{2}$ millim., diam. 10; apertura $8\frac{1}{2}$ longa, 6 lata.

Hab. Usagara (*Bishop Hannington*).

Of five specimens of this species all have a slender band or line at the periphery and another, sometimes a little broader, somewhat lower down. They all also exhibit a somewhat pellucid or brownish zone around the umbilicus. A line which passes round the middle of the fourth whorl is sometimes continued on the fifth and last; this line in two examples is interrupted, thus forming a transverse series of elongate dots. A single example is irregularly marked with brown at the lower part of the body-whorl and has a second interrupted line just above the peripherial zone. The dark scattered dots are few and irregular. Owing to the thinness of the shell the markings are as vivid within the aperture as upon the exterior. There is only the feeblest trace of spiral striation. *B. nigrilineatus* from Madagascar is very like this species in form, but exhibits more distinct spiral striation, has a narrower perforation, is more numerously banded, its general tint more yellow, and not sparsely dotted. *B. trutta*, Blanford, an Indian form, is also very closely related.

Bulimus (*Rhachis*) *quadricingulatus*. (Pl. V. fig. 6.)

Testa oblonga, subturrita, perforata, tenuis, nitida, flavo-lactea, ad apicem purpurea, lineis saturate fuscis (in anfr. ultimo quatuor, in superioribus tribus) cincta; anfr. $6\frac{1}{2}$, perconvexi, regulariter sublente accrescentes, incrementi lineis tenuibus obliquis, striisque spiralibus confertis exilissimis sculpti, ultimus zona subpellucida circa umbilicum, strigisque obliquis paucis subhyalinis hic illic ornatus; peristoma tenue, ad insertionem columellæ breviter expansum et reflexum; apertura ovata, longit. totius $\frac{2}{5}$ paulo superans.

Longit. $12\frac{1}{2}$ millim., diam. 7; apertura $5\frac{1}{2}$ longa, $3\frac{1}{2}$ lata.

Hab. On the plains within 50 miles of Mamboia (*Last*).

This is a narrower shell than *B. usagarica*, differently banded, and has a smaller body-whorl and a larger spire in proportion to the length of the aperture. Only a single specimen is at hand, and in this, of the three dark zones on the penultimate whorl, the uppermost and lowest are quite close to their respective sutures, and the intervening band falls just above the middle. The three apical whorls are of a rich purple-brown colour, which gradually passes into a paler tint on the succeeding volution.

Bulimus (*Cerastus*) *mamboiensis*. (Pl. V. fig. 7.)

Testa elongata, conica, turrita, subpellucida, albo-cornea vel opalescens, nitida, anguste umbilicata, liris obliquis confertis tenuibus, infra medium anfr. ultimi subevanescentibus, instructa; anfr. 8, convexi, sublente accrescentes, sutura vix obliqua, subprofunda sejuncti; spira elongata, ad apicem obtusa; apertura ovalis, superne et infra acuminata, longit. totius $\frac{5}{11}$ adæquans; perist. tenue, margine columellari expanso et reflexo, extremitatibus callo tenuissimo junctis.

Longit. 22 millim., diam. maj. $10\frac{1}{2}$, min. 10; apertura $9\frac{1}{2}$ longa, 5 lata.

Hab. On the plains within 50 miles of Mamboia.

One of the four specimens of this species is somewhat stumpier than the others and has the aperture closed with a firm white epiphragm.

Bulimus (*Cerastus*) *Lasti.*

Testa ovata, superne producta, late perforata, subpellucido-albida, epidermide tenuissima pallide flava induta, nitida, oblique confertim et regulariter striata; anfract. 7, convexi, sutura profundiuscula, fere horizontali, sejuncti, ultimus inferne leviter saccatus, striis ad basim productis; apertura ovata, superne acuminata, antice rotundata, longit. totius $\frac{4}{9}$ subæquans; perist. tenue, margine columellari late expanso et reflexo; spira obtuse conica, ad apicem haud acuta.

Longit. 18 millim., diam. maj. 11, min. 10; apertura 8 longa, 5 lata.

Hab. Same as *B. mamboiensis*.

This is a much shorter species than *B. mamboiensis*, with the aperture rounder below, the sculpture on the body-whorl continued equally strong to the base, the umbilicus slightly larger, and the columellar reflexion broader.

Bulimus (*Cerastus*) *Emini.* (Pl. V. fig. 8.)

Testa *Bulimo Lasti* persimilis, differt apice magis acuminato, apertura magis perpendiculari, anfractibus striis vel lineis spiralibus ornatis.

Longit. 19 millim., diam. maj. 11, min. $10\frac{1}{4}$; apertura 8 longa, 5 lata.

Hab. Hkata, Kidete, Htoni Hiranza (*Emin*).

Although very like *B. Lasti* in form, I think there is little doubt that this species is distinct. On comparison the spire is seen to be more pointed, the aperture less lateral, and the whorls exhibit numerous fine, transverse, white lines, which seem to be in the texture of the shell and are more plentiful in some specimens than in others. They are scarcely visible to the naked eye.

Bulimus (*Cerastus*) *kidetensis*. (Pl. V. fig. 9.)

Testa anguste umbilicata, elongato-ovata, superne prolongata, nitida, subpellucido-albida, oblique regulariter confertim striata et tenuiter lirata; apex mediocriter acutus; anfract. 8, convexi, lente crescentes, sutura profunda vix obliqua discreti; apertura ovata, pyriformis, longit. totius $\frac{1}{3}$ paulo superans; perist. tenue, margine columellari modice dilatato et reflexo.

Longit. $15\frac{1}{2}$ millim., diam. maj. 8, min. $7\frac{1}{2}$; apertura 6 longa, $3\frac{2}{3}$ lata.

Hab. Kidete (*Emin*); on the plains within 50 miles of Mamboia (*Last*).

Although similarly sculptured this is a smaller form than *B. Lasti*, the spire is longer, and the proportions altogether different. A small variety, consisting of seven whorls and only 12 millim. long, was collected by Bishop Hannington in Usagara.

Bulimus (*Cerastus*?) *uniplicatus*. (Pl. V. fig. 10.)

Testa anguste umbilicata, ovata, superne producta, parum nitida, albida, epidermide tenui flavescente induta, oblique tenuiter liratula; anfractus 7, perconvexi, regulariter sublente accrescentes, sutura leviter obliqua, profunda, sejuncti; apex obtusus; apertura parva, ovata, longit. totius $\frac{1}{3}$ paulo superans; perist. tenue, margine columellari dilatato, modo leviter reflexo, intus plica obliqua intrante basim versus instructo.

Longit. 14 millim., diam. maj. $7\frac{1}{4}$, min. $6\frac{3}{4}$; apertura $5\frac{1}{3}$ longa, $3\frac{1}{3}$ lata.

Hab. Mamboia, at an elevation of 4000 to 5000 feet.

This species has a fold towards the base of the columella similar to that in *B. ptychaxis*, Smith, a much larger shell from Ujiji. The peristome on the columellar side is not much reflexed over the umbilicus, but forms a continuous curve with the basal margin.

Bulimus (*Cerastus*?) *introversus*. (Pl. V. fig. 11.)

Testa elongata, superne acuminata, anguste rimata, haud nitida, tenuis, viridi-cornea; apex introversus; anfract. 7, duo vel tres primi subfortiter costulati, cæteri convexiusculi, oblique striati, ultimus circa medium carina obsoleta cinctus; apertura ovata, longit. totius $\frac{1}{3}$ paulo superans; perist. tenue, margine columellari sublate dilatato, supra rimam aliquanto reflexo, intus, basim versus, oblique subtruncato vel plicato.

Longit. 16 millim., diam. 7; apertura 6 longa, 4 lata.

Hab. Mamboia, at an elevation of 4000 to 5000 feet.

The resemblance in form and the faint raised line around the body-whorl recall to mind the typical form of *Subulina subcarinifera.* That species is imperforate, much more coarsely sculptured, and has a more distinctly truncate columella. The apex in both forms is similarly introverted.

Bulimus (*Buliminus*) *subolivaceus.*

Buliminus olivaceus (Gibbons, MSS.), Taylor, Quart. Journ. Conch. vol. i. p. 253, pl. ii. fig. 5.

Hab. Bauri Island, Zanzibar (*Taylor*).

Five specimens of this species were presented to the British Museum by J. S. Gibbons, Esq., in 1876. The name *olivaceus* being preoccupied by Pfeiffer for a species from Candia, I propose to designate the present species *B. subolivaceus*, the colour being decidedly pale olive.

Bulimus (*Hapalus*) *subvirescens.* (Pl. V. fig. 12.)

Testa imperforata, elongata, tenuis, nitida, subpellucida, dilute virescens; anfract. 7, leviter convexi, striis incrementi curvatis sculpti; spira ad apicem obtusa; sutura leviter obliqua, distincta; apertura inverse subauriformis, longit. totius $\frac{5}{13}$ adæquans; labrum tenuissimum, in medio prominens, curvatum; columella subtortuosa, albida, leviter et tenuiter reflexa, callo tenui labro juncta.

Longit. 14 millim., diam. $5\frac{1}{3}$; apertura 5 longa, $2\frac{1}{2}$ lata.

Hab. Mamboia, at an elevation of 4000 to 5000 feet.

This is a more slender species than *Hapalus Grateloupi*, Pfr., the type of the group, has a somewhat shorter body-whorl, and a less distinct spiral curve on the columella. In one of the specimens there are about half a dozen roundish eggs, which are seen through the transparency of the shell, as in many species of *Stenogyra.*

Bulimus (*Hapalus*) *disparilis.* (Pl. V. fig. 13.)

Testa perforata, ovata, superne paulo acuminata, albida, vel cerea, nitida; anfract. 6, convexiusculi, sutura leviter obliqua sejuncti, longitudinaliter argute striati, striis curvatis, inferne plus minus desinentibus, ultimus magnus, subventricosus; apex subobtusus; apertura elongata, inverse auriformis, longit. totius $\frac{1}{2}$ superans; labrum tenue, in medio prominens, curvatum, prope suturam quasi incisum vel sinuatum; columella leviter obliqua, expansa et reflexa, vix contorta.

Longit. 13 millim., diam. $6\frac{1}{2}$; apertura $6\frac{2}{3}$ longa, 3 lata.

Hab. Mamboia, at 4000 to 5000 feet elevation (*Last*).

In the single specimen from the above locality the striæ upon the upper whorls are strongly marked near the suture above, and become weaker towards the lower part. On the last volution, however, the striæ are equally strongly incised all over the surface, being especially distinct near the outer lip. There is a slight depression below the suture in this whorl, but it may only be an individual peculiarity.

In three specimens collected by Sir J. Kirk in Usagara, which are smaller than the type, the striæ are still stronger and continue from suture to suture. They also differ in having the whorls slightly more convex and in being imperforate; but this may be due to their immaturity. Notwithstanding these differences, on placing them side by side they all appear to belong to the same species.

Bulimus (*Hapalus*) *associatus*. (Pl. V. fig. 14.)

Testa elongata, angusta, vix perforata, nitida, albida, vel cerea; anfract. 6, convexi, lente accrescentes, striis fortibus, regularibus, confertis, subhorizontalibus, leviter curvatis, sculpti, sutura paulo obliqua discreti, ultimus parvus; apertura parva, longit. totius $\frac{3}{8}$ adæquans; labrum tenue, leviter arcuatum; columella leviter contorta, expansa et reflexa, callo tenui labro juncta.

Longit. $7\frac{1}{2}$ millim., diam. $3\frac{1}{3}$; apertura 3 longa, $1\frac{1}{2}$ lata.

Hab. Mamboia, at an elevation of 4000 to 5000 feet.

This species has the sculpture very like that of *Hapalus disparilis*, but is quite distinct on account of its very different form.

Stenogyra (*Subulina*) *subcarinifera*. (Pl. V. fig. 15.)

Testa elongata, superne acuminata, imperforata, nitida, olivaceo-fusca; anfract. 7, primus intortus, sequentes duo convexi, costis oblique curvatis subdistantibus ornati, cæteri convexi, costis tenuioribus, valde confertis, instructi, sutura leviter obliqua, profunda, discreti, ultimus oblongus, circa medium linea elevata indistincta cinctus; spira producta, ad apicem obtusa; apertura irregulariter pyriformis, longit. totius $\frac{2}{5}$ subæquans; labrum tenue, antice angustissime expansum; columella albida, in medio arcuata, inferne oblique truncata, infra truncaturam sinuata.

Longit. 16 millim., diam. $7\frac{1}{2}$; apertura $6\frac{1}{3}$ longa, 4 lata.

Var. major. Testa pallidior, anfr. 8, secundo et tertio costis quam in forma typica magis numerosis.

Longit. 18 millim., diam. $8\frac{1}{2}$; apertura 7 longa, $4\frac{1}{2}$ lata.

Hab. On the plains within 50 miles of Mamboia; also at an elevation of 4000 to 5000 feet (*Last*).

The columella is not so suddenly truncate as in typical forms of *Achatina*, but has rather the appearance of being obliquely plicate at the lower part. There is a slight film of callus connecting it with the upper end of the outer lip. The larger variety, like the type, has the faint raised line around the middle of the body-whorl, and agrees in all other respects except in the points above mentioned.

Stenogyra (*Subulina*) *mamboiensis*. (Pl. V. fig. 16.)

Testa elongata, subulata, subclavata, alba, epidermide flavescente et strigata induta; anfract. 10, convexiusculi, lente crescentes, lineis incrementi obliquis tenuibus striati, sub lente striis spiralibus confertis microscopicis sculpti; sutura obliqua, subprofunda; apex mammillaris; apertura albida, subovata, supra et infra paulo acuminata, longit. totius $\frac{1}{4}$ æquans; columella bene arcuata, callo tenui albo induta, antice abrupte truncata; labrum tenue, regulariter curvatum.

Longit. 46 millim., diam. $13\frac{1}{2}$; apertura $11\frac{1}{2}$ longa, $6\frac{1}{2}$ lata.

Hab. On the plains within 50 miles of Mamboia (*Last*).

This fine species bears a general resemblance to *S. rangiana*, Pfr. (Reeve's Conch. Icon., *Achatina*, fig. 65), but has longer whorls and is rather larger. An egg from one of the specimens is elongate-ovate and 5 millim. in length.

Stenogyra (*Subulina*) *usagarica*. (Pl. V. fig. 17.)

Testa gracilis, subulata, nitida, albido-subpellucida, epidermide olivaceo-fusca plus minus induta; spira sursum attenuata, ad apicem obtusa; anfract. 15, apicales pauci convexi, cæteri planiusculi, lente crescentes, lineis incrementi obliquis, superne prope suturam arcuatim subplicatis, sutura leviter crenulata et obliqua sejuncti, ultimus subquadratus; apertura acute ovalis, longit. totius $\frac{1}{6}$ adæquans; columella arcuata, antice truncata, callo tenui induta.

Longit. 37 millim., diam. 7; apertura 7 longa, $3\frac{1}{2}$ lata.

Hab. Usagara (*Bishop Hannington*); Kidete (*Emin Pasha*).

This is a very elongate species with almost flat whorls. The subplicate lines of growth, especially on some of the upper volutions, give the sutural line a somewhat crenulated appearance. *S. Foxcrofti*, Pfr., from Sierra Leone, has longer and more convex whorls and they are fewer in number.

Stenogyra (*Subulina*) *Lasti*. (Pl. V. fig. 18.)

Testa gracilis, subulata, polita, olivaceo-fusca, colore saturatiore hic illic oblique strigata; spira superne angustata, ad apicem mam-

millata; anfract. 11, convexi, incrementi lineis obliquis tenuibus striati; apertura parva, acute ovalis, longit. totius $\frac{1}{5}$ æquans; columella arcuata, antice truncata.
Longit. 15 millim., diam. $3\frac{2}{3}$; apertura 3 longa, $1\frac{2}{3}$ lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

The two specimens of this species at hand are probably not full-grown, as a faint angulation at the periphery of the body-whorl suggests this opinion. In that case the number of whorls and the proportion of the aperture to the total length may hereafter require modification. *S. involuta*, Gould, is similarly coloured, but is a larger and thicker shell.

Stenogyra (*Subulina*) *Emini*. (Pl. V. fig. 19.)

Testa elongata, gracilis, pyramidalis, subpellucida, pallide virescens vel flavo-viridis, polita; anfract. 9, convexiusculi, lente crescentes, lineis incrementi obliquis levissime striati, sutura subprofunda, obliqua, discreti; apex obtuse rotundatus; apertura parva, ovalis, superne acuta, longit. totius $\frac{1}{5}$ paulo superans; columella bene arcuata, antice oblique truncata, callo tenui albo induta.
Longit. 16 millim., diam. $3\frac{2}{3}$; apertura $3\frac{1}{4}$ longa, 2 lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

This species bears a general resemblance to *S. stricta*, Poey, from Cuba, but differs in having much rounder whorls, a more arcuate columella, with a distinct basal truncation. *S. Lasti* is differently coloured and has shorter and more numerous whorls. *S. mammillata*, Craven, is a larger species with a strongly puckered suture.

Stenogyra (*Subulina*) *intermedia*, Taylor.

Testa gracilis, superne parum angustata, subpellucida, stramineo-alba, nitens; anfract. 8–9, convexiusculi, elongati, oblique tenuissime striati, superne infra suturam obliquam minute corrugata; apex rotundatus, obtusus; apertura parva, ovata, superne acuminata, longit. totius $\frac{1}{5}$ subæquans; columella valde curvata, antice abrupte truncata.
Longit. 10 millim., diam. $2\frac{1}{2}$; apertura 2 longa, 1 lata.

Hab. Mamboia (*Last*); Zanzibar (*Gibbons*).

This is a pale straw-coloured glassy shell with rather long whorls, which are minutely (not very distinctly) puckered above at the suture. This feature is not mentioned by Mr. Taylor in the original description (Quart. Journn. Conch. vol. i. p. 282), nor is it depicted in the figure (pl. i. fig. 5), in which the aperture is drawn rather too narrow.

Stenogyra (*Opeas*) *stenostoma.* (Pl. V. fig. 20.)

Testa anguste rimata, elongata, gracilis, superne attenuata, ad apicem obtusa, rotundata, nitida, pellucido-subvirescens; anfract. 8, leviter convexi, striis incrementi arcuatis sculpti, sutura oblique sejuncti, ultimus elongatus, cylindraceus; apertura elongata, angusta, longit. totius $\frac{2}{7}$ subæquans; labrum tenue, prorsum curvatum; columella fere perpendicularis, anguste expansa et reflexa.

Longit. $10\frac{1}{2}$ millim., diam. 3; apertura 3 longa, $1\frac{1}{2}$ lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

This species has a long body-whorl and aperture, recalling to mind the little *Cecilianella acicula.*

Streptaxis mamboiensis. (Pl. VI. fig. 1.)

Testa oblique ovata, umbilicata, parum distorta, alba, nitida; anfract. 6, convexiusculi, celeriter crescentes, peroblique arcuatim striati, superne ad suturam profundam crenulati, ultimus lævior, obliquus, antice leviter ascendens; apertura flavescens, antice late curvata, longit. totius $\frac{1}{2}$ æquans; labrum prope suturam sinuatum, haud reflexum, inferne paulo expansum, obliquum; columella flavescens, late dilatata et reflexa, callo flavescente lato suturæ juncta.

Longit. 18 millim., diam. 14; apertura 9 longa, 7 lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

The sutural line is very prettily denticulated by the ends of the oblique curved liræ; these are almost obsolete on the body-whorl above the umbilicus and aperture.

Streptaxis ordinarius. (Pl. VI. figs. 2, 2 *a*.)

Testa parva, clauso-rimata, valde distorta, polita, dilute viridi-alba; anfract. 6, ad suturam crenulati, superiores regulares, peroblique tenuiter striati, hic illic lineis obliquis saturatioribus picti, ultimus lævis, obliquus, antice angustatus, supra aperturam subplanulatus, prope labrum breviter ascendens; apertura parva, alba, longit. totius $\frac{2}{5}$ adæquans; perist. angustissime reflexum, marginibus callo tenui junctis, columellari paulo latiore.

Longit. $6\frac{1}{2}$ millim., diam. 4; apertura $2\frac{1}{3}$ longa, 2 lata.

Hab. Mamboia, at 4000 to 5000 feet elevation (*Last*).

In young specimens the umbilicus is moderately broad and pervious to the apex, and the shell looks rather like a small *Hyalinia.*

Gibbus (*Gonidomus*) *breviculus.* (Pl. VI. fig. 3.)

Testa ovata, clauso-rimata, solidiuscula, viridi-flavescens; anfract. 6–7, convexiusculi, costulis gracilibus, confertis, obliquis, arcuatis, instructi, sutura crenulata, fere horizontali sejuncti, ultimus antice vix descendens; spira brevis, convexa, ad apicem lævem obtusa; apertura antice contracta, intus pallide lilacea, longit. totius $\frac{3}{7}$ vix æquans; perist. album, leviter incrassatum, anguste reflexum, marginibus callo tenui, tuberculo obsoleto prope labrum munito, junctis.

Longit. 14 millim., diam. $9\frac{1}{2}$; apertura 5 longa, $4\frac{1}{3}$ lata.

Hab. Usagara (*Sir J. Kirk*).

A short stumpy species, with the aperture considerably receding in front, so that, viewed laterally, the labrum is very oblique.

Ennea Hanningtoni. (Pl. VI. fig. 4.)

Testa pupiformis, cylindracea, perforata, albo-straminea, polita, hic illic linea obliqua olivacea picta; spira ad apicem rotundata; anfract. 8, lente crescentes, superiores convexiusculi, tres ultimi planiusculi, sutura angustissima canaliculata discreti, ultimus haud ascendens, pone labrum scrobiculatus; apertura parva, rotunde subtriangularis, longit. totius $\frac{1}{4}$ paulo superans; perist. album, incrassatum et reflexum, dentibus sex, albis, inæqualibus munitum.

Longit. 10 millim., diam. 5; apertura 3 longa et lata.

Hab. Usagara (*Hannington and Kirk*); Mamboia, at an elevation of 4000 to 5000 feet (*Last*).

This is a smooth glossy species like *E. lævigata*, Dohrn, but rather more slender and with different teeth in the mouth. There are three small ones on the outer lip, a fourth of the same size at the lower part of the columella, a large, very prominent one at the upper part, and a large lamellar one close to the termination of the labrum. The teeth on the outer lip and at the lower part of the columella are indicated externally by slight indentations.

Ennea Newtoni. (Pl. VI. fig. 5.)

Testa ovata, pupiformis, haud rimata, polita, subpellucida, pallide cornea, hic illic linea olivacea picta; anfract. 8, parum convexi, supra anguste marginati, oblique striatuli, striis pone labrum validis, ultimus antice subascendens; apertura quinquedentata, mediocris, longit. totius $\frac{1}{3}$ adæquans; perist. album, leviter expansum et reflexum; columella intus lata.

Longit. 11 millim., diam. $5\frac{2}{3}$; apertura $3\frac{1}{2}$ longa, 3 lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

This species differs from *E. Hanningtoni* in being a little stouter, in having some strong striæ behind the labrum, and in the armature of the mouth. Of the five teeth, one of the largest is on the middle of the outer lip, a small one is at the base of the aperture, a similar one on the middle of the columella, a very minute one close to the upper extremity of the outer lip, and the fifth, which is about the same size as that on the labrum, is close to the very small one, thin and lamellar. *E. quadridentata*, Martens, is very like this species.

Ennea fortidentata. (Pl. VI. fig. 6.)

Testa pupiformis, pseudorimata, alba, nitida, ad suturam minute denticulata; anfract. 8, parum convexi, oblique striatuli, lente crescentes, ultimus pone et infra labrum, etiam in regione umbilicali valde scrobiculatus; apertura ringens, dentibus sex inæqualibus munita, longit. totius $\frac{1}{3}$ paulo superans; perist. late expansum, reflexum, album.

Longit. 9 millim., diam. $4\frac{1}{2}$; apertura $2\frac{1}{3}$ longa et lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*); Hkata (*Emin*).

The teeth in this species, with the exception of a very minute one on the body-wall just above the columella, are large and strong. Two are on the outer lip, a bifurcate one on the columella, one at the base of the aperture, and the fifth, which is lamelliform, near the junction of the outer lip with the whorl. The deep pit behind the columella produces a somewhat umbilicated appearance. Quite distinct from *E. natalensis*, to which it is allied.

Ennea consanguinea. (Pl. VI. fig. 7.)

Testa *E. fortidentatæ* similis, sed paulo minor, fortius striata, apertura dentibus quinque diversis munita.

Longit. $7\frac{1}{2}$ millim., diam. 4; apertura $2\frac{1}{2}$ longa, 2 lata.

Hab. Kidete (*Emin*); Mamboia, 4000 to 5000 feet (*Last*).

This species is very like *E. fortidentata* in form, but differs in being rather more strongly striated and in the armature of the mouth. There are two teeth, of which the upper is the smaller, on the outer lip, a strong bifurcate tooth on the columella, a large lamellar tooth, also bifurcate at the end nearest the columella, joining the upper end of the labrum, and a fifth, somewhat squarish denticle is situated at the lower part of the aperture, but further in than the other teeth.

Ennea curvilamella. (Pl. VI. fig. 8.)

Testa tenuis, subpellucida, pupiformis, superne conoidea, haud rimata, albida; anfractus 8, convexiusculi, costulis tenuibus obliquis instructi, in interstitiis microscopice spiraliter interrupte striati; apex obtuse conoidalis, lævis; anfr. ultimus antice leviter ascendens, pone labrum profunde effossus; apertura parva, longit. totius $\frac{1}{3}$ adæquans, dentibus duobus munita; perist. album, paulo dilatatum et reflexum; columella intus lata.

Longit. $8\frac{1}{3}$ millim., diam. 4; apertura $2\frac{1}{2}$ longa, 2 lata.
,, $6\frac{3}{4}$,, ,, $3\frac{3}{4}$,, $2\frac{1}{2}$,, 2 ,,

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

Of the two teeth in the mouth of this species one corresponds to the indentation behind the outer lip, the other, which is lamelliform, prominent, and curved, is on the body-wall and almost joined to the extremity of the labrum. The ends of the fine riblets give a pretty denticulate appearance to the suture. The microscopic striæ do not extend from riblet to riblet, but appear to be only on the left side of the riblets when the shell is examined with the spire upwards.

Ennea consociata. (Pl. VI. fig. 9.)

Testa pupiformis, superne obtuse conoidea, albida, parum nitida; anfract. 8, convexiusculi, sutura profunda sejuncti, oblique fortiter striati, ultimus antice paulo ascendens, pone et infra aperturam scrobiculatus; apertura subquadrata, ringens, dentibus 4-5 albis, inæqualibus, instructa, longit. totius $\frac{1}{3}$ paulo superans; perist. album, sublate dilatatum et reflexum.

Longit. 7 millim., diam. $3\frac{1}{2}$; apertura $2\frac{1}{2}$ longa, $2\frac{1}{3}$ lata.

Hab. Kidete (*Emin*).

This is a more slender shell than *E. consanguinea*, differently striated, and it has different teeth in the aperture. Of these one on the outer lip is almost double, a second strong tooth is situated on the columella, a third smaller one within the lower margin, a fourth much curved, hollowed out, lamellar one adjoining the outer lip above, and, finally, a sixth minute denticle occurs above the large central tooth on the labrum.

Ennea æquidentata. (Pl. VI. fig. 10.)

Testa parva, cylindracea, superne paulo latior, ad apicem obtusa, albo-pellucida, nitida; anfract. 6, convexiusculi, lævigati, superne ad suturam subprofundam minute denticulati, ultimus penultimo angustior, prope aperturam longitudinaliter striatus, utrinque et infra scrobiculatus; apertura subquadrata, quadridentata, alba,

longit. totius $\frac{1}{3}$ adæquans; perist. sublate expansum, album, marginibus callo tenui junctis.
Longit. 6 millim., diam. 3; apertura 2 longa, $1\frac{2}{3}$ lata.

Hab. Hkata (*Emin*).

The teeth in the aperture are almost equidistant from one another. One is on the columella, one exactly opposite on the outer lip, one (the smallest) at the base of the aperture, and the fourth, which is lamellar, curved, and hollowed out on the right side, joins the termination of the labrum.

Ennea ænigmatica. (Pl. VI. fig. 11.)

Testa parva, brevis, pupiformis, supra conoidalis, perforata, parum nitida, alba; anfract. 8, lente crescentes, convexiusculi, angusti, costellis numerosis leviter obliquis et arcuatis instructi, sutura profunda sejuncti, ultimus antice vix ascendens, utrinque et infra labrum valde scrobiculatus et distortus; apertura parva, insigniter plicata, contorta; perist. solutum, continuum, tenue, dilatatum, maxime irregulare, dextrorsum sinuatum, siphonatum, album.
Longit. $4\frac{1}{2}$ millim., diam. 3; apertura $1\frac{1}{3}$ longa et lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

The aperture of this little shell exhibits such distortions, plications, and wrinklings that the orifice is almost closed; indeed it seems impossible to convey in words any adequate idea of it.

Ennea soror. (Pl. VI. fig. 12.)

Testa parva, anguste perforata, pupiformis, superne conoidea, subpellucido-albida, parum nitida; anfract. 7, convexiusculi, apicales læves, cæteri tenuiter oblique et confertim costulati, sutura subprofunda, crenulata, haud obliqua, sejuncti, ultimus antice constrictus, utrinque et infra aperturam valde scrobiculatus; apertura parva, longit. totius $\frac{1}{3}$ adæquans, ringens, dentibus sex albis, valde inæqualibus, instructa; perist. undique expansum et reflexum, album.
Longit. 5 millim., diam. $2\frac{2}{3}$; apertura $1\frac{1}{2}$ longa, $1\frac{1}{4}$ lata.

Hab. Same as that of *E. ænigmatica.*

The teeth in the aperture are disposed as follows:—A small denticle on the columella, a larger prominence behind it further within the aperture, a thin curved lamellar tooth on the body-wall at the junction of the labrum with the whorl, a very large one on the middle of the outer lip with a very minute one above it or, it might be said, adjoining it, and the sixth, which is also a very small denticle, situated between the large one on the outer lip and the smaller one on the columella. The pits on the last whorl outside the aperture correspond with the denticles within, that behind the labrum being remarkably deep. *Pupa minuscula* *, Morelet, closely resembles this species.

Ennea subhyalina. (Pl. VI. fig. 13.)

Testa cylindracea, ad apicem obtusa, hyalina, nitida, anguste rimata; anfract. 7, leviter convexi, læves, ad suturam quasi anguste marginati, ultimus antice constrictus, pone et infra labrum scrobiculatus; apertura ringens, longit. totius $\frac{1}{3}$ æquans, dentibus albis sex munita; peristoma album, expansum et reflexum, marginibus callo tenuissimo junctis.
Longit. 6 millim., diam. $2\frac{1}{4}$; apertura 2 longa et lata.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

Five of the teeth within the aperture are about equal in size. Two are on a columellar prominence, two opposite on the outer lip, and the fifth at the lower part of the aperture. The sixth parietal tooth is thin, lamellar, curved, and joins the extremity of the labrum. *E. larva*, Morelet, is a smaller species, with longer whorls and only a single tooth on the columella.

Ennea subflavescens. (Pl. VI. fig. 14.)

Testa cylindracea, superne obtusa, imperforata, nitida, subpellucida, dilute flavescens; anfract. 7, convexiusculi, læves, superne quasi anguste marginati, ultimus pone et infra labrum scrobiculatus; apertura parva, longit. totius $\frac{1}{4}$ adæquans, valde ringens, dentibus 9–10 inæqualibus, albis munita; labrum leviter expansum et incrassatum.
Longit. 6 millim., diam. 2; apertura $1\frac{1}{2}$ longa et lata.

Hab. Same as *E. subhyalina.*

This species is remarkable for its cylindrical form and the armature of the mouth. The columella is prominent, with three teeth upon it; two teeth are at the lower part of the aperture, three, of which the middle one is largest, within the right lip, and a very prominent, thin, squarish one on the whorl and joining the termination of the labrum. Three out of four specimens exhibit a tenth minute denticle at the lower part of the mouth.

Ennea amicta. (Pl. VI. fig. 15.)

Testa anguste perforata, pupiformis, albida, epidermide tenui, pallide viridi-flavescente induta, subnitida; anfractus 7, convexiusculi,

* This species is figured (Journ. de Conch. 1877, pl. xii. fig. 5) under the name *P. Fischeriana.*

regulariter crescentes, sutura subprofunda juncti, lineis incrementi tenuibus aliisque spiralibus subobsoletis striati; apex obtusus, rotundatus; apertura parva, rotunde subquadrata, longit. totius $\frac{1}{3}$ adæquans; perist. vix incrassatum, margine externo et inferne brevissime expanso, columellari late dilatato, callo tenui labro juncto.

Longit. $6\frac{1}{2}$ millim., diam. $3\frac{1}{3}$; apertura 2 longa.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

This little species exhibits a distinct epidermis and has no teeth in the aperture. A slight sinus is visible in the outer lip near the suture.

Ennea lendix. (Pl. VI. fig. 16.)

Testa cylindracea, imperforata, alba, subpellucida, nitida; spira ad apicem obtuse rotundata; anfractus 8, vix convexiusculi, læves, sutura simplice sejuncti, lineis incrementi vix striatuli; apertura rotunde subquadrata, longit. totius $\frac{1}{4}$ paulo superans, denticulo minuto supra medium columellæ, altero majore, lamelliformi, parietali, prope extremitatem labri, munita; perist. leviter incrassatum, vix expansum, margine dextro superne sinuato, in medio arcuato, prominente, columellari anguste dilatato.

Longit. 8 millim., diam. 3; apertura $2\frac{1}{4}$ longa, $1\frac{1}{3}$ lata.

Hab. Mamboia, at 4000 to 5000 feet elevation (*Last*).

Like *E. subflavescens* and *E. subhyalina* this species is cylindrical, smooth, and very glossy, but differs in having only two teeth in the aperture.

Ennea microstoma. (Pl. VI. fig. 17.)

Testa breviter cylindracea, ad apicem obtusa, anguste rimata, albo-pellucida, nitida; anfract. 7, convexiusculi, oblique leviter striati, ultimus inferne liris paucis longitudinalibus instructus, antice contractus, utrinque labrum scrobiculatus; apertura parva, ringens, dentibus tribus validis, albis, munita, longit. totius $\frac{1}{4}$ adæquans; perist. album, tenue, expansum, sinuatum, marginibus callo tenuissimo junctis.

Longit. $3\frac{1}{3}$ millim., diam. $1\frac{2}{3}$; apertura fere 1 longa.

Hab. Mamboia, at an altitude of 4000 to 5000 feet (*Last*).

The mouth of this minute species is much closed up by the three denticles, which converge towards the centre. One on the outer lip and one on the columella are thick and rounded, whilst the third is thin, lamellar, and joins the upper termination of the labrum. Under a powerful lens the deepish suture appears to be faintly denticulate. The short longitudinal liræ on the last whorl do not extend upward as far as the suture, but are most distinct around the umbilical depression.

Ennea peculiaris. (Pl. VI. fig. 18.)

Testa parva, pupiformis, vix rimata, albida vel pallide straminea, nitida, striis confertis, oblique curvatis, conspicuis sculpta; anfract. 7, apicales duo lævigati, superne obtusi, cæteri convexi, sutura leviter obliqua, profundiuscula juncti, ultimus antice contractus, pone labrum haud profunde scrobiculatus; apertura parva, longit. totius $\frac{1}{4}$ adæquans, superne peculiariter sinuata, dentibus tribus munita; perist. leviter incrassatum, subreflexum, marginibus callo tenui junctis, dextro superne circulariter sinuato.
Longit. 4 millim., diam. 2; apertura 1 longa et lata.

Hab. Mamboia, at an elevation of 4000 to 5000 feet (*Last*).
The peculiar, almost circular sinus at the upper part of the aperture is formed by the outer lip bending forward in the middle into a tooth-like projection, which is almost met by a prominent but not very thick tooth on the whorl and adjoining the termination of the labrum. The third denticle is small and situated within the lower margin of the aperture. The columella at the upper part seems to exhibit far within a broad horizontal plate, but being so far within the aperture, it is not easily defined.

EXPLANATION OF THE PLATES.

Plate V.

Figs. 1, 1 *a*. *Hyalinia Lasti.*
Fig. 2. *Hyalinia Eminiana.*
Fig. 3. *Trochonanina mamboiensis.*
Fig. 4. *Trochonanina episcopalis.*
Fig. 5. *Bulimus* (*Rhachis*) *usagaricus.*
Fig. 6. *Bulimus* (*Rhachis*) *quadricingulatus.*
Fig. 7. *Bulimus* (*Cerastus*) *mamboiensis.*
Fig. 8. *Bulimus* (*Cerastus*) *Emini.*
Fig. 9. *Bulimus* (*Cerastus*) *kidetensis.*
Fig. 10. *Bulimus* (*Cerastus*?) *uniplicatus.*
Fig. 11. *Bulimus* (*Cerastus*?) *introversus.*
Fig. 12. *Bulimus* (*Hapalus*) *subvirescens.*
Fig. 13. *Bulimus* (*Hapalus*) *disparilis.*
Fig. 14. *Bulimus* (*Hapalus*) *associatus.*
Fig. 15. *Stenogyra* (*Subulina*) *subcarinifera.*
Fig. 16. *Stenogyra* (*Subulina*) *mamboiensis.*
Fig. 17. *Stenogyra* (*Subulina*) *usagarica.*
Fig. 18. *Stenogyra* (*Subulina*) *Lasti.*
Fig. 19. *Stenogyra* (*Subulina*) *Emini.*
Fig. 20. *Stenogyra* (*Opeas*) *stenostoma.*

PLATE VI.

Fig. 1. *Streptaxis mamboiensis.*
Figs. 2, 2 *a.* *Streptaxis ordinarius.*
Fig. 3. *Gibbus* (*Gonidomus*) *breviculus.*
Fig. 4. *Ennea Hanningtoni.*
Fig. 5. *Ennea Newtoni.*
Fig. 6. *Ennea fortidentata.*
Fig. 7. *Ennea consanguinea.*
Fig. 8. *Ennea curvilamella.*
Fig. 9. *Ennea consociata.*
Fig. 10. *Ennea æquidentata.*
Fig. 11. *Ennea ænigmatica.*
Fig. 12. *Ennea soror.*
Fig. 13. *Ennea subhyalina.*
Fig. 14. *Ennea subflavescens.*
Fig. 15. *Ennea amicta.*
Fig. 16. *Ennea lendix.*
Fig. 17. *Ennea microstoma.*
Fig. 18. *Ennea peculiaris.*

XVIII.—*On a new Species of* Guiraca. By EDWARD BARTLETT, Curator of the Maidstone Museum.

WHILE closely comparing my specimens of this genus I observed a great difference in the bills and in the general colour of the birds obtained by Mr. H. Whitely on the Carimang River, British Guiana, which I think are sufficient to separate them from the well-known *Guiraca cyanea*, auct.

The bill of *Guiraca cyanea* is short, robust, and much curved on the culmen; the lower belly is greyish blue; under tail-coverts blue, like the breast.

Guiraca Rothschildii, sp. n.

Bill similar to *Guiraca cyanoides*, straight, acute; culmen not curved as in *Guiraca cyanea*, length of culmen 0·75.

Male.—General colour similar to *Guiraca cyanea*, the silvery blue of forehead and spot of same on cheek brighter and more extended; upper and lower parts darker blue than in the old form; rump uniform with the mantle; belly nearly black; under tail-coverts blackish, faintly tinged with dark blue.

Female.—Dark umber-brown, palest on the forehead and chin. Much darker than the female of *Guiraca cyanea*.

This well-marked species by its size, colour, and straight culmen cannot be confused with either *Guiraca cyanea* or

Guiraca cyanoides, the two nearest allied forms, although it possesses characters of both, being an intermediate phase which might readily be taken for a hybrid.

I append dimensions of four species.

It affords me much pleasure in naming this new species after the Honourable Walter Rothschild.

Guiraca argentina, Sharpe.
(Bill robust, culmen slightly curved.)

No.	Length.	Wing.	Tail.	Tarsus.	Culmen.
1. ♂, Cosquin, Cordova, Argentine Rep. (*E. W. White*)	6·7	3·6	3·6	0·85	0·7
2. ♀, Catamarca, Arg. Rep. (*E. W. White*)	6·6	3·4	3·3	0·85	0·7

Guiraca cyanea (Linn.).
(Culmen much curved.)

No.	Length.	Wing.	Tail.	Tarsus.	Culmen.
1. ♂, Brazil	5·95	2·9	2·7	0·8	0·6
2. „ „	5·85	2·9	2·8	0·8	0·6
3. „ „	5·4	2·9	2·65	0·8	0·55
4. ♂, Central America	5·5	2·9	2·85	0·85	0·55
5. ♀, Brazil	5·5	2·6	2·6	0·8	0·6

Guiraca Rothschildii, sp. n.
(Culmen straight.)

No.	Length.	Wing.	Tail.	Tarsus.	Culmen.
1. ♂, River Carimang	6·0	3·05	2·85	0·8	0·75
2. ♀, „ „	5·75	2·95	2·55	0·8	0·7

Guiraca cyanoides.
(Culmen slightly curved.)

No.	Length.	Wing.	Tail.	Tarsus.	Culmen.
1. ♂, Panama	6·2	3·2	2·85	0·8	0·7
2. ♀, Antioquia	6·3	3·0	2·7	0·8	0·7

XIX.—*Descriptions of two new Cyprinodontoid Fishes.* By G. A. Boulenger.

Cyprinodon Danfordii.

D. 12–13. A. 11–12. V. 5. L. lat. 27–28. L. tr. 11.

Height of body $2\frac{2}{3}$ to 3 times in males, $3\frac{1}{3}$ times in females, in the total length (without caudal); length of head $3\frac{1}{3}$ to $3\frac{1}{2}$ times in males, $3\frac{2}{3}$ in females. Diameter of eye equal to length of snout and contained $3\frac{1}{2}$ to $3\frac{2}{3}$ times in length of head; interorbital space half length of head; snout short and obtuse. Dorsal not extending when depressed to the caudal; its origin above the eleventh or twelfth scale of the lateral line, midway between the occiput and the root of the caudal in males, between the gill-opening and the root of the caudal in females. Origin of anal below the thirteenth or fourteenth scale of the lateral line in males, below the fifteenth in females. Caudal truncated. *Males* with ten or eleven dark brown vertical bands, separated by yellowish-brown interspaces; dorsal blackish, with transverse series of black dots; anal yellowish, with transverse series of black dots; caudal yellowish, with three or four blackish vertical lines. *Females* brown, with small blackish spots; a black spot at the root of the caudal; fins yellowish.

Total length, male 45 millim., female 52.

Several specimens were obtained in Asia Minor, at Albistan, by Mr. C. G. Danford. *C. dispar*, Rüpp., was likewise found in the same locality by Mr. Danford.

Haplochilus Hartii.

D. 9–10. A. 15–16. V. 6. L. lat. 39–43. L. tr. 10–11.

Height of body 5 to $5\frac{1}{2}$ times in males, $4\frac{1}{2}$ times in females, in the total length (without caudal); length of head $3\frac{2}{3}$ to 4 times in males, $3\frac{1}{2}$ to $3\frac{2}{3}$ in females. Diameter of eye equal to length of snout and one fourth the length of the head; interorbital space half length of head; snout very short, lower jaw projecting beyond the upper; a short tentacle on each side of the snout. Origin of the dorsal above the middle of the anal, twice as far from the occiput as from the root of the caudal, corresponding to the twenty-fifth to twenty-seventh scale of the lateral line. Pectorals not reaching ventrals, latter not reaching anal. Brown or bronzy above, yellowish inferiorly; each scale with a darker spot, best defined in the males; dorsal and anal fins whitish, with grey dots, anal with a fine blackish edge; caudal grey or blackish.

Total length 80 milllim.

Trinidad. "Known as the *Wabine*; has a great power of leaving the water and jumping by its tail." Several specimens were presented to the British Museum by Mr. J. H. Hart, Superintendent of the Royal Botanic Gardens, Trinidad, to whom we already owe the discovery of an undescribed frog on that island *.

* *Eupemphix trinitatis*, Bouleng. Ann. & Mag. Nat. Hist. (6) iii. 1889, p. 307.

XX.—*Description of a new Squirrel from Borneo.* By Oldfield Thomas.

In the Oriental Region four of the many species of squirrel there found are characterized by having their muzzles markedly elongated, the proportions of their skulls being therefore quite different from those of ordinary squirrels. These four are the following:—*S. laticaudatus*, Müll. & Schl., formed into a separate genus, *Rhinosciurus*, by Gray, on account of the great length of its muzzle; *S. Pernyi*, M.-Edw.; *S. rufigenis*, Blanf.; and *S. Berdmorei*, Bly *.

To this list I now have to add a fifth, discovered by that able naturalist and collector Mr. A. H. Everett on Mount Penrisen, West Sarawak, during the wet season of 1889–90. I propose to call it

Sciurus Everetti, sp. n.

Fur thick and soft, markedly more so than in the somewhat similar *S. tenuis*, Horsf., found in the same district. Colour uniform dark grizzled olive, rather darker than in *S. tenuis*; sides of cheeks, shoulders, and front of hips with a very faint fulvous suffusion. Under surface dirty greyish white, the hairs everywhere slaty grey for two thirds their length, then tipped on the throat and belly with dirty white and on the chin and breast with dull fulvous. Ears short, rounded, not tufted or emphasized in colour. Tail unusually short, comparatively short-haired, almost cylindrical, the hairs ringed with dull fulvous and black. Skull small and lightly built, muzzle proportionally very long and narrow. Premolars $\frac{2}{1}$. Molars small and delicate, their series on the two sides parallel, little bowed.

Measurements of the type (an adult skin):—Head and body 175 millim.; tail, without hairs 109, with hairs 144; hind foot, without claws, 40. Skull: tip of nasals to bregma (centre of fronto-parietal suture) 36; zygomatic breadth 24·5, interorbital breadth 14; length of nasals 15·7, breadth of nasals anteriorly 5·2, posteriorly 4; palate, length 24·2; diastema 12; length of tooth-series 8·7.

A second specimen is rather larger, measuring:—Head and body 180 millim., tail without hairs 118, hind foot 40·5.

This species is superficially by no means unlike *S. chinensis*, Gr., or *S. lokriah*, Hodgs., agreeing with both in its general size and its uniform dull grizzled olive-colour; but it

* See Thomas, P. Z. S. 1886, p. 71.

may be readily distinguished from either by its elongated snout, which allies it to the four species first mentioned. Of these, *S. laticaudatus* is separated by its larger size, shorter hair, browner colour, nearly white belly, and still longer muzzle; *S. rufigenis* by the brilliant rufous of its cheeks and the underside of its tail; *S. Pernyi* by its similarly rufous tail; and *S. Berdmorei* by the black and white longitudinal stripes with which its body is ornamented. No other species that I can find have any close relationship to the new form discovered by Mr. Everett, in whose honour I have very great pleasure in naming it.

XXI.—*On the Anatomy of Horny Sponges belonging to the Genus* Hircinia, *and on a new Genus.* By H. Fol *.

The genus *Hircinia* was created by Nardo in 1833 for certain horny sponges possessing two systems of fibres—some coarse and analogous to those of the bath-sponge (*Euspongia*), and others very fine and numerous, resembling the elastic fibrillæ of the connective tissue of Vertebrates. The structure of these fibrillæ was investigated by Lieberkühn, O. Schmidt, and F. E. Schulze, who showed that they do not anastomose, but terminate in all directions in rounded swellings. The two latter authors, however, like Kölliker and Hyatt, considered that these fibrils probably belonged to a parasite or to a commensal of these sponges. It was for this reason that the family Filiferæ was actually abandoned; so that Vosmaer, in his monograph of the Spongiariæ, does not recognize a single genus belonging to this family, and suppresses it.

Sections which I have made of specimens of *Hircinia variabilis* and *Hircinia* sp. n., from the neighbourhood of Nice, have enabled me to solve the disputed question of the origin and nature of the fibrillæ, and this in a sense opposed to that of recent authors.

On making a series of somewhat thick transverse sections of a specimen macerated for a few hours only, so as to separate the epithelia while leaving the connective tissue untouched, we see at once in the clearest possible way that the fibrils are not disposed at random, as would be the case were we dealing with a parasite, but form a system of incomplete septa, which alternate with the fibres of the skeleton, with

* Translated from the 'Comptes Rendus des Séances de l'Académie des Sciences,' tome cx., June 9, 1890, p. 1209 *et seq.*

which they but rarely come into contact. If we choose, for the purpose of cutting sections, a portion in process of rapid growth, we shall find in the place of the fibrillæ large tracts of fusiform cells which clearly belong to the connective tissue of the sponge. Lower down these tracts spread out, and nascent fibrils are observed on which the fusiform cells are disposed like a string of beads. Further on still the cells have atrophied, and there only remains their product, the fibril.

The authors mentioned were therefore wrong in holding without a particle of proof that the fibrils were the work of an unknown parasite; on the contrary, they form an integral part of the sponge. The family Filiferæ must be reinstated, as being the surest and best characterized division of all those which have been made in the order of Horny Sponges.

There is met with in abundance in the waters round Nice a blackish sponge of large size, which I cannot discover has ever been described. This sponge adheres tenaciously to rocks exposed to the open sea, at depths of from 10 to 30 metres, and it can only be collected by aid of the diving-dress. It attains the size of a man's head. In colour it is of the neutral tint of water-colour painters; it is shining, and is provided with numerous conuli, which are more widely separated than in *Hircinia*, but less so than in *Spongelia*, and with a very small number of large oscula. If left to itself in an aquarium a larger number of oscula open after a few hours; these are very minute and are situated between those already mentioned.

This sponge is friable, owing to the fact that the fibres of its skeleton are wide apart; but its tissue is very dense and in section reminds one of calf's sweetbread. It consists for the most part of a compact and almost indestructible connective tissue, in which are lodged canals and flagellated chambers, disposed as in *Euspongia*.

There is much difficulty in eliminating this tissue by maceration; but after doing so, there remains a skeleton of very coarse fibres, widely separated, but anastomosing and affecting a regular disposition. These fibres are hollow, composed of several concentric sheaths, and enclose, in their axis only, numerous foreign bodies of large size, such as grains of sand, pieces of the skeleton of other animals, &c.

This sponge, then, comes between *Spongelia* and *Aplysina* by reason of its skeleton; by its tissue, which offers a much greater resistance to the action of chemical agents than that of *Aplysina*, it recalls the *Chondrosiæ*; while by its canal-system it is allied to *Hircinia* and *Euspongia*. It occupies an intermediate position between the known types.

I bestow the name *Sarcomus* * on this new genus, which appears to me to deserve a new family. The species from the environs of Nice I designate *Sarcomus Georgi* †.

XXII.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland)*.—No. XII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

1. Preliminary Note on the Occurrence of the Pelagic Annelids and Chætognaths in St. Andrews Bay throughout the Year.
2. On the British Species of *Spinther*.
3. On the Young Stages of the Gunnel (*Centronotus gunnellus*).

1. *Preliminary Note on the Occurrence of the Pelagic Annelids and Chætognaths in St. Andrews Bay throughout the Year.*

The following remarks on the pelagic Annelids of the Bay of St. Andrews are preliminary, and formed indeed part of a survey of the whole pelagic forms from fishes downwards during the year 1888—especially in their relation to the fisheries ‡.

So far as regards the marine *Polychæta* the contrast with southern waters is marked, since hitherto there has been an absence of such typical pelagic Annelids as the Alciopidæ, so well described by Greef §, or the Syllidians, which have lately received the careful attention of Viguier ||. The only adult pelagic forms, indeed, are *Autolytus* and the sexual forms of the Nereides. All the others are larval, postlarval, and young stages of Annelids, and thus fall under the temporarily pelagic group. They often occur in large numbers and probably exercise an important function in connexion with the food of post-larval and young fishes, for it is well known that

* From σάρκωμα, a fleshy excrescence.

† Named after Georges Guessler, a very skilful diver employed by me, and who obtained for me the first specimen of this sponge. Since then I have often collected it myself.

‡ I have the same acknowledgment to make as in the previous note (XI.) in regard to the assistance given me in the examination of the various nets by Mr. J. Pentland Smith, M.A., B.Sc.

§ "Untersuchungen über Alciopiden," Nova Acta L. C. 39.

|| "Sur les Animaux inférieurs, II. Annelides Pelagiques," Archiv. Zool. Expér. 2e sér. iv. p. 347.

no group is more eagerly followed by the fishes than the marine Annelids.

As in certain groups the spawning-period of the Annelids is considerably prolonged (though not necessarily in individuals), that is, larvæ of the same species are found during several months, a constant succession of young forms taking the place of those which have advanced to the later stages after undergoing changes more or less noteworthy, and many of which settle on new sites on the bottom or amidst the rocks to form fresh colonies. A large number of these young stages are caught near the bottom by the trawl-like tow-net*, and they are only occasionally to be found near the surface under favourable conditions of temperature and the sea itself.

The great larval bristles so characteristic of the young of the Spionidæ do not seem to prevent in all cases their being eaten by young fishes, though the observations are as yet too few to enable definite conclusions to be made on this point. These long bristles, however, may constitute an effectual guard from the attacks of the smaller predatory Invertebrates, which otherwise would prey on them. They certainly form a striking fringe in the early stages, and the metallic lustre in some species gives them no little beauty.

Tomopteris, formerly considered somewhat rare, is a form which frequents the inshore waters from January to December. The enormous numbers of the Chætognaths again almost throughout the entire year is a feature of moment in connexion with the food of fishes, which readily devour them. In some inshore areas the bag of the large midwater-net, after a brief haul in autumn, is distended with a semisolid mass of them.

The activity of the post-larval Annelids is great. They glide rapidly through the water and often circle nimbly in a limited area and again shoot towards the side of the vessel next the light, where they collect like the Copepoda. They are also voracious; for instance, a post-larval *Nerine* (*cirratulus*?) seized on the tail of a *Scolecolepis* a little less than itself, and it was only after a severe struggle, in which both exerted themselves desperately, that the latter managed to withdraw its tail—now considerably injured—from the eager mouth of the *Nerine*.

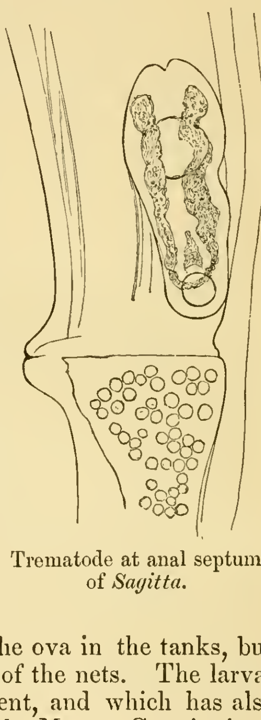
In the beginning of January various marine Annelids present symptoms of maturity, such as the Polynoidæ and

* As formerly mentioned this net is invaluable in such investigations, bringing to light, for instance, such forms as *Agalmopsis* and *Hybocodon*, which otherwise would have escaped notice.

Arenicola, and yet the latter has been found equally mature in October. The Polynoidæ especially are early in this respect both in Europe and America. None of their pelagic larvæ, however, have hitherto been found at St. Andrews in January. Hensen*, again, in the Baltic procured only a very few larvæ of *Polydora* during this month.

Tomopteris at St. Andrews occurred on many occasions; indeed its absence from the tow-nets was rarer than its presence.

Sagittæ of various sizes were abundant and some were large, with advanced reproductive organs, as Lo Bianco and others found at Naples. Their occurrence in large numbers in winter has long been known †, and the multitudes of fine living examples stranded on the beach sparkle like needles of glass. The larger forms (about 1 inch) were captured in the midwater-nets and the smaller (about ½ inch) in the surface- and bottom-nets. A considerable number of the larger specimens had a parasitic Nematoid in the alimentary canal, while some presented a Trematode in the same situation (see woodcut).



Trematode at anal septum of *Sagitta*.

Next month (February) the pelagic Annelids were represented by females of *Autolytus* with the ventral ovigerous sac and males. The midwater-net also captured an epitocous *Nereis* (olim *Iphinereis fucicola*), which in former years had been tossed on shore by storms. Young Polynoidæ (*Harmothoë imbricata* &c.) escaped from the ova in the tanks, but none were recognized in the contents of the nets. The larval *Nerine* with the reticulated investment, and which has also been found in the Forth in February by Messrs. Cunningham and Ramage ‡, and larval examples of *Polydora* also occurred. In regard to the latter, Hensen found this month and the next most prolific of them in the Baltic, and he gives the spawning-period as from October to April. The bristles

* Fünfte Bericht der Komission &c. (Berlin, 1887).

† *Vide* Ann. & Mag. Nat. Hist. 4th ser. xiv. p. 155 (1874).

‡ Trans. R. Soc. Edinb. vol. xxxiii. pt. 3, p. 638, pl. xxxvii. fig. 2 H.

(paleolæ) of *Sabellaria spinulosa* and *Harmothoë imbricata* were common in the bottom-net. *Tomopteris* about half-grown occurred in midwater-, bottom-, and surface-nets. If there was any difference in size it was in favour of those from the bottom-nets.

The Chætognaths were extremely abundant, especially in the midwater-net, and many were almost mature. The larger forms in this net measured 1⅛ inch, and some of the same size were seen in the other nets. Besides the Trematode parasite several showed a larval Trematode in front of the caudal septum.

The same forms were found in March so far as it was possible to examine during the intervals of storms. Many of the littoral Polynoidæ continued fully ripe, such as *Harmothoë*, *Evarne*, and *Lepidonotus*. Though it is known that certain of the Nemerteans spawn at this time, no larval forms occurred in the tow-nets, in which they seem to be rarely found.

Amongst the Annelids in April were also *Autolytus prolifer* and the epitocous form of *Nereis* (*Iphinereis*). The former bred freely in the laboratory and their variations in colour were noteworthy. Viewed from the dorsum many females are pinkish with dark brown eyes. The ovigerous region is reddish and green, the former chiefly characterizing the segment-junctions. The succeeding region is greenish in front, pale posteriorly. Ventrally the colours are similar but fainter. The alimentary canal has a dull yellowish coat. The coloration of the ova and embryos in the sac in some cases is pale, in others dull yellowish or greenish. The young after emergence agreed with the descriptions of previous authors, and appeared to be more elongated than the larval examples of *Autolytus cornutus* of Alex. Agassiz * before the tentacles appeared. Agassiz found his forms in April. The reproductive period of *A. prolifer* in this country is prolonged.

No example of *Alitta virens* was procured in any of the nets; yet the beach in former years in March and April has often been strewn with splendid examples, some more than 3 feet in length. They would therefore not seem to be so characteristically pelagic at the reproductive season as *Palolo*, the Syllidians, or other Nereids.

Tomopteris was frequent and of fair size (1 inch), while the Chætognaths were on the whole less conspicuous than in the previous month, though some reached ⅝ inch long. A

* "On Alternate Generat. in Annel.," Journ. Bost. Soc. Nat. Hist. vii. p. 392.

few were mature at the beginning of the month, but the majority were immature or had spawned. This corresponds with the condition in the Neapolitan forms.

The Annelids mentioned as occurring in April likewise were present in May, while there was a decided increase in the larval forms pertaining to other genera. Thus trochospheres of *Phyllodoce* and *Eulalia* frequently appeared along with young *Mageloncæ*, which agreed in most points with the description and figures of Claparède, though he does not make it clear that the young *Magelona* has at first only slender spine-like papillæ on its elongated tentacles, as in *Spio*, and that the characteristic thick cylindrical ones are developed first at the base. Thus in some pelagic examples about 4 millim. in length (body) both kinds exist on the organs. The young forms referable to Claparède's fig. 12, Taf. x.*, seem to be *Spio*-like, and show no circulation of corpuscles in the tentacles, while those resembling his fig. 10 have active corpuscular circulation in the tentacles, the distal parts of which are readily lost. Moreover, the former is occasionally considerably larger than the latter. When the circulation is established in the tentacles a small rounded black eye appears at the anterior and inner border of each tentacle, while two small and indefinite pigment-specks occur on each side of the middle line in front of the mouth and nearly in a line with the outer eyes. Further investigation therefore is necessary to clear up the doubtful points. These young examples swim freely, with a wriggling motion, after coiling the long tentacles like a spring, and again settle on the bottom or at the surface and stretch out the two long tapering tentacles. Numerous young Terebellids in the transparent sheaths were common in the bottom-nets.

The only form observed in the midwater-net during June was *Tomopteris*, which appeared once in considerable numbers and from 1 to 1½ inch in length. Numerous ova occurred in the perivisceral diverticula of the feet. Chætognaths were obtained in the same net, but they were comparatively few and small, only the larger forms reaching 15 millim. This therefore differed from the condition during the winter months, when the bay teemed with large and active *Sagittæ*. The bottom-net was extremely rich as the month advanced in larval forms of *Nerine* (two species), *Polydora*, and other Spionidæ, such as *Magelona*. Young *Harmothoë imbricata* with four scales and seven bristled feet, advanced young of *Nephthys* with a pair of eye-spots opposite the third bristled

* Beobach. über Anat. u. Entwicklungsgesch. &c. (Leipzig, 1863).

foot, the tip of one tentacle being bifid, males of *Autolytus prolifer*, advanced young of *Phyllodoce maculata*? about 4 millim., *Eumida sanguinea* of about sixteen bristled segments, *Polydora* of twenty segments, *Eteone* of twenty-five segments, *Eulalia* of 6 millim., and young of *Amphicora* were other forms occasionally met with in the bottom-net. Though less abundant than the Copepods they formed a prominent feature in the pelagic life and made a notable addition to the food of the post-larval fishes, which as they get older seek the bottom. When the nets were worked close to the rocky margins the larval forms of *Spirorbis* were also common. Numerous *Polydoræ* and *Mageloneæ* were still in the mature condition, so that the spawning-period extends over a considerable area.

A decided increase in the number of pelagic larval Annelids took place in July. In every instance they were present in greater or less numbers in the bottom-nets, while as the month advanced they likewise became frequent in the surface-nets. The most abundant were the larval and postlarval forms of *Spio*, *Polydora*, and *Nerine*. *Terebellæ* and *Nicoleæ* were also common, and a few of the older examples of these strengthened the hyaline tube with particles of sand and mud. Minute postlarval Polynoidæ occurred frequently in the bottom-nets. It is rare, so far as present experience goes, to find many young Polynoidæ between tide-marks, where the adults are so common, and their abundance in the bottom-nets at a distance from the shore, in a truly pelagic condition, partly explains the reason. Besides the foregoing, minute postlarval forms of *Eulalia*, *Castalia*, *Pholoë*, *Capitella*, and *Aricia* were also procured. On the whole the wealth of pelagic larval Annelids was noteworthy.

The Chætognaths were less conspicuous close inshore and they chiefly appeared in the midwater-net. Yet perhaps they were not far removed, since in former years masses were obtained at the end of the month in the midwater-net on the wolf-fish-ground towards the mouth of the Forth.

The larval Annelids attained their maximum in August, the same forms occurring in the bottom-net as during July. Some of the post-larval Polynoidæ reached $\frac{1}{8}$ inch in length. The use of the net beyond the Bay, as off the Bell Rock and south-east of the Island of May, showed that the same types abounded in these regions. *Tomopteris* was comparatively rare.

The midwater-net captured *Tomopteris* somewhat more frequently along with an occasional *Nereis*, probably from pelagic seaweeds or débris, or perhaps from accidentally touching the ground. The larval forms of *Nerine*, *Polydora*, *Polynoë*, and *Terebella* were also obtained; but this net was less productive of *Polychæta* than the bottom-net.

In the surface-net, in addition to the forms already mentioned, larvæ of *Nereis* and young forms of *Magelona papillicornis* appeared. *Tomopteris* was procured only once. In the open sea near the Bell Rock the chief novelty was a young example of *Hermadion pellucidum*.

Throughout September the bottom-nets were especially rich in the larval, post-larval, and young Annelids, the most conspicuous being still those of the Spionidæ, e. g. *Nerine*, *Spio*, and *Polydora*, from the minute larvæ with the enormous bristles to the more elongated forms with a pair of tentacles. The fifth body-segment in the *Polydoræ* showed the characteristic bristles with the hook at the tip, and some reached 2·5 millim. in length. The abundance of *Polydora* is not surprising, since it is one of the most common species in the sea, perforating the rocks along the beach and shells—both living and dead—from the tidal margin to deep water. The adult forms of *Nerine*, *Scolecolepis*, and *Spio* are also very frequent between tide-marks.

Besides the foregoing was a young *Aphrodita* 5 millim. long, trochospheres of Polynoidæ with post-larval and young forms, a young example of *Lænilla setosissima* about 1 millim. long with bristles and scales, a young specimen of *Pholoë minuta* with four pairs of parapodia, a young *Nephthys* with six pairs, a caudal style of two segments articulated like the glandular hair of a plant, and a young *Cirratulus* about 3 millim. long. Young Phyllodocidæ, *Terebellæ*, and Ariciidæ, unknown trochospheres, and a young Turbellarian of a light greenish colour by transmitted light were also present. *Autolytus prolifer*, after an absence of some weeks, again made its appearance this month.

The midwater-net presented a contrast to the foregoing, since larval forms of the Spionidæ only were observed occasionally, and once a young example of *Nerine* $\frac{1}{4}$ inch long. On the other hand, *Tomopteris* $\frac{3}{4}$ inch in length was obtained several times, though sparingly. *Sagittæ* also occurred frequently in this net, but in small numbers, except on the 5th. They ranged from 12 to 16 millim.

Larval Annelids were much more frequent in the surface-nets than in the latter, though they fell far short of the bottom-net in this respect. The majority pertained to the Spionidæ, as already explained, and some were obtained in every haul of the net, though larval forms of the Polynoidæ occurred occasionally. *Tomopteris* appeared only once, but the finest example in the museum was procured this month. A few *Sagittæ* 18 millim. long were present once.

Throughout October the larval Annelids still abounded in the bottom-nets, demonstrating how ample the food-supplies of the smaller fishes are from this group during a considerable period of the year. The forms consisted chiefly of the larvæ of *Nerine*, *Polydora*, and *Polynoë*. *Sagittæ* were obtained sparingly in this net in the earlier part of the month, but at the end they were very numerous and ranged from 8 to 15 millim.

In the midwater-net *Tomopteris* occurred occasionally in small numbers, ranging from 1½ inch in length downwards. Very few *Sagittæ* appeared in this net, and only on one occasion.

In the surface-net the larval stages of *Nerine* and *Polydora* were captured along with a few small examples of *Tomopteris* during the first half of the month. The paucity of their numbers formed a contrast with those immediately preceding.

In November the surface-net gave only a very few small specimens of *Tomopteris*, while the bottom-net, besides a few similar specimens, added a few Nematodes. These free Nematodes are occasionally got at considerable depths. *Sagittæ*, again, of good size occurred in all the nets and often in great numbers. They took the place of the absent Hydromedusæ.

The paucity of Annelidan life was equally marked in December. In the surface-net a single *Tomopteris* ¾ inch long was obtained. The same form occurred in the midwater-net occasionally from ½ to ¾ inch. In the bottom-net only bristles of *Sabellaria* and *Nereis* with fragments of *Polynoë* were taken. The same bristles moreover occurred in the contents of a tow-net sent me by Mr. Shrubsole from Sheerness-on-Sea.

The *Sagittæ*, again, were remarkably numerous and large. In the surface-net and in the bottom-net they appeared in similar proportions, but not always in correspondence; thus the record of the surface-net on the 5th, 13th, 14th, and 18th was "numerous, few, many, few," while in the bottom-net it was "few, many, many, few" on the same dates. In the midwater-net they were especially abundant and large, ranging from ¾ to 1 inch, and the reproductive organs were well developed. They formed an important element in the food of the various fishes at this season.

Only a portion of the life-history of the Annelids (*Polychæta*) is thus brought before us in the pelagic fauna; but it is interesting to note how persistently the larval and post-larval forms of some species occur for months. Any danger which a limited spawning-period might engender is thus obviated. As soon as the later stages are reached, with the exception of *Tomopteris*, they cease to be pelagic, and have to be sought at the bottom or between tide-marks.

2. *On the British Species of* Spinther.

In his recent elaborate account of the genus *Spinther** Prof. L. von Graff has placed the form I had mentioned as *Spinther oniscoides*, Johnst., under *Spinther arcticus*, Wirén. The British form referred to was procured in the beginning of August 1865 from the long lines of the fishermen in the Minch. It was small, dead or nearly so, and rapidly decomposing, so that the dorsal lamellæ and other parts were injured. The original specimen of *S. oniscoides* is not in the British Museum, and is thought by Prof. Jeffrey Bell to have been lost, and some doubt then existed as to the minute characters. It differs from the other species which have been subsequently discovered, especially in regard to the cirrus on the parapodia and the presence of bristles with simple tips in the dorsal lamellæ.

A minute examination of the Hebridean specimen, however, shows that while the species is not *Spinther oniscoides*, Johnston, it is certainly not *S. arcticus*, Wirén. The contour and general structure approaches that of *S. miniaceus*, Grube, and in this Prof. von Graff now agrees with me. No cirrus is present, and the free lateral (circumferential) lamellæ diverge from the condition in the other two forms mentioned. The bristles of the dorsal lamellæ are bifid, any simple tips seen in the preparations being due to position (on edge). The ventral surface is marked by rows of minute warts, while the pharyngeal region in protrusion forms a smooth trumpet-like expansion, and thus differs from the organ in *S. arcticus*.

Spinther is one of the rarest British Annelids, and seems to be confined to the western shores. The Irish coast should be specially searched, as it is very desirable to have an example of the original species described by Dr. Johnston, which was sent to him from Belfast Bay (6–10 fathoms).

3. *On the Young Stages of the Gunnel* (Centronotus gunnellus).

In the paper on the "Development and Life-histories of Teleostean Fishes" an account is given of the gunnel from

* Arbeiten aus d. Zoolog. Institut zu Graz, ii. Bd. No. 3 (1887).

the egg up to a stage when a hypural thickening occurred in the tail, which also presented fin-rays. At this stage * "a well-marked interrupted line of black pigment runs from the cardiac region to the anus, passes forward and upward behind it, and is then continued to the tail; the marginal fin is continuous from the anus to the tail; a narrower [preanal] fin occurs in front of this, and it diminishes about the region of the gall-bladder, which is large and distinct. The dorsal fin again is similar and deepens a little in front of the caudal, which in outline is somewhat lobate. The fin-rays are present in the tail and are at this time better marked in the ventral (anal) than in the dorsal fin. They are also distinct in the pectorals. The snout now extends forward about half the diameter of the eye in front of it, and the mandible projects a little further, but is motionless, the animal aerating its gills in its progress through the water." The large size of the otocysts and their continuation upward so as nearly to meet in the median dorsal line is another interesting feature. At this stage they are fully 12 millim. in length. It may further be noted that the ventral median line of black pigment ceases before reaching a line from the pectorals, an oblique bar on each side, forming a Λ with the apex directed forward, occurring at this region, only a short streak of pigment existing in the middle line in front. No trace of ventral fins is apparent.

Lately (23rd May) the trawl-like bottom tow-net brought up a remarkably transparent fish about 35·5 millim. in length which gives us an intermediate stage between the foregoing and those which resemble the adult, though perhaps they only exceed this specimen by a few millimetres. The gunnel at this stage appears to live on the bottom, and probably hides amongst the sand like the young *Anguilla*, to which at first sight it has a close resemblance.

The proportions of this translucent fish differ materially from the earlier form. Thus the eye is much less in proportion to the size of the head and the latter occupies much less bulk in proportion to the body. Nevertheless the eyes seemed to be large and prominent in life when viewed from above. The eye has a silvery lustre laterally, emerald and dark olive-green when viewed from above. Ventrally a black pigment-line begins on the hyoid and continues along the median line to the anus, just as in the earlier form, except that in front it now passes between the separated limbs of the Λ-shaped arrangement. A line of the same pigment-dots behind the

* M'Intosh and Prince, Trans. R. Soc. Edin. vol. xxxv. p. 869 (1890).

vent proceeded to the base of the tail. In addition to the foregoing a band of small though distinct black pigment-spots commenced on the lateral region behind the pectoral on each side and extended to the anal region. Moreover a single spot occurred on each side beneath the pectoral, and thus below the line just mentioned. A touch of the same pigment existed in front of the shoulder-girdle. During life all these pigment-specks were in a state of contraction; but as death approached they gradually assumed a stellate form, and thus the spirit-preparation shows the coloration much more distinctly than the living animal.

The pectoral fins are proportionally large. All the dorsal interspinous bones, as also the articulation of the fin-rays, are evident, whereas only the first three or four of the anal are seen, the first indeed alone presenting an articulation with the fin-ray. Thirty-seven hæmal spines occurred in front of the anus. A few minute black pigment-specks were visible (under the microscope) along the spinal cord. The notochord remained simple from the anterior edge of the lower hypural to the termination, only a minute ventral knob occurring between the first and second hypural. Eight caudal rays abutted on the inferior or large hypural, three on the next above, then one more or less intermediate, three to the upper hypural, above which lay the tip of the notochord, while four rested on the epiurals. The total number was thus nineteen. Day gives fifteen as the number of the rays. The dorsal fin-rays were 79 or 80; Day gives 75 to 82. The anal fin had 44 rays; Day mentions 39 to 45. Only 11 pectoral rays were distinguishable; Day states the number to be 11 or 12. As the fish was quite translucent these numbers are of interest. Both dorsally and ventrally a portion of the larval fin existed in front of the caudal. The gall-bladder forms a distinct pale area at the posterior border of the liver. The urinary bladder is large and its opening conspicuous.

In the paper formerly referred to it was mentioned that young gunnels resembling the adults had been procured in July. They were captured off the Isle of May in the mid-water-net at 30 fathoms, but probably the net touched the bottom. They are only a few millim. longer than the foregoing translucent form, but they are thicker and more massive throughout, and the region from the base of the pectoral to the tip of the snout is longer. Moreover they have well-formed ventral fins. The pigment along the sides forms a series of reticulations with the long diameter of the ovoid pale spaces vertical. Eleven black bars are continued from the body to the dorsal fin without trace of the eye-like areas of the adult.

Similar though much fainter touches inferiorly proceed on the anal fin. Traces of the line of pigment seen at the younger stage a little above the ventral border of the abdomen are still present; but all the reticulations just described have been developed subsequently and independently. The median ventral pigment-line is also quite distinct from the branchiostegal region to the vent. The modification of the numerous and somewhat small lateral reticulations into the larger vertical bars of the adult is easily observed in a series, as also the gradual diminution of the pectorals. A characteristic feature of this young stage is the presence of a K-shaped arrangement of black pigment on each side of the head, the strong bar of the K uniting with its fellow over the brain and proceeding forward over the eye to the tip of the snout. One leg of the K goes from the eye straight downward to the edge of the mandible, while the other slopes backward to the opercular region.

The earlier stage here described would appear to represent a season's growth, and, indeed, it is possible that the later stage referred to is a form about two months older.

XXIII.—*On the Anatomy of* Sesia tipuliformis *and* Trochilium apiforme, *Linn.* By Prof. E. K. Brandt *.

Two years ago, while studying the anatomy of *Sesia scoliæformis*†, I discovered that the structure of the moth differs much from the usual Lepidopterous type, and I thought it would be interesting to compare the connexion between the outward form and the internal structure of other moths belonging to the same group. In the summer of 1887 I had an opportunity of dissecting several specimens of *Sesia tipuliformis* and *Trochilium apiforme*, and ascertained by repeated experiments that they agreed in most essential points.

* Translated from the Russian by W. F. Kirby, F.L.S., F.E.S., &c. [The accompanying paper was written in June 1888, and published in 'Horæ Societatis Entomologicæ Rossicæ,' vol. xxxii. pp. 41–49, in 1889. I have not seen any translation or abstract elsewhere; and as the subject, relating to a very aberrant group of Lepidoptera, is of considerable interest and importance, and the languages of Eastern Europe are at present unfamiliar to many entomologists, I thought it might be useful to give the article a somewhat wider circulation.—W. F. K.]

† [This insect is very rare in England, and fresh specimens would be unattainable for dissection; but the other two species discussed in this paper are sufficiently abundant.—W. F. K.]

The anatomy of the Clear-wings is particularly interesting, because these moths exhibit obvious mimicry. The most remarkable point about the anatomy of *S. scoliæformis* is that this mimicry does not originate in the perfect state, but exhibits a partial arrest of development at the normal condition of the pupa-state. The imperfect scaling of the wings may be thus explained; for the scales of Lepidoptera are developed gradually during the formation of the pupa. A similar arrest of development at some stage in the formation of the pupa is likewise visible in the internal structure. This shows that the Clear-wings are probably ancient forms which have latterly acquired a special adaptation to (or mimicry of) other flower-frequenting insects.

The present paper includes my observations on the dissection of three specimens (one male and two females) of *Sesia tipuliformis* and two specimens (male and female) of *Trochilium apiforme.*

Sesia tipuliformis.

The *skeleton* exhibits the same peculiarities which I had already noted in *S. scoliæformis.* It deserves special attention that there are three distinct thoracic segments in these Clear-wings.

As regards the *mouth-organs*, the proboscis is moderately developed but very weakly constructed.

The *nervous system* is composed of nine ganglia, viz. two cephalic (supra- and infra-œsophageal), three thoracic, and four abdominal. The supra-œsophageal ganglion is well developed and exhibits considerable and well-marked sinuosities; the visual parts are broad, thick, and short. The infra-œsophageal ganglion is small and placed very near to the supra-œsophageal. The first thoracic ganglion is placed nearer to the infra-œsophageal than to the second thoracic ganglion, but the second and third thoracic ganglia are very near together. The abdominal ganglia are rather small and placed at equal distances apart. The last thoracic ganglion is larger than the rest and distributes nerves to the various limbs and also to the reproductive organs and to the straight intestine. The nervous system is arranged on the same principle in both *Sesia tipuliformis* and *scoliæformis*, but is arrested in development, for we find here three thoracic ganglia, as is usually the case in the pupa, whereas only two separate thoracic ganglia are usually present in the imago in the typical nervous system of Lepidoptera.

The digestive organs exhibit the following parts:—(1) the œsophagus, (2) the crop, (3) the stomach, (4) the intestine. The last is distinctly divided into the small and large intestine, and is furnished with a blind branch (the cæcum). The œsophagus is a very long and narrow tube, which is gradually dilated at the lower end, and thus forms a large sac-like crop, opening into the œsophagus at the wide part. The stomach is of an oval shape, very narrow at each end. The small intestine is much more slender and does not form any expansions. At the commencement of the intestine appears a pear-shaped branch, which is the blind intestine (cæcum).

With regard to the morphological importance of the digestive apparatus, I think it possible that it represents about half the usual development in typical Lepidoptera. But the peculiar structure of the crop indicates an arrest of development in the pupa-stage. The crop does not communicate with the middle of the œsophagus, as is normally the case in Lepidoptera, but is placed near the lower end and communicates with the hinder part, not by means of a long slender canal, but, on the contrary, it opens into the œsophagus at the broad end, imperceptibly passing into the sac-like portion. The crop is formed thus in the last stage of the development of the digestive apparatus in the pupa, when it is not placed any more forward, and its commencement does not form a stalk.

The salivary glands are feebly developed. They consist of two long slender tubes, one end of which opens into the lower part of the mouth; the other end is usually rounded.

The Malpighian vessels present no peculiarity, being arranged on the usual type found in Lepidoptera. On each side of the alimentary canal are two vessels, opening into the commencement of the small intestine. Each vessel consists of two tubes, one of which is simple, but the other forms a connexion between the two vessels. Near the openings of the two Malpighian vessels they form a very small oblong expansion, the rudiment of a urinary bladder.

The heart or dorsal vessel is a long and rather narrow tube with several constrictions. There are eight chambers and attachments for the alæ musculares on the dorsal surface.

The respiratory system is arranged as follows:—There are two large respiratory tubes on the ventral surface, running along the whole trunk of the insect, and communicating with it by means of two transverse arching tracheæ. At the hinder end of the body they are connected by means of a transverse tube. Numerous fine branches are distributed to the various internal organs, and from these also run smaller transverse branches which communicate with the spiracles. The aircavities or air-vessels are not yet tracheæ. In this respect the Sesiidæ differ much from the Sphingidæ, in which they are placed together in one cluster in front, and in which such vesicles or sacs are absent in the transverse branches of the tracheæ on the ventral surface.

The male sexual apparatus of *S. tipuliformis* consists of the following parts:—(1) the testes, (2) the deferent ducts, (3) the *vesiculæ seminales*, (4) the *ductus ejaculatorius*, (5) the penis, (6) the accessory glands.

The *testes*, as is invariably the case in Lepidoptera, are two in number, and are enclosed in a common sac or scrotum. The *deferent ducts* are short and broad, opening into the *vesiculæ seminales*, which are small oblong sacs. The *ductus ejaculatorius* is a long sinuous tube. The *penis* is horny, with a guitar-shaped depression in the middle. The *accessory glands* are long and very sinuous.

The female sexual apparatus of *S. tipuliformis* consists of the following parts:—(1) the two ovaries, (2) the oviduct, (3) the vagina, (4) two accessory glands, (5) *receptaculum seminis*, (6) unpaired accessory gland, (7) copulatory pouch, and (8) ovipositor.

While investigating the anatomy of *Sesia scoliæformis* I noted a remarkable peculiarity in the structure of the ovaries. Each ovary contains fourteen tubes, each of which emits a small excretory canal. Every two canals unite, forming seven egg-tubes, which then combine to form one oviduct on each side, and afterwards unite at the vagina. This peculiarity in the structure of the ovaries is very remarkable and constitutes an exception to their usual type in Lepidoptera. In all other Lepidoptera hitherto examined there are only four egg-tubes in each ovary. It would be very interesting to discover whether the same anomaly in the structure of the ovaries is to be met with in other species of *Sesia*, or whether it is peculiar to *S. scoliæformis*. On dissecting *S. tipuliformis* I found that it exhibited the normal structure of the ovaries. I only count four egg-tubes in each ovary. These ducts are long, rather narrow, and only slightly constricted, so that they form straight rather than undulating tubes. The short broad oviducts open into the long vagina, which is considerably dilated at the end. There are two accessory glands, each of which is constructed of a broad pear-shaped part, opening into the vagina, and a long narrow tube, coiled in the peritoneal cavity. The unpaired supplementary gland consists of a long, narrow, stalk-like tube, opening at the lower end of the vagina. The *receptaculum seminis* is a long narrow tube, with the rounded end coiled in the cavity of the body, but the narrow hinder end opening into the vagina. There is also a connecting canal extending from the middle of the *receptaculum seminis*, and opening into the efferent channel of the copulatory pouch—the small round sac which terminates in a separate external opening by means of a separate canal.

The structure of the female reproductive organs exhibits considerable development. It hardly differs from the usual Lepidopterous type except in the absence of branching fatty glands. There is, however, a very slight trace of deviation from the normal type, seen in the imperfect development of certain parts.

Trochilium apiforme, Linn.

The skeleton exhibits the same peculiarities of structure which are characteristic of *Sesia tipuliformis* and *scoliæformis*.

The nervous system likewise exhibits the same arrangement, showing the remarkable arrest in the development of the insect in the pupa state. There are nine ganglia—two cephalic (supra- and infra-œsophageal), three thoracic, and four abdominal, of which the last is the largest.

The digestive system exhibits the following parts:—(1) the œsophagus, (2) the crop, (3) the stomach, (4) the small intestine, (5) the large intestine, provided with a blind branch (the cæcum). The œsophagus is very long and narrow and is enlarged at the lower end. The crop exhibits the dilatation of the lower and lateral end of the œsophagus at its side, as in the pupa. It remains in that condition when it changes from the lower to the lateral position. The crop is narrower and longer than in *Sesia tipuliformis* and *scoliæformis*, and opens into the stomach by a short broad stalk. The remainder is longer and narrower. The blind appendage is comparatively short, but the large intestine, behind the blind branch and the cæcum, is broad and thick, as in *Sesia tipuliformis* and *scoliæformis*.

The salivary glands are two long slender tubes, constructed throughout exactly as in the two *Sesiæ*, and opening into the mouth in just the same way.

The Malpighian vessels exhibit the typical structure. There are three on each side of the intestine. Two of these unite in a common canal, but the third joins them, and then they all terminate in a common canal, opening at the commencement of the small intestine. This common canal is shorter, wider, and thicker than in *S. tipuliformis*. The Malpighian vessels themselves are very long and sinuous tubes. The amalgamated Malpighian vessels exhibit no dilatation near the opening of the intestine.

The heart or dorsal vessel is constructed exactly as in *S. tipuliformis*.

The respiratory system consists of two large respiratory tubes, placed at the sides of the abdomen, and composed of the united respiratory tubes which run from the tracheæ. These abdominal respiratory tubes are continued to the thorax, and subdivide. At the hinder end of the abdomen the two main respiratory tubes are united in a curve, but there is no connexion between them at any other part of their course, and thus they differ from the respiratory tubes of *S. tipuliformis*, in which the conducting respiratory canals are connected by wide respiratory tubes at each segment.

The male reproductive system is of the same form and construction as in *S. tipuliformis*. It includes :—testes, contained in a common scrotum; two deferent ducts, opening into the large round *vesiculæ seminales*; the *ductus ejaculatorius*, shaped like a long sinuous tube; a horny penis, provided with a furrow; and two long, sinuous, accessory glands.

The female reproductive system consists of the following parts:—(1) two ovaries, (2) two oviducts, (3) vagina, (4) copulatory pouch, (5) *receptaculum seminis*, (6) one unpaired accessory gland, (7) two paired accessory glands, and (8) ovipositor. Each ovary consists of four very long sinuous egg-tubes. These four tubes unite into one common oviduct, and then both oviducts open into the vagina. The *receptaculum seminis* is a little round sac, which opens at one end into the copulatory pouch and at the other into the vagina. The unpaired accessory gland resembles a long, narrow, sinuous tube, provided with two short, rounded, bag-like processes at the upper end. The paired accessory glands resemble two short sinuous tubes. The copulatory pouch is an oval and rather large sac, which opens outwards by a separate outlet through the deferent canal, but which communicates with the *receptaculum seminis* by a connecting tube, and appears to be indirectly connected with the vagina.

XXIV.—*On the Circulatory System of the Carapace in the Decapod Crustacea.* By E. L. Bouvier *.

The circulatory system of the Decapod Crustacea, as described in the classic memoirs, after the investigations of Lund,

* Translated from the 'Comptes Rendus des Séances de l'Académie des Sciences,' tome cx., June 9, 1890, p. 1211 *et seq.*

Krohn, and, above all, of H. Milne-Edwards, consists (1) of an arterial system which conveys the blood directly from the heart and pours it into the lacunæ of the body-cavity, (2) of a branchial system in which the blood from the lacunæ, after being arterialized, circulates in the direction of the heart, and is eventually poured into the pericardial chamber by which the latter is surrounded.

Huxley reproduces these ideas in his work on the Crayfish, and adds that the pericardial sinus is perhaps partially occupied "by some blood which has not passed through the branchiæ, though this is doubtful" *. Claus, in a recent paper, is much more positive; he states that the membrane of the carapace always contains venous blood, derived it may be from the lacunæ of the body-cavity, it may be from the arterial extremities of the tegumentary branches of the lateral anterior arteries (antennary arteries), and he justly observes that this blood "certainly does not flow into the branchial sinus for the purpose of passing through the branchiæ, but passes directly from the body-walls into the pericardial sinus" †. The learned carcinologist appears to make use of this fact to combat the opinion of Milne-Edwards, who holds the heart of the Decapod Crustacea to be an arterial heart in the sense that the Molluscan heart is; however, he merely formulates, without further details, the rule quoted above, contenting himself with describing very minutely the circulation in the carapace of the *Phyllosoma*-stage of the larva of the lobster.

Now, if we consider that the larvæ of Decapod Crustacea, before the branchiæ appear, have no other respiratory apparatus than the membrane of the carapace, and must therefore respire in the same manner as *Mysis* ‡, we are forced to believe that, in the absence of demonstrative proof, we cannot draw conclusions from the larva as to the adult, and we ask ourselves whether Milne-Edwards may not be right after all in holding the Decapod heart to be exclusively arterial.

Numerous experiments and a large number of injections performed on crayfish (*Astacus fluviatilis*), on species of *Pagurus* (*Eupagurus Bernhardus*, *E. Prideauxii*), on *Dromia* (*Dromia vulgaris*), on aquatic crabs (*Platycarcinus pagurus*,

* Huxley, 'The Crayfish; an Introduction to the Study of Zoology,' p. 56 (1880).

† Claus, "Zur Kenntniss der Kreislaufsorgane der Schizopoden und Decapoden," Arbeiten aus dem Zool. Instit. d. Univ. Wien, Bd. v. p. 40 (1884).

‡ Delage, "Circulation et respiration chez les Crustacés Schizopodes (*Mysis*)," Arch. Zool. Exp. 2e série, t. i. (1883).

Carcinus mœnas), and on land-crabs of the genus *Cardisoma*, have enabled me to study in all its details the circulation in the membranous walls which clothe the carapace in the branchial region, and to substantiate by definite investigations on adults the rule enunciated by Claus.

The afferent system of the membrane which clothes the carapace in the branchial regions has its origin in the vast postcephalic lacuna which surrounds the liver and the entire stomach; a quantity of blood, very variable in amount in the different types, also enters this membrane by the ultimate branches of the lateral anterior (antennary) and posterior arteries. In the land-crabs of the genus *Cardisoma*, as in *Birgus latro*, which was studied by Semper, the largest portion of the blood is drawn from the ventral region of this lacuna and forms a large trunk in front, which then divides into several branches, the secondary divisions of which are very numerous, very minute, and gather themselves into a plexus; but in the more distinctly aquatic Decapod Crustacea the large afferent trunk usually does not exist, and we are confronted with an infinite number of little anastomosing lacunar canals, which detach themselves from the lacuna at its points of contact with the membrane.

The efferent system is absolutely constant; it consists of a well-defined trunk which follows the membrane close to the lower free border of the carapace; very narrow anteriorly, this trunk receives on its way the efferent branches of a plexus which is continuous with the afferent plexus; it increases considerably in size the further back it gets, and opens directly into the pericardium either at its posterior angle (*Astacus*) or at the sides (edible crab, *Cardisoma*). The whole of the efferent system, the pericardium, and the entire arterial system can be easily injected by way of this large efferent trunk.

In studying the disposition of the afferent and efferent canals in this region of the membrane we are soon convinced that we are dealing with a cutaneous respiratory apparatus analogous to that of *Mysis*, and that it is the exaggeration of this arrangement which allows certain Crustaceans (land-crabs, *Birgus latro*) to live a very long time out of the water. In other words, the blood which returns directly to the pericardium by way of the large efferent trunk of the carapace is not venous but arterial blood. It is possible that a portion of the venous blood of the lacunæ returns directly to the pericardium, and we even find two orifices at the bottom of the pericardial sinus of the edible crab, which seem to be intended to serve this purpose; but in any case we are bound to concede to the system of the carapace an efficient respiratory *rôle*.

We may sum up our results as follows:—In the Schizopods and in the abranchiate larvæ of Decapod Crustacea respiration is purely cutaneous and is principally effected in the membrane which clothes the lateral walls of the carapace. In the adult Decapods this respiratory apparatus persists, and presents an absolute fixity, at any rate as far as regards its large efferent canal; but a secondary respiratory system is added to that of the larva, and it is this latter system, in which the branchiæ are intercalated, which is really the only one described in the classic works. This branchial system is undoubtedly the more important from a physiological point of view (except perhaps in the terrestrial species); but it is a secondary apparatus which in no way lessens the importance of the cutaneous system.

XXV.—*Description of a new Species of* Mormyrus. By G. A. Boulenger.

Mormyrus mento.

D. 29. A. 36. V. 6. L. lat. 85. L. tr. $\frac{18}{18}$.

Snout short, curved, once and a half the diameter of the eye, $\frac{3}{10}$ the length of the head. Mouth terminal, on a line with the lower border of the eye, its width one fifth the length of the head. Teeth moderately large, notched, five in the upper jaw, six in the lower. Diameter of the eye one fifth its length, about two thirds the width of the interorbital space. Chin strongly swollen. Origin of the dorsal halfway between the gill-opening and the caudal, and above the ninth ray of the anal. Pectoral as long as its distance from the nostrils, extending a little beyond the base of the ventral, which measures nearly half the length of the head. Depth of body $3\frac{1}{2}$ times in total length (without caudal), length of caudal peduncle $5\frac{1}{2}$ times; depth of caudal peduncle one fourth its length. 12 scales round the caudal peduncle. Silvery, with fine brown dots, which are very crowded on the head and the dorsal and ventral lines.

Total length 190 millim.

Closely allied to *M. senegalensis*, Stdr., from which it is distinguished by the smaller scales and the more slender caudal peduncle, and to *M. cyprinoides*, L., which has smaller teeth and a deeper caudal peduncle surrounded by 16 scales.

A single specimen, from the Gaboon.

BIBLIOGRAPHICAL NOTICE.

A Synonymic Catalogue of Recent Marine Bryozoa. By [Miss] E. C. Jelly.

Students of the systematic arrangement of the Polyzoa will welcome the publication of this exceedingly useful book. The author remarks in the preface that in the compilation two chief ideas have been kept in view—firstly, to collect as far as possible all the names of recent Polyzoa that have been published, and, secondly, "to reduce the synonymy to something like fact." Even a cursory examination of the contents of the Catalogue will give evidence of the, if possible, too conscientious care with which the first part of the programme has been carried out. For instance, no less than eighty-seven bibliographical references are given to *Scrupocellaria scruposa* and one hundred and forty to *Membranipora pilosa* and its varieties. Many of the papers referred to may be of interest from an antiquarian point of view; but, so far as the systematic zoologist is concerned, are worthy only of a place in an index expurgatorius. We would not be understood to find fault with the compiler of a catalogue for aiming at completeness, which is one of the chief merits of a work of this description.

The correct classifying of synonyms requires a practical knowledge of the group. This part of the work has been carried out with considerable judgment. The genera are arranged in alphabetical order, as also are the species included under each genus. The specific names are printed in the same type as the generic, to distinguish them from the synonyms. A useful, and in this case indispensable, bibliographical index, followed by a general index, is inserted at the end of the book.

We regret to have to point out a few faults in this valuable work. The synonymy is occasionally incorrect. *Farcimia cereus*, Pourtales (p. 166) is not synonymous with *Nellia simplex*, Busk. The insertion of dates of publication in every case where it was possible would have increased the usefulness of the work.

With regard to the title of the Catalogue, it is not insular prejudice but a careful weighing of the evidence which leads us to adopt the name Polyzoa, first applied by Vaughan Thomson, in preference to "Bryozoa" (Ehrenberg), chiefly used by continental zoologists. The arguments for retention of the former name put forward by Mr. Hincks appear to be conclusive.

But it would be ungracious to be severely critical concerning the errors, in view of the immense mass of information brought together and arranged with such painstaking labour and judgment. The author assuredly deserves the gratitude of all students of Polyzoa.

MISCELLANEOUS.

On two new Species of Coccidea infesting the Stickleback and the Sardine. By P. Thélohan.

The Coccidea of fishes have not yet formed the subject of any descriptive treatise, and what we know about them is confined to the mere mention of their existence *.

* Eimer, 'Ueber die Ei—oder kugelförmigen Psorosp. der Wirbelthiere,' p. 55 (1870); Bütschli, Bronn's 'Thierreichs Klass. und Ord.,' Bd. i., Protozoa, p. 584.

I have met with two species—one in the liver of the stickleback, the other in the testis of the sardine. Both belong to the genus *Coccidium*, as characterized by the successive works of Leuckart, Schneider, and Balbiani; that is to say that, on arriving at their full development, they form four spores, each of which encloses two falciform bodies.

(i.) *Coccidid of the Stickleback* (Coccidium gasterostei, *sp. n.*).—I discovered this species in April of the present year in sticklebacks (*Gasterosteus aculeatus*) from the marshes of Vilaine, in the Morbihan. This Coccidid is of small size and its cysts only measure 16 to 18 μ. It lives in the hepatic cells, undergoing the whole of its development in the same cell. I have several times observed cells containing three or four cysts. These facts are easily made out by teasing a portion of diseased liver. By making sections of the organ, after fixing, hardening, and embedding it in paraffin, I have been enabled to discover the developmental phases and to study them much more easily than by teasing; but it was by means of the latter method alone that I succeeded in determining the exact relations of the parasite to the hepatic cell. I have not been able to observe the very young stages. On attaining its full development *Coccidium gasterostei* measures, as I have already said, 16 to 18 μ in diameter. It is a little spherical mass of plasma enclosing a very large number of coarse globules; these are tolerably refractile, but do not affect polarized light.

At this point the *Coccidium* encysts, that is to say the plasma surrounds itself with a delicate transparent pellicle of a uniform spherical shape. The plasmic mass then contracts, leaving an empty space between it and the wall of the cyst. The nucleus lies in the centre of the plasma, though the granulations of the latter sometimes render it difficult to determine its presence. After a short time it migrates to the periphery and divides. The small size of the nucleus renders the task of observing it an extremely delicate one, and I have therefore not been able to follow all the stages of its division; I have, however, found figures sufficiently distinct to enable me to recognize karyokinesis.

The two nuclei resulting from this division divide in their turn, and we finally get four nuclei placed at the extremities of two perpendicular diameters of the plasmic sphere. The latter then splits up into four little spheres, each of which encloses a nucleus. This segmentation of the primitive mass appears to take place very rapidly, and most probably in the majority of cases it does so all at once. There is sometimes a second stage, which, by reason of its extreme rarity in my preparations, is probably a very short one, that is supposing it to be constant. The four little nucleated spheres are sporoblasts. Their nucleus divides (always indirectly) and the binuclear sporoblasts then lengthen out, surround themselves with an envelope, and reassume the characters of typical spores of *Coccidium*, that is to say, each of them encloses two falciform bodies provided with a nucleus. During the formation of these sporozoids there is to be seen a residual granular mass, which diminishes little by little during their increase in size (Schneider's residue). The mature spore is fusiform in shape and 10 μ long by 4 to 6 μ wide.

Each of these sporozooids occupies nearly the entire length of the spore, but they are intertwined in such a way that the broad extremity of the one corresponds to the tapering extremity of the other. The nucleus is situated towards the middle. At one of the extremities, and often at both, we find a little globule analogous, in position at least, to the vacuoles described by Schneider in the spores of *Coccidium sphæricum* and of *Coccidium proprium* *.

I have not been able to follow the history of this parasite further, and the ultimate destiny of the spores is unknown to me, as is also the manner in which the sticklebacks become infected. Probably the spores reach the intestine by way of the bile-ducts and are thence carried to the exterior; but I have never met with them in the digestive tract.

(ii.) *Coccidid of the Sardine* (Coccidium sardinæ, *sp. n.*).—I met with this second species in the testis of sardines which M. Henneguy procured from Concarneau and which he was good enough to permit me to examine for parasites. Unfortunately I am compelled to restrict myself to giving the characters of the adult state, the only one which I was able to observe.

The spherical cysts measure about 50 μ in diameter. In sections of the testis they are to be found in the seminiferous tubules; but I was not able to determine their presence in the cells. In the interior of the cyst one finds a granular mass applied against the membrane, and in this four fusiform spores are implanted. The latter, approximated at their fixed extremity, diverge at their free ends and affect a more or less regular radial arrangement. Each of these spores encloses two sporozooids with a nucleus; the sporozooids do not occupy the whole length of the spore, and they are only very slightly intertwined.

A remarkable and highly distinctive character of *Coccidium sardinæ* is the small amount of space in the cyst occupied by the granular mass and the spores.

This is the sum of the facts which I have been able to make out concerning this new enemy of the sardine. I have been led to publish this incomplete description owing to the interest attaching to the affinity between and comparison of the two Coccidea whose characters I have just given. By the disposition of the spores, which are free in *Coccidium gasterostei* and implanted in a residual mass in *C. sardinæ*, the latter species is allied to *C. sphæricum* and *C. proprium* (Sch.), and the former to *C. oviforme.*

In conclusion, these two Coccidea present this interesting character, viz. that the whole of their development takes place in the organ which they have attacked, and that one does not notice two periods in their cycle of development, as is the case in many of these parasites, and especially in *Coccidium oviforme.*—*Comptes Rendus des Séances de l'Académie des Sciences*, tome cx. June 9, 1890, pp. 1214 *et seq.*

* "Coccidies nouvelles ou peu connues," Tablettes zoologiques, t. ii. (Poitiers, 1887).

THE ANNALS

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XXVI.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 16. *On the Bathybial* Fishes collected in the Bay of Bengal during the season* 1889-90. By A. ALCOCK, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

[Plates VIII. & IX.]

CONTENTS.

§ 1. Enumeration and Topography of the Dredging Stations.
§ 2. Review of the Collection, with List of the Fishes and Descriptions of new Species.

§ 1. *The Dredging Stations.*

OF nine hauls of the trawl in depths of a hundred fathoms and over within the limits of the Bay of Bengal during the surveying-season of 1889–90, only five added anything to the collection of fishes, and it will not be necessary to mention here any but these five.

* Following the precedent of Dr. Günther, I have here taken the 100-fathom line as the near boundary of the bathybial fauna. In the Bay of Bengal, at any rate, where already at 70 fathoms we find among all the classes of marine animals numerous characteristic reactions to bathybial conditions, the 100-fathom line appears to be a sufficiently unequivocal limit.

1. *Station* 96.—4th March, 1890.

Off Madras coast, lat. 18° 30′ N., long. 84° 46′ E. Depth 98 to 102 fathoms. Bottom hard sand.

Temperature at surface 80° Fahr., at bottom about 64° Fahr.

This was a clean sandy bank in clear water standing out from the mud, which in that vicinity is almost universal. There was a strong surface-current running northerly. The old 'Challenger'-pattern trawl was used, and over a thousand fishes, of twelve species, and a very large number females with mature ovaries, were brought up, besides great numbers of crabs (chiefly *Leucosina* and Maiidæ), Penæids, and Mollusks. It seems probable that this bank was a spawning-ground.

2. *Station* 97.—14th March, 1890.

Off Madras coast, lat. 18° 26′ N., long. 85° 24′ E. Depth 1310 fathoms. Bottom olive mud.

Temperature at surface 80° Fahr., at bottom 36°·2 Fahr. Blue water, with a strong surface-current running northerly.

Twelve fishes, all quite dead, of six species of deep-sea genera were obtained, besides very numerous and varied Crustaceans and Annelids, Echinoderms, and Mollusks.

3. *Station* 101.—29th March, 1890.

Off Madras coast, lat. 16° 11′ 15″ N., long. 82° 30′ 30″ E. Depth 922 fathoms. Bottom brown mud.

Temperature at surface 87° Fahr., at bottom 39° Fahr. Blue water and strong northerly current.

The take included two fishes of different species, Penæids, Schizopods, and Actinids—all quite dead on arrival at the surface.

4. *Station* 102.—1st April, 1890.

Off Madras coast, lat. 15° 38′ N., long. 82° 30′ E. Depth 920 to 690 fathoms. Bottom brown mud.

Temperature at surface 85° Fahr., at bottom 39°·75 Fahr. Blue water and strong northerly current.

Result: two fishes of different species, deep-sea Medusæ, Corals, Echinoderms, and Crustaceans, all dead on arrival at the surface.

5. *Station* 103.—2nd April, 1890.

Off Madras coast, lat. 15° 14′ N., long. 81° 9′ E. Depth 1260 fathoms. Bottom blue mud.

Temperature at surface 86° Fahr., at bottom 36° Fahr.

In the trawl-bag were two fishes of different species, both quite dead.

§ 2. *Review of the Collection, with List of the Fishes and Descriptions of the new Species.*

The number of specimens obtained in the above five hauls was considerably over a thousand, most of which, however, were from the sandy bank at Station 96. They fall into twenty-four species, of which nine (belonging to eight genera and six families) are already known, though rare; while fifteen (belonging to thirteen genera and nine families) do not appear to have been yet described. Of the thirteen genera into which the undescribed species fall, five have been founded upon supposed generic types in this collection. To glance at the subject of distinction: while the fishes from the less depths (98 to 102 fathoms) mostly belong to well-known East-Indian genera, yet as exceptions we must note with some interest *Centropristis investigatoris*, sp. n., and *Trigla hemisticta*, Schlegel; those from all depths show, as would be expected, identities or marked alliances with the bathybial and hemibathybial forms of the seas of Aru, Banda, Celebes, &c.; lastly, the discovery in the Bay of Bengal of a deep-sea Pediculate showing the closest affinities with *Oneirodes* from the Greenland Sea is another remarkable illustration of the wide range of distribution of the true deep-sea fishes.

ACANTHOPTERYGII.

Family **Percidæ**.

CENTROPRISTIS, C. & V.

1. *Centropristis investigatoris*, sp. n.

Closely allied to *C. pleurospilus*, Gthr., from the Arafura Sea.

B. 7. D. 10/10. A. 3/6. L. lat. 42. L. tr. $\frac{2\frac{1}{2}}{\frac{1}{1}}$.

The dorsal and ventral profiles are quite symmetrical. Height of the body between $3\frac{1}{2}$ and $3\frac{2}{3}$, length of the head about $2\frac{1}{16}$, in the total, without caudal. Head inclined to depression in its anterior half, deep, broad, and inflated in its branchial region, with the operculum prolonged; scaly, except on the snout and upper jaw. Snout depressed, rounded; its tip formed by a prominent median knob on the projecting lower jaw; its extreme length (including the mandibular element) is equal to the major diameter of the eye and is less than its breadth. Eyes in their long diameter $4\frac{2}{3}$ in the head-length; the upper border of the orbit enters the dorsal profile; the breadth of the interorbital space is one third the length of the eye. Nostrils superior. Mouth wide, oblique; jaws strong, the maxilla reaches the vertical through the posterior border of the orbit, the mandible closes outside the maxilla; teeth in villiform bands in the premaxilla and palatines and in a small patch on the vomer; small canines in the mandible and at the maxillary symphysis; tongue long and spathulate.

Gill-opening very wide; operculum with two flat spines; preopercular border rounded and serrated throughout; sub- and interoperculum large; pseudobranchiæ coarse; gill-rakers tuberculate. Scales, except on the lateral line and in the row flanking the dorsal fin, large, finely ctenoid, except on the operculum; eight series on the cheek. Lateral line salient, with very small scales. One dorsal, with its spinous and soft portions of equal extent, the fourth and fifth spines the greatest and one fourth longer than the eye; the rays slightly increasing in length to the ninth, which is less than two thirds of the maximum body-height and shorter than the corresponding anal ray. Caudal emarginate, with the upper lobe the longer, its basal half scaly; its length is about equal to that of the pectoral, which is rather longer than the postorbital portion of the head. Ventrals subjugular, the second ray almost as long as the pectoral fin. Pyloric cæca few. Air-bladder small.

Colours in life:—Head and body bright pink, belly and throat white; a broad bright yellow band passes from the tip of the snout through the eye to the caudal fin; indefinite bright yellow markings on the cheeks, opercles, and fins. In spirit, faded yellow, with four incomplete cross bands of grey.

Total length $5\frac{1}{8}$ inches.

Hab. Vide Station 96. Two specimens.

BREPHOSTOMA, Alcock.

2. *Brephostoma Carpenteri.* (Pl. IX. fig. 4.)

Brephostoma Carpenteri, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 383.

More careful examination of this fish, now that it has been delineated, leads me to the conclusion that instead of being related to the Trachinidæ it has close affinities with *Pomatomus,* Risso; and I take this opportunity of placing it in what I believe to be its proper natural position in the group Apogonina.

If this position be conceded, the following diagnosis of the genus should be sufficient:—

Head-bones and opercles unarmed; preoperculum with a double edge. Mouth edentulous. Eyes large. Two separate dorsal fins, the first with five spines. Anal fin with one spine and similar to second dorsal. Scales large, adherent, ctenoid. Seven branchiostegals. Pyloric cæca in moderate number. No air-bladder.

PARASCOMBROPS, Alcock.

3. *Parascombrops pellucidus,* Alcock.

Parascombrops pellucidus, Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. pp. 296, 297, pl. xxii. fig. 1.

About one hundred specimens were taken at Station 96 (98–102 fathoms), none of them being more than 4 inches long; many were mature females. The *facies* of this fish (of which one specimen had previously been found in 68 and one in 65 fathoms) decidedly inclines to the bathybial.

Family **Berycidæ.**

MELAMPHAËS, Günther.

4. *Melamphaës mizolepis,* Gthr.

Melamphaës mizolepis, Günther, Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 185; and Zool. Chall. Exp. vol. xxii. p. 28.

A mutilated specimen, which corresponds in almost every verifiable particular with the diagnosis of this species, was dredged at Station 97, in 1310 fathoms. The radial formula of our specimen is D. $\frac{2}{11}$, A. $\frac{1}{8}$, V. $\frac{1}{6\text{—?}7}$.

A single scale was found still adherent to the thorax; it was soft and almost coriaceous, and measured a quarter of an inch in its major diameter. The pectoral fins reach to the eighth anal ray.

Family Carangidæ.

Bathyseriola, gen. nov.

Body oblong and compressed, covered with small deciduous cycloid scales. Lateral line apparently unarmed. First dorsal fin continuous, with rather feeble spines; the second and the anal much more developed and without finlets. Anal spines approximated to and continuous with the rest of the fin. Ventral with a continuous membranous attachment to the abdomen. Cleft of mouth narrow; villiform teeth in the jaws only. Preopercular border entire. Seven branchiostegals. Pseudobranchiæ. Pyloric appendages numerous. No air-bladder. Vertebræ 10/14.

5. *Bathyseriola cyanea*, sp. n.

All the tissues fragile.

B. 7. D. 8–9/24–25. A. 3/22. P. 22. V. 1/5.

Body oblong and compressed; its height about $3\frac{1}{4}$ in the total and one ninth less than the length of the head.

Head compressed and thin in its lower, broad and heavy in its upper half; its muciferous cavities well developed. Snout rounded, a little inflated at the tip, the jaws equal in front; its length, which is hardly equal to its greatest breadth, is equal to the diameter of the eye. Eyes circular, their diameter not quite one fourth of the length of the head; they are encircled by a sharp-edged adipose fold, widest fore and aft; interorbital space wider than the eye, convex from side to side. Nostrils large, situated almost superiorly at the tip of the snout. Cleft of mouth narrow, the maxillary hardly reaching the vertical through the middle of the eye; jaw-bones weak, with a trenchant edge, which bears a narrow band of villiform teeth; tongue large and fleshy; buccal folds very broad. Gill-cleft wide; gill-membranes united anteriorly; gill-covers with thin, almost membranous, bones, the operculum with two diverging weak stays above, the preoperculum bulging backwards as a large, striated, entire lobe; gill-laminæ broad, gill-rakers on the first arch long, close-set, acute; pseudobranchiæ fleshy. The mucosa of the whole oro-branchial cavity black.

Scales extremely deciduous; the few that still adhere are small and membranous, and those of the lateral line, which are $\frac{1}{12}$ inch in their major diameter, have each a salient membranous tube.

The dorsal and anal fins have thick gelatinous bases; the dorsal spines are short and rather weak, and their interconnecting membrane is delicate; the anal spines are in close contact with each other and with the rest of the fin. Caudal symmetrically forked. Pectorals pointed, their length rather more than four fifths the height of the body. Ventrals much shorter than the pectorals; they are adherent to the abdomen throughout their inner border, and can be retracted within a shallow furrow in the middle abdominal line.

Peritoneal cavity large, the membrane black; numerous pyloric cæca in an arborescent mass; no air-bladder. Vertebræ 10/14.

Colours in life, uniform bluish black, with an uneven silvery sheen.

Total length $6\frac{1}{4}$ inches.

Hab. Vide Station 96. Four specimens, all mature ovigerous females.

This fish appears to have many Nomeid affinities.

Family **Trachinidæ.**

PONERODON, gen. nov.

Body elongate, naked. Eyes lateral. Two separate dorsal fins, of which the second is much the longer, and equal, opposite, and similar to the anal; ventrals thoracic; pectoral rays branched. Cleft of mouth extremely wide; jaws distensible and armed with canine teeth, as are also the palatines. Gill-openings very wide, the gill-membranes united anteriorly; preoperculum with a (small) spine at its angle; seven branchiostegals; pseudobranchiæ. Lateral line single, uninterrupted. Abdominal cavity enormous. No air-bladder. No pyloric cæca. No anal papilla. Vertebræ 14/24.

6. *Ponerodon vastator*, sp. n. (Pl. IX. fig. 5.)

Tissues fragile; gape and abdomen enormously distensible.

B. 7. D. 10/29. A. 29. P. 12. V. 1/5.

Body somewhat elongate and compressed, its height being $4\frac{1}{2}$ in the total without the caudal.

Head low, long, and compressed, its length being $3\frac{1}{4}$ in the same standard; its surface is studded with pores, those on the crown being elliptical and arranged in numerous longitudinal rows. Snout depressed, tapering, and rounded, its length being twice the diameter of the eye and one fourth the length of the head; the lower jaw projects slightly. Eyes lateral, small, circular, deep-set; interorbital space twice the diameter of the eye and nearly flat from side to side; it is traversed by two anteriorly-converging ridges which enclose a V-shaped groove, in the centre and also at the apex of which is a luminous (?) gland. Nostrils large, superior, situated near the tip of the snout. Cleft of mouth oblique, extremely wide, its angle nearly reaching the preopercular angle; the maxilla, which is much more slender than the premaxilla, is almost three fourths the length of the head; the symphyseal connexions are loose; the labial folds are thin and almost obsolete. Depressible hinged fangs in two rows, those of the inner row being much the larger, in both jaws, and a row of distant, fixed, recurved teeth in each palatine; the most anterior and external premaxillary tooth is very stout, curved, and fixed. Tongue free, thin, foliate. Gill-openings wide; gill-covers thin and flexible, the preoperculum with a very oblique edge, a small, stout, obliquely decurrent spine at its angle, and a thick muscular covering; gill-membranes attached to the isthmus in its anterior half; four gills, the last gill-cleft a small foramen, branchial arches extremely weak and flexible; no gill-rakers; pseudobranchiæ well developed.

Skin entirely scaleless, thin, covered with a uniformly thick adherent layer of mucus; a single lateral line, which follows the dorsal profile from occiput to base of caudal.

Two dorsal fins, separated by an interval equal to two thirds the length of the snout: the first, which begins slightly in advance of the vertical through the base of the pectoral, consists of ten slender but well-ossified spines, of which the longest (third) is barely as long as the rostro-orbital portion of the head; the second contains twenty-nine slender articulated rays, branched at the tip and decreasing regularly in length from before backwards, the longest (second) being about half the length of the head. Anal equal, opposite and similar to the second dorsal. Caudal symmetrically forked. Pectorals slender, as long as the postorbital portion of the head, all the rays branched. Ventrals thoracic, equal in length to the rostro-orbital portion of the head.

The abdomen is a great elastic sac, which extends behind the normally situated vent into the tail; it contains a vast collapsed stomach, which extends from its anterior to its extreme posterior limit, but no air-bladder and no pyloric appendages.

There are fourteen abdominal and twenty-four caudal vertebræ.

Colours in life:—Blotchy violet-black to black; gill-membranes and opercles black; oral cavity, but not the peritoneum, darkly pigmented.

The enormous gape, the loosely articulated jaw-bones, and the structure of the abdomen and stomach would permit the deglutition of a relatively immense object.

When brought on board the fish was a good deal ruptured, its belly was distended and pendent, and several ounces of grumous chyme escaped from a tear in the tail.

Hab. Vide Station 102.

Total length $6\frac{1}{6}$ inches. One specimen.

Uranoscopus, C. & V.

7. *Uranoscopus crassiceps*, sp. n.

Diagnosed at once by the extraordinary size of the head.

B. 6. D. $4/\frac{1}{13}$. A. 13. C. 15. P. 18. V. 1/5.

Length of the head $2\frac{6}{7}$ in the total including the caudal, its maximum breadth in repose (that is, when the opercles are not extended and expanded for defence) is $\frac{2}{3}$ the length, its maximum height (and that of the body) is about $\frac{2}{5}$ the length; bones of the head massive and rugose; the preorbital much sculptured, with a coarse procurrent spine at its antero-inferior angle; the anterior border of the preoperculum raised and inflated, especially in its middle, with numerous strong ridges radiating from it across the bone upwards, backwards, and downwards, the last ending in four or five procurved spines, and a similar spine on the suboperculum; clavicular spine small, grooved, its length equals the diameter of the orbit; points of pubic bones projecting forwards as acute spines on each side of the clavicular symphysis. Diameter of the eye not quite one seventh the length of the head; supra-orbital margin broad, massive, longitudinally grooved. Lips fringed with papillæ; no prelingual filament; curved, acute (caniniform) teeth, in two rows in the upper, one in the lower jaw and palatines, a second incomplete row at the mandibular symphysis, a patch of small teeth on the vomer. No scales on the throat or anterior part of belly.

Stomach an enormous sac, which in the specimen dissected (a mature female with gravid ovaries) contained seven entire individuals of *Scopelus pterotus* besides much débris; intestine longer than the entire body, coiled, with nine pyloric appendages; no air-bladder.

Colours in life:—Dorsum dirty greenish yellow, marbled with lighter shades, venter silvery white, first dorsal black.

Total length of mature specimens $5\frac{2}{3}$ inches. About twenty-five specimens.

Hab. Vide Station 96.

Family Pediculati.

Halieutæa, C. & V.

8. *Halieutæa stellata* (Wahl).

(*Vide* Günther, Catalogue, iii. pp. 203, 204.)

One small specimen from Station 96 (98–102 fathoms).

The skin is smoother and the dermal spines less robust than in shallow-water specimens, while the mouth is slightly smaller and the eye rather larger; the last character may either be due to immaturity or may be a reaction to depth.

A second small Pediculate from 1260 fathoms remains outside the area of incidence of any hitherto defined genus. It is closest to *Oneirodes*, Lütken, and *Melanocetus*, Günther. It is with some diffidence that I propose to establish a new genus for the reception of a single small specimen; but there seems to be no other course.

Paroneirodes, gen. nov.?

Differs from *Oneirodes*, Lütken, in possessing a second cephalic instead of a true dorsal spine.

9. *Paroneirodes glomerosus*, sp. n. (Pl. IX. fig. 6.)

D. 1/1/6. A. 4. C. 8.

When captured the form of the body was ovoid, though unstable; hardened in spirit it becomes compressed and oval. The length of the head is five eighths, its greatest height nine sixteenths of the total, without the caudal. The eye is rudimentary, being deeply buried beneath a circular patch of transparent (unpigmented) skin; above the eye is a prominent, coarse, procumbent spine. Mouth moderately large, its cleft obliquely ascending; the length of the maxilla is one third that of the head; a narrow band (?) of small teeth in each jaw and on the vomer; tongue large; only the floor of the mouth pigmented.

Gills $2\frac{1}{2}$; gill-opening a small circular aperture just beneath the root of the pectoral fin.

Skin thin and perfectly smooth and scaleless; it is protected by a thick coat of mucus.

Two clavate cephalic tentacles, the first being rather more than twice the length of the second, situated close together immediately behind the interorbital space, with luminous organs imbedded in their enlarged tips. Second dorsal and anal placed far back on the tail, almost in contact with the caudal, which is pointed and in length a little more than one fourth of the total; all the rays of the vertical fins simple; pectorals very short, pointed; ventrals absent.

Colours:—Body and fins jet-black; in spirit the tip of the cephalic tentacles become white. Pharyngo-branchial and peritoneal membranes unpigmented.

One specimen, $1\frac{1}{6}$ inch long.

Hab. Vide Station 103.

Family **Cottidæ**.

Trigla, Artedi.

10. *Trigla hemisticta*, Schlegel.

Trigla hemisticta, Temm. & Schleg. Faun. Japon., Poiss. p. 36, tab. xiv. figs. 3, 4, tab. xiv. B; Günther, Cat. ii. pp. 201, 202.

About forty specimens from Station 96 (98–102 fathoms), many of them being females with mature ovaries. It is remarkable that the largest specimen barely reaches a length of 7 inches.

The original description of the vomerine teeth is "il n'en existe qu'un petit tas," and in these Indian specimens the vomerine teeth are inconspicuous, obsolescent, or even in some cases absent. The intestine is long and convoluted, and there are five large pyloric cæca. The stomachs of the dissected specimens contained *Scopeli*.

Colours in the fresh state:—Head pink, dorsal half of body pink, with large scattered black spots, ventral half silvery white; pectoral interradial membrane dark olive-green, pectoral appendages and ventrals pink; first dorsal fin with a large black patch from second to sixth spines; second dorsal with a longitudinal row of black spots.

Family Gobiidæ.

Gobius, Artedi.

11. *Gobius cometes*, sp. n. (Pl. VIII. fig. 2.)

Tissues fragile; all the fins elongate.

B. 5. D. 6/10 (11). A. 10 (11). L. lat. 23–24.
L. tr. 5–6. C. 18–20. P. 23. V. 1/5.

Head with thin bones and inflated branchial region; its length about one fourth of the total, caudal included, three eighths greater than its height and almost twice its breadth. Maximum body-height about one sixth of the total length, caudal included.

Snout truncated, its breadth much greater than its length, which is two thirds the major diameter of the eye. Eyes large, their major diameter being contained $3\frac{2}{3}$ times in the head-length; they are situated far forwards, on the top of the head, but with lateral visual axis, and are separated by a narrow shallow groove. Mouth with very oblique cleft; the maxilla reaches the vertical through the middle of the eye, and the mandible is hardly prominent; in each jaw an inner band of villiform teeth, and an outer regular row of uniformly enlarged, acute, slightly curved teeth; tongue large and fleshy. Gill-covers large, the suboperculum much larger than the operculum; gill-laminæ broad; gill-rakers small and weak. Scales large (0·23 inch in the vertical, 0·18 inch in the antero-posterior diameter), very finely ctenoid; they cover the crown of the head as far as the eyes, leaving only the cheeks and opercles scaleless; there are five or six rows of scales between the second dorsal and the anal fins.

All the fins are elongated; the second and third dorsal spines are about half as long as the head; the rays of the feathery second dorsal and anal increase in length from before backwards as far as the antepenultimate ray, which is a good deal longer than the head. The caudal is long and pointed, its longest rays, which are on the dorsal aspect, are one third the total length. The ventrals are united, but are not adherent to the abdomen; their length is a little greater than the height of the body. Pectorals with a long fleshy base, their longest (middle) rays are nearly equal to the length of the head.

Intestine short; anal papilla long and slender. A large thin-walled air-bladder is present. Vertebræ 11/13.

Colours in life:—Transparent grey, with seven broad bright-yellow cross bands not quite reaching the abdominal raphe, and the gills showing through the opercle as a bright pink blotch; the second dorsal and caudal fins beautifully pencilled in alternate, narrow, obliquely transverse stripes of black and white; anal with a broad dark border; ventrals blue-black. In spirit, the yellow cross bands almost entirely fade.

Total length 4 to 5 inches.

Hab. Vide Station 96. About 350 specimens of all sizes.

Callionymus, L.

12. *Callionymus carebares*, sp. n. (Pl. VIII. fig. 8.)

Allied to *C. kaianus*, Gthr., from the Arafura Sea.

Head large; tissues delicate.

B. 7. D. 4/9. A. 9. C. 12. P. 21. V. 1/5.

The upcurved branchiostegal rays are prolonged considerably beyond the suboperculum, so that the extreme length of the head is three sevenths of the total without, and about one third with, the caudal. The height of the low cylindrical body is one eighth of the first standard and much less than the height of the head. Eyes large, their major diameter being rather over one fourth of the extreme head-length and one fourth longer than the snout; they are separated by a narrow shallow groove.

Floor of the mouth darkly pigmented.

Preopercular spine upcurved, very fine and acute; its length is two thirds the long diameter of the eye; its base is advanced to form a forward-projecting sharp spine of considerable length; and on its upper border, close behind the angle of the preoperculum, are one or two rather procumbent spinelets.

The gill-opening is not much smaller than the orbit and rather more on the flank than on the top of the head; the branchial arches are slender and flexible, the gill-rakers almost rudimentary.

The skin is loose and very thin. Lateral line single. The first dorsal fin is lower than the second, its flexible spines decreasing in length from before backwards; the height of the second dorsal and of the anal is not quite twice the greatest body-height; the length of the caudal is rather more than one fourth of the total; the pectorals are rather shorter than the ventrals, which are as long as the postorbital portion of the head and reach just beyond the origin of the anal when laid back.

The intestine is convoluted; the anal papilla is very slender, and in the male it is very much longer than it is in the female. Vertebræ 8/13.

Colours in life:—The upper half of the head and body and all the fins range from sepia-grey to blotchy black, and the ventral surface of the body is transparent and colourless; the first dorsal fin has in the male a central black patch, and in the female a central, black, white-edged ocellus.

Total length 5 inches.

Hab. Vide Station 96. About seventy specimens.

ANACANTHINI.

Family Ophidiidæ.

NEOBYTHITES, Goode & Bean.

13. *Neobythites pterotus*, sp. n.

With long feathery pectoral fins which reach to the origin of the anal fin.

B. 7–8. D. circa 120. A. circa 95. V. 2. P. 18. C. 10.

Snout pointed; head and body compressed; tail long and tapering, ending in a long narrow caudal fin, which is free except at its extreme base.

Head with its mucous cavities well developed; its length is about $\frac{3}{7}$ that of the entire trunk, or about $\frac{1}{6}$ of the total without the caudal; its maximum height behind the occiput is more than $\frac{2}{3}$ of its length, or $\frac{10}{13}$ of the maximum body-height; its breadth is nearly half its length; there is a strong acute spine in the upper half of the operculum, but no other armature. Snout pointed, overhanging the mouth; its length, less than its breadth, is $3\frac{6}{7}$ in the length of the head, or twice the major diameter of the eye, which is deeply set beneath the skin without any orbital fold; interocular space convex, $2\frac{1}{2}$ times the diameter of the eye; nostrils very large, one near the tip of the snout, the other at the angle of the eye. Cleft of mouth wide, oblique; maxilla more than half as long as the head, expanded and scaly at its posterior end; in repose the lower jaw is completely included within the upper; villiform teeth in narrow bands in jaws, in a V-shaped patch on the vomer, in broad elliptical bands on the palatines; entire oro-branchial cavity intense black.

Gill-cleft very wide, the membranes being united only quite anteriorly; branchiostegals (in the one specimen obtained) seven on the right side, eight on the left; gill-laminæ very narrow; nine very long scabrous gill-rakers on the middle of the first branchial arch besides rudimentary ones above and below; each pseudobranchia consists of two small pinnules.

Head, body, base of pectoral fin, and basal two thirds of dorsal covered with small adherent scales; between the base of the dorsal and the vent there are thirty rows.

Dorsal fin much higher than the anal; its rays, the longest of which are half the maximum body-height, are imbedded in a thick gelatinous tissue covered with scaly skin, in their basal two thirds. Caudal narrow, its length is a little more than that of the postrostral portion of the head; it projects freely beyond the other vertical fins, with which it is connected only at its base. Pectorals entire, their bases fleshy and free, their rays long and delicate, reaching the origin of the anal fin. The ventrals arise behind and above the pectoral symphysis, their bases separated by an interspace about equal to $\frac{2}{3}$ the diameter of the eye; each consists of two short filaments, of which the outer is a little the longer.

Stomach siphonal; intestine much coiled; no pyloric cæca; air-bladder developed; peritoneum deeply pigmented throughout.

Colours in the fresh state:—Body chocolate; head, abdomen, and all the fins black.

Total length $8\frac{1}{4}$ inches.

Hab. Vide Station 97. Only one specimen.

Bathyonus, Gthr.

14. *Bathyonus glutinosus*, sp. n.

Allied to *Sirembo oncerocephalus*, Vaillant.

B. 8. D. circ. 125. A. circ. 105. V. 1. P. 29–30. C. 10.

Head and body in spirit much compressed, but in the fresh state, owing to the presence of a uniform thick subcutaneous layer of mucus, rounded and subcylindrical; tail long and tapering.

Length of the head greater than that of the rest of the trunk, or about $5\frac{1}{3}$ in the total without the caudal, the length of the entire trunk being about one third of the same standard and $2\frac{7}{8}$ times the maximum body-height or head-depth; anterior third of the head somewhat abruptly depressed, its vertical profile forming an arc of a much smaller ellipse than that of the posterior part of the head. Snout depressed, rounded, somewhat inflated at the tip; its length, which is less than its breadth, is one fifth the length of the head.

Eyes situated in the uppermost part of the anterior third of the head, deep-set, without orbital folds, their major diameter being one tenth to one eleventh of the head-length and one third the width of the convex interocular space. Nostrils large, one at the antero-superior limit of the orbit, the other midway between the first and the tip of the snout. Mouth wide, oblique; the maxilla, which is half as long as the head, completely encloses the mandible in repose; villiform teeth in narrowish bands in the jaws, palatines, and vomer, the last arranged in a V with incurved limbs; oro-branchial cavity jet-black throughout.

Gill-covers large; the preoperculum overlaps large portions of all the other opercular bones, extending almost to the hinder edge of the operculum; the operculum with a feeble flat spur at the postero-superior angle, and another below concealed by the overlying preoperculum; gill-openings very wide, the membranes separate throughout; gill-laminæ narrow; seventeen long scabrous gill-rakers on the first branchial arch, besides some rudimentary ones above; no pseudobranchiæ.

Small, thin, deciduous scales cover the entire head and body behind the snout; there are twenty-five rows between the dorsal fin and the vent. Lateral line indistinguishable.

All the fin-rays delicate. The dorsal and anal fins are thick and fleshy; the highest rays of the dorsal—near the middle of the fin—are higher than the corresponding anal rays, and measure nearly half the maximum body-height; the dorsal begins well in advance of the gill-opening. Caudal very narrow, its length nearly one twelfth of the total; it is confluent with the other vertical fins only at its base. Pectorals entire, pointed, half as long as the head. Ventrals arising at the pectoral symphysis, close together; their single ray is as long as the postorbital portion of the head.

Stomach siphonal; intestine wide, much coiled; no pyloric cæca; liver large; an air-bladder.

The stomach of the dissected specimen contained a Penæid.

Colours in the fresh state: transparent grey; head, belly, and pectorals black.

Length 7 to 8 inches.

Hab. Vide Station 97. Five specimens.

TAUREDOPHIDIUM, gen. nov.

Allied to *Acanthonus*, Gthr.

Head large and thick, armed on the opercles with strong spines; body compressed. Snout broad, not overhanging the large mouth. Eyes none. No barbel. Villiform teeth in the jaws, vomer, and palate. Gill-membranes rather broadly united; four gills; eight branchiostegals; no pseudobranchiæ. Small deciduous scales on body and head; lateral line indistinguishable. Vertical fins confluent; pectorals entire; ventrals widely separated, each consisting of two filaments.

15. *Tauredophidium Hextii*, sp. n. (Pl. VIII. fig. 1.)

The soft tissues comparatively firm, and the bones, except those of the opercles, strong and compact; no eyes; immense spines on the opercles.

B. 8. D. 64. A. 58. V. 2. P. 18. C. 10.

The trunk much deeper and broader than the tail, its length being $2\frac{1}{2}$ in the total without the caudal and its height about $4\frac{1}{2}$ in the same; the tail low, compressed and acuminate.

Head broad, pyramidal, its dorsal outline rising straight from the tip of the snout to the occiput at an angle of nearly 45°; its length is about one fourth of the total without the caudal, its height about $\frac{7}{8}$, its breadth about $\frac{2}{3}$, of its length; the cranial bones are compact and resistant, forming a sort of buckler in the broad frontal region; the preoperculum and operculum have each an independent lateral ginglymoid motion, allowing the erection of the enormous grooved spines with which these bones are armed; the operculum, which is a short narrow bone, carries at its postero-superior angle a single straight retrorse spine, measuring half the length of the head; the preoperculum bears three spines, which radiate from its angle, the middle one being the longest and nearly three fourths the length of the opercular spine; the occipital crest projects subcutaneously as a coarsely pointed eminence, and behind it the stout, elongate, first (?) neural spine projects similarly but even more conspicuously. The snout is broad and rounded, and does not overhang the mouth. The eyes are completely atrophied; the small orbital cavities are hidden beneath thick scaly skin, and are filled with connective tissue, deeply imbedded in which is a small pigmented ocular bulb about the size of an ordinary pin-head. Nostrils large. Muciferous cavities of snout and mandible well developed and opening to the exterior by pores. Mouth large, its cleft nearly horizontal; maxilla more than half the length of the head, much expanded behind, protractile, completely including the lower jaw in repose; labial fold absent on the upper, rudimentary on the lower jaw. Teeth in narrowish villiform bands in jaws, vomer, and palatines. Tongue large. Oro-branchial cavity intense black throughout. Gill-opening moderately wide, the membranes rather broadly united below the isthmus anteriorly; gill-laminæ very narrow; ten long pointed scabrous gill-rakers on the first branchial arch, besides some rudimentary ones above and below.

Head and body covered with small deciduous scales; apparently 22 rows between the dorsal fin and the vent. Lateral line indistinguishable.

Vertical fins united; the dorsal begins just behind the vertical through the base of the pectoral, its longest rays—about the middle of the fin—are rather over one third the maximum body-height and exceed the corresponding anal rays in length. Caudal long and pointed. Pectorals entire, pointed, as long as the head without the operculum. Ventrals jugular, arising from bony bases which are distant by a wide interspace equal in width to one third the length of the head; each consists of two filaments, of which the inner is much the longer, reaching beyond the origin of the anal fin.

A bunch of about six slender cæca situated above the pylorus. Air-bladder present.

Colours in the fresh state:—Uniform chocolate; fins blackish; throat and belly black, owing to the pigmentation of the peritoneum.

Total length $4\frac{1}{10}$ inches.

Hab. Vide Station 97. Three specimens.

When brought on board the skin of the head was injected and spotted with small capillary hæmorrhages.

Family **Macruridæ**.

Macrurus, Bloch.

Subgenus Macrurus, Bloch.

16. *Macrurus Hoskynii*, sp. n.

B. 6. D. 11. A. circ. 90. V. 9. P. 19–20.

Length of the head about one fifth of the total, its height about two thirds, its breadth not quite half, its length. Snout subtrihedral, its length almost equal to the diameter of the large circular eye, which is about one fourth the length of the head; interorbital space slightly convex, its width one fourth greater than that of the eye. Nostrils close together in front of the angle of the eye, the posterior very large. Mouth small, completely inferior, the infraorbital ridge being most distinct; the maxilla reaches a short way behind the vertical through the anterior border of the orbit. Teeth in broad bands in both jaws, villiform in the lower, cardiform in the upper. Barbel barely one fourth the length of the eye.

Gill-opening narrow, the gill-membranes being broadly united; synarthrosis of first branchial arch and gill-cover very broad; gill-laminæ narrow; oro-pharyngobranchial cavity uniformly deeply pigmented.

Body and head, except the jaws and the glosso-hyal region, covered with spinigerous, imbricating, rather deciduous scales. Those on the body are of uniform large size ($\frac{5}{24}$ of an inch in either diameter), imbricate in the anterior two thirds and upper and lower fifth, and longitudinally fluted throughout their free portion, the ridges between the grooves bearing spinelets along the greater part of their length. On a scale from the flank there are usually thirteen such ridges, of which all but the outermost are spiny, the spinelets of the central ridge being superior in size to all the others, and they alone project beyond the edge of the scale. The lateral line runs five rows of scales below the origin of the first dorsal fin.

First dorsal spine rudimentary; the second prolonged into a filament and almost as long as the head, its front edge armed with about thirty decumbent spinelets; the second dorsal fin begins about a snout-length behind the first, its rays being very inconspicuous. Pectoral short, its length being less than half that of the head; somewhat rounded. Ventrals with the first ray prolonged into a filament, the entire ray being nearly as long as the second dorsal ray.

Stomach siphonal. Intestine long and much coiled; nine pyloric appendages. A large air-bladder.

Colours in the fresh state:—Chocolate; the jaws, gill-covers, belly, and fins black.

Total length 14¼ inches.

Hab. Vide Station 97. One specimen.

Macrurus Hoskynii—named after the accomplished Superintendent of the Indian Marine Survey—appears to be allied to *Macrurus asper* and to be one of the known bathybial Macruri. It is the deepest-water species yet obtained in the Bay of Bengal, and it seems significant that it is the largest. The specimen described emitted a powerful and disagreeable musky odour when in the fresh state.

Family **Pleuronectidæ.**

SCIANECTES, Alcock.

Scianectes, Alcock, Journ. As. Soc. Bengal, vol. lviii. pt. ii. p. 284.

This genus was established to include two Indian species (*Sc. lophoptera* and *Sc. macrophthalmus*), taken in 68 to 100 fathoms by the 'Investigator,' and represented at the time by only three small specimens. The 'Investigator' has since collected several fine specimens of *Sc. macrophthalmus,* from the examination of which several errors in the original diagnosis have been detected.

I beg now to amend that diagnosis and to place *Scianectes* in what now appears to me to be its proper position, near *Lœops*, Gthr.

Cleft of the mouth narrow, the maxillary being less than a third the length of the head, with the dentition much more developed on the blind side. Vomerine teeth present. The dorsal fin commences before the eye on the snout. Eyes on the left side, close together. The rays of the vertical fins simple, elongated, weak, and filamentous. Scales minute, very deciduous. Lateral line with a curve above the pectoral. Gill-membranes united at the throat.

17. *Scianectes macrophthalmus*, Alcock.

Scianectes macrophthalmus, Alcock, J. A. S. B. vol. lviii. pt. ii. p. 292, pl. xvi. fig. 4; and Ann. & Mag. Nat. Hist. November 1889, p. 398.

B. 6. D. 85–88. A. 68. L. lat. circ. 95.

Body pyriform, very delicate, its height about $2\frac{1}{2}$ in the total without caudal. The length of the head is one third of the same standard and rather less than its height. Snout obtuse, about half as long as the eye. Eyes on the left side, close together, separated by a salient decliving ridge, the lower slightly in advance; their major diameter about one fourth the length of the head. Cleft of the mouth nearly vertical; length of the maxilla a little more than one fourth that of the head; the lower jaw projecting in repose. Villiform teeth in a band on the blind side of each jaw and in a patch on the vomer.

Gill-cleft very high; the opercles thin and the branchiostegal rays prolonged; gill-membranes broadly united; gill-rakers distant, small, lanceolate.

Scales minute, thin, smooth, deciduous. Lateral line salient, curved above the pectoral, continued right along the caudal fin.

The dorsal fin commences on the blind side of the snout in front of the level of the eye, its longest rays (just behind the middle of the fin) are not quite half the length of the head and are slightly shorter than the corresponding anal rays. The pectoral fin is more developed on the coloured side, where, if laid forward, it reaches to the posterior border of the lower (anterior) orbit. Ventrals six-rayed, the left wider than the right. Caudal pointed, with 17 rays, its length nearly one fifth of the total.

Colours in the fresh state:—Left side dark sepia; vertical fins and left ventral black; left pectoral grey in its basal third, black in its distal two thirds; branchiostegal fringe on the left side black, right side unpigmented.

Originally obtained in 100 fathoms, 40 miles S.W. of Akyab; now from Station 96, where eleven specimens (the longest $4\frac{3}{4}$ inches) were taken.

Cynoglossus [Hamilton-Buchanan].

18. *Cynoglossus Carpenteri*, Alcock.

Cynoglossus Carpenteri, Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. p. 287, pl. xviii. fig. 1.

Several hundred specimens were taken at Station 96 (98–102 fathoms), many of them being mature females. The general *facies* of this fish is certainly bathybial.

Physostomi.

Scopelus, Gthr.

19. *Scopelus* (*Myctophum*) *pterotus*, sp. n.

D. 11–12. A. 17. L. lat. circ. 30. P. 15. V. 8.

Body compressed, with the posterior half much lower than the anterior; its greatest height just over one fourth of the total without the caudal, its least height, midway between the adipose dorsal and the base of the caudal, one third its greatest height at the shoulder.

Head large, its length a little more than one third the total without the caudal, its height two thirds its length. Snout obtuse, symmetrically rounded, its depth more than three times its length, which is less than half the diameter of the eye. Eye circular, moderately large, its diameter being one third the length of the head; the posterior border of the orbit is half an eye-diameter distant from the vertical border of the preoperculum; no spine above the orbit; interorbital space less than a diameter of the eye in width anteriorly, more posteriorly. Mouth large, moderately oblique; the jaws perfectly equal in repose; the maxilla reaches the preopercular angle and is dilated at its hinder end; no vomerine teeth. Opercles large; the operculum produced into a membranous spur behind; the vertical border of the preoperculum very obliquely recurrent.

Scales extremely deciduous, smooth, cycloid, their average diameter one twelfth of an inch.

The dorsal fin begins nearer to the tip of the snout than to the base of the caudal, but behind the bases of the ventrals, which are much advanced, its last ray falls in the vertical through the first or second anal ray; adipose dorsal entire. Pectorals long, extending to the first or second anal ray.

Luminous organs:—A lateral series extending close to the mid-ventral line from the isthmus to the base of the caudal, and numbering four to base of ventral, three more to origin of anal, ten more to hinder end of anal, and one more at base of caudal; above this rectilinear series are the following, rather more diffused—one at the angle of the preoperculum, two along the edge of the gill-opening, one on the base of the pectoral, two on the base of the ventral, three in a straight line along the middle of the flank, and three along the middle of the tail; no luminous organ on the back of the tail.

Nine pyloric cæca. A well-developed air-bladder.

Colours in the fresh state:—Uniform silvery, with thickly scattered black specks; opercles, iris, and first branchial arch burnished silver.

Total length $1\frac{7}{8}$ inch.

Hab. Vide Station 96. About sixty specimens, many of them being mature females.

20. *Scopelus pyrsobolus*, sp. n. (Pl. VIII. fig. 3.)

D. 12. A. 13. P. 12. V. 8.

Head large; body compressed.

Length of the head, not including a membranous expansion of the suboperculum which reaches considerably beyond the root of the pectoral fin, $2\frac{6}{7}$ in the total without the caudal. Greatest height of the body or of the head not quite one fourth of the same standard, its least height behind the adipose dorsal $2\frac{1}{2}$ in the greatest.

Snout almost obliterated by the encroachment of the large eye; it is rounded, with the jaws exactly equal and opposed throughout; its length is one fourth the diameter of the eye.

Eye large, circular, bulging beyond the dorsal profile of the head; its diameter is one third the head-length as above limited; its *least* distance from the vertical border of the preoperculum is equal to half its diameter; supraorbital margin smooth; interorbital space anteriorly $\frac{1}{2}$, posteriorly $\frac{3}{2}$, the diameter of the eye. Mouth wide, oblique, the jaw-bones thin and weak, the maxillary slightly expanded behind and not reaching as far as the preopercular angle; villiform teeth developed on the vomer. Opercles large but extremely thin; the operculum and suboperculum both with membranous prolongations backwards; the vertical border of the preoperculum obliquely recurrent.

Owing to the almost complete denudation of the integuments the nature of the scales cannot be determined.

The dorsal fin begins to arise nearer to the tip of the snout than to the base of the caudal by a distance about equal to half the length of its own base, and its first ray is almost in the vertical through the origin of the ventrals; the entire fin is nearly one third the length of its base in advance of the anal fin; adipose dorsal well developed. The pectorals reach at least behind the sixth anal ray. The ventrals are broad.

The luminous organs have been too much damaged for description; two series, traversing the ventral half of the body on each side, still remain; two long luminous organs occupy respectively the mid-dorsal and mid-ventral line close to the base of the caudal.

About five large pyloric cæca; a well-developed air-bladder.

Colours in the fresh state:—What was left of the integument was jet-black, like the entire oro-pharyngeal cavity; iris and antero-inferior part of opercles burnished silver, the latter in the evening twilight emitting brilliant coruscations of greenish-blue light.

Total length without the caudal $3\frac{1}{12}$ inches.

Hab. Vide Station 102. One mature female specimen.

The shattered condition of this fish proved that it had been dragged up through a a great depth of water; and its *facies* is typically bathybial.

21. A third species of *Scopelus*, taken from the stomach of a *Trigla hemisticta*, must be mentioned, as it cannot be included among any of the species to which I have had literary access.

Its radio-squamal formula is:—D. 11. A. 14. P. 12? V. 8. L. lat. 32.

Its eye is not quite one third the length of the head, the scales are smooth and of a uniform size, the pectorals are minute and the ventrals singularly large, and there is a conspicuous luminous organ immediately in front of the eye; the dorsal fin is nearer to the snout than to the base of the caudal and entirely in front of the anal. But the single specimen has been too much damaged to become the type of a new species and the subject of a description.

Family **Stomiatidæ**.

Thaumastomias, gen. nov.

Allied to *Malacosteus*, Ayres.

Body elongate, compressed, scaleless, with the vent not far distant from the caudal fin. Head compressed, with the cranium small, the snout short, and the cleft of the mouth exceedingly wide. A long elastic muscular band passing from the hyoid bone to the inner aspect of the mandibular symphysis. Teeth acute, unequal, in single series in premaxillæ, maxillæ, mandibles, and palatines; none on the tongue. Eye moderate. Gill-covers rudimentary. One dorsal fin opposite to the anal, situated in the posterior fourth of the body, near the caudal. No pectoral fins. Ventral fins situated in the anterior half of the body. Gill-openings very wide. No air-bladder.

22. *Thaumastomias atrox*, sp. n. (Pl. VIII. fig. 7.)

Head small, mouth extremely wide. Body elongate, low, compressed, not diminishing much to the origin of the vertical fins, but there rapidly and symmetrically narrowing to the caudal peduncle, which is not quite one fifth the body-height in depth.

D. 23. A. 25. C. circ. 25. P. 0. V. 6.

Length of the head one fifth, height of the body one tenth, of the total without the caudal.

Snout truncated, broad, with a slightly concave vertical profile, its length one third the diameter of the eye. Eye large, circular, its diameter about one fourth the length of the head; interorbital space wider than the eye, convex. On each side there is a small luminous organ, about the size and shape of a caraway-seed, below and partly in front of the eye, and another large salient slipper-shaped one, in length more than one third the length of the head, lying parallel with the upper jaw behind the eye. Mouth enormous, its cleft as long as the head; its floor is completely wanting except at the extreme anterior limit, its place being taken by a long elastic muscular band which extends from the tip of the hyoid to the inner surface of the mandibular symphysis; the mouth-cleft and the gill-cleft being thus continuous beneath almost divide the head from the rest of the body; the lower jaw projects beyond the upper. Teeth, everywhere except in the maxilla, in the form of slender acute rigid fangs; in each premaxilla laterally eight or nine, with three remote stouter ones at the symphysis; in each half of the mandible laterally an uneven row of over twenty, with five (one median flanked on each side by a pair) of superior size at the symphysis; in each palatine a row of seven or eight, increasing in size from before backwards, and a patch on the upper pharyngeal bones; maxillary teeth in the form of even, close-set, recurved serrations, of which there are over thirty in each bone.

Gill-cleft extremely wide and oblique, its antero-superior limit being above the middle of the eye; gill-cover reduced apparently to a narrow straight preoperculum, very obliquely articulated, furnished with a narrow membranous fringe; four branchial arches, extremely weak and flexible, bearing very narrow laminæ; gill-rakers rudimentary.

Body scaleless. Skin thick, soft, velvety, and uniformly covered with adherent tenacious mucus; apparently no lateral line. Besides the large luminous glands already described, there are two regular rows of minute luminous organs along the ventral half of the body on each side: the upper, numbering about fifty, extending from the gill-opening to the base of the caudal; the lower, numbering about forty, skirting the ventral profile from the isthmus to the fifth anal ray; a few similar luminous organs on the crown of the head.

The dorsal fin begins slightly in advance of the posterior fifth of the body, and is equal and opposite to the anal. The longest (central) anal rays are a little longer than the corresponding dorsal rays, and are equal to the depth of the tail at their point of origin. The caudal is deeply forked, with the lower lobe the broader and longer and about $\frac{1}{22}$ of the total length.

Pectorals absent. The ventrals arise in the anterior half of the body, their point of origin being $1\frac{1}{3}$ times as far from the vent as from the margin of the gill-cleft; the two outer rays are thickened, coherent throughout, and prolonged, their length being two fifths of the total length including the caudal; the inner rays are short and weak.

Stomach siphonal, its *cul-de-sac* extending halfway along the abdominal cavity; intestine straight, opening at the origin of the anal fin; apparently no pyloric cæca. No air-bladder.

Colours in the fresh state, as in spirit, intense black.

The small luminous organs were not distinguishable through the enveloping mucus until after immersion in spirit; but the large postocular organs were very conspicuous, that on the right side being bright rose-pink, while that on the left side was covered, except round its lower edge, which showed as a silvery streak, with deeply pigmented cuticle.

Total length $4\frac{7}{8}$ inches.

Hab. Vide Station 97. One specimen, which was quite dead when brought to the surface.

The other Physostomes obtained were (23) *Gonostoma microdon*, Gthr., at Station 101, and (24) *Chauliodus Sloanii*, Bl. Schn., at Stations 101 and 103.

The largest *Chauliodus*—a female with gravid ovaries—measured nearly 9 inches.

In concluding this paper I should like to express once again my deep obligations to my friend Professor J. Wood-Mason, of the Indian Museum.

EXPLANATION OF PLATES VIII. & IX.

Fig. 1. *Tauredophidium Hextii*, ♀.
Fig. 2. *Gobius cometes.*
Fig. 3. *Scopelus pyrsobolus*, ♀.
Fig. 4. *Brephostoma Carpenteri.*
Fig. 5. *Ponerodon vastator.*
Fig. 6. *Paroneirodes glomerosus.*
Fig. 7. *Thaumastomias atrox.*
Fig. 8. *Callionymus carebares*, ♀.

XXVII.—*British Fossil Crinoids.*—III. Thenarocrinus callipygus, *gen. et sp. nov.*, *Wenlock Limestone.* By F. A. Bather, M.A., F.G.S.

[Plate X.]

In pursuance of the intention expressed at the end of Paper I., I now enter on the description of the Fistulata from the Wenlock Limestone; and the first to be dealt with is an interesting genus, which has not yet been described, but which has been alluded to in Paper II. under the name of *Thenarocrinus*.

The specimens on which the following description is based are as follows:—

In the British Museum:

48049, a perfect specimen from root to crown, seen from anterior; bought of Mr. B. M. Wright. (Pl. X. fig. 4.)

57478 *a*, crown and 1 inch of stem, seen from R. side, anal plates just shown on L. of specimen; bought of Mr. S. Allport. (Pl. X. fig. 3.)

57478 *b*, crown and $\frac{1}{4}$ inch of stem, seen apparently from L. side; arms broken at postpalmars leave ventral sac exposed; bought of Mr. S. Allport. (Pl. X. fig. 5.)

In Dudley Museum:

One specimen; arms preserved up to postpalmars; cup crushed; about 2 inches of stem, somewhat broken; orientation uncertain. (Pl. X. fig. 7.)

In Mason College Museum, Birmingham:

138, crown and $\frac{1}{8}$ inch of stem, seen from posterior; arms broken off after postpalmars, showing $\frac{1}{2}$ inch of ventral sac; rest of sac broken away; cup fractured. (Pl. X. fig. 8.)

144, crown and $\frac{1}{2}$ inch of stem, free from matrix, flattened in antero-posterior plane; arms preserved up to postpalmars 4 *; on R. side ventral sac shows through arms. (Pl. X. fig. 1.)

153, crown and $\frac{3}{8}$ inch of stem, free from matrix except at distal ends of arms; much rolled but not flattened, cup fractured. (Pl. X. fig. 2.)

These three specimens were in Mr. Charles Ketley's collection.

In the collection of William Madeley, Esq., of Dudley:

One specimen, seen from anterior; arms preserved up to postpalmars 3; $1\frac{1}{8}$ inch of stem, slightly crushed. (Pl. X. fig. 9.)

In the collection of Charles Holcroft, Esq., of Kingswinford, near Dudley:

293, a young specimen; crown and $\frac{3}{4}$ inch of stem, seen from

* I use the expression "postpalmars 2, 3, 4 &c." for postpalmars of the second, third, fourth, and subsequent series. "Postpalmars" alone signifies the first series.

L. posterior side; distal ends of arms worn away. (Pl. X. fig. 6.)

431, a much weathered crown, greatly crushed in the transversal (or lateral) plane; free from matrix.

For the ready loan of the specimens in their possession my best thanks are due to Mr. Holcroft and Mr. Madeley. I have also to thank Mr. Madeley, in his capacity as Secretary of the Dudley and Midland Geological Society, for lending the specimen belonging to the Dudley Museum. For furnishing the specimens from the Mason College Museum, Prof. Charles Lapworth is to be thanked. Finally, for permission to figure the specimens in the National Collection, I am indebted to Dr. Henry Woodward, F.R.S.

These specimens all appear to come from the Upper or "Thin" bed of the Wenlock Limestone of Dudley, concerning which I am favoured by Mr. Madeley with the following note:—"This bed is far more prolific of Crinoids, both as to number and variety, than the Lower or 'Thick' bed, and all those well-preserved specimens where the fossil lies on a thin bed of fine shale on the top of the limestone come from this Upper or Thin bed of the Limestone."

Generic Diagnosis.

IB. 5; B. 5; R. 5; Arms simple, dichotomous; R′ in Basal circlet, resting on r. post. IB.; × rests on post. B. and R′, and only just reaches top of Radial circlet.

This arrangement of the anal plates, combined with the great proportional width of all the other plates of the dorsal cup and with the flat broad backs of the proximal arm-ossicles, produces a very flat appearance, and the fossil, as it lies stretched on the rock, resembles the outspread palm of a hand; hence the proposed generic name, from *θέναρ*, the palm.

Since all the above-mentioned specimens appear to belong to one species, the foregoing characters are the only ones that can be definitely taken as generic, and the following detailed description applies to both genus and species.

Detailed Description.

Dorsal cup, broad and composed of thin plates. Specimens 48049 B. M., 57478 *a* & *b* B. M., 138 Mason College, 144 Mason College, Dudley, and Madeley give the following average measurements:—Breadth at base 7·14 millim.;

breadth at summit 16·57 millim.; height of cup 8·71 millim. Specimen 293 Holcroft has—breadth at base 4·5 millim.; breadth at summit 10 millim.; height of cup 5·5 millim.: these proportions are practically the same as those of the mature individuals. But since all these specimens are more or less flattened the proportions are not those of the cup in life; nevertheless they will be found characteristic of most of the fossils, and it must be remembered that this flattening is itself largely due to the structure of the cup. The proportion of the cup in life may be gathered from the uncrushed specimen 153 Mason College, of which the mean measurements are:—Breadth at base 9 millim.; breadth at summit 15 millim.; height of cup 11 millim. This cup is larger than the others, but, taking its proportions as correct and reducing them, we find that the mean measurements and true proportions of the dorsal cup are:—Breadth at base 7·14 millim.; breadth at summit 11·9 millim.; height of cup 8·73 millim. Consequently the angle which the side of the cup makes with the long axis is about $9\frac{2}{3}$°.

Infrabasals, 5; pentagonal, except r. post. IB., which is hexagonal owing to truncation of distal angle; mean measurements—greatest width 5 millim., height 3 millim. Measurements in 293 Holcroft—width 3·25 millim., height 1·8 millim.

Basals, 5; hexagonal; mean measurements, 6 millim. wide by 5 millim. high; width of l. post. B. about 1 millim. less, while r. post. B. is a little distorted. In 293 Holcroft the normal basals are about 4 millim. wide by 3 millim. high.

Radials, 5; in general outline pentagonal, or more accurately a hexagon of which the distal angle is truncated by a wide reëntrant curve for the articulation of the first costal; mean measurements—width 7·3 millim., height, from proximal angle to middle of articular curve, 3·5 millim. In 293 Holcroft a fracture crosses the radial circlet, but the measurements appear to be about 4 millim. wide by 2·5 millim. high. The curve varies in width, sometimes occupying almost the whole width of the radial, but never quite so little as two thirds of its width. On either side of the facet the distal portions of the radial bend inwards to meet the tegmen.

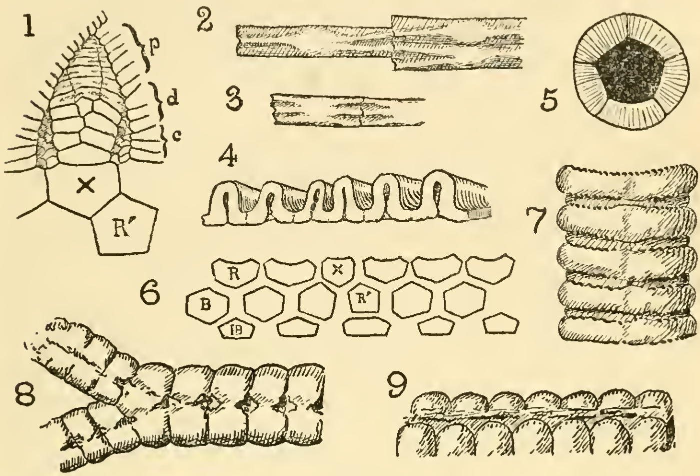
Arms, to judge from specimens 4809 and 57478 *a*, about seven times as long as height of cup: seen from outer or dorsal surface, appear broad and flat-backed in the proximal regions; but undergo rapid dichotomy, and, as the ossicles of each series are about five-sevenths the width of those in the preceding series, in the distal regions are remarkably attenuate, being ·16 millim. wide. In 57478 *a* the free brachials are postpalmars of at least the sixth series; in other words the dichotomy is seen to take place at least 8 times, so that the final branches of the arms can have numbered no less than 1280, and were probably nearer 2000. The ossicles are of peculiar shape; even in the more proximal series their sides are seen to curve round in a curious manner towards the ventral surface, as is well shown by specimen 57478 *b*; and, as dichotomy progresses and the transverse axis of the ossicles shortens, the dorso-ventral axis becomes much longer, so that in the first postpalmars the ratio of depth to width is as 5 to 3, and in the third postpalmars as 7 to 3; this is clearly seen in specimen 144 Mason College (Pl. X. fig. 1). In most specimens the backs or outer portions of the arms present a continuously smooth appearance, but in others the edges of the ossicles are more rounded, inducing a slightly moniliform aspect; the smoothness may therefore be due to attrition. Be this as it may, there can be little doubt but that the arm-ossicles are more ridged at the sides of the arms than on their backs, and this in such a manner that the greatest transverse diameter of each ossicle is towards its upper or distal end, and towards its ventral surface. The condition of the specimens does not permit the direct demonstration of a dorsal canal; but that such existed seems certain not only from the shape of the ossicles, but also from the fact that in much weathered specimens a groove is formed in the median line on the dorsal surface; this is best shown by specimens 138 Mason College and 431 Holcroft (Diagram 8). The ventral surface of the arms is partially exposed in specimen 57478 *b*: the covering-plates are no longer *in situ*, and the food-groove, which is rather shallow in proportion to the depth of the ossicles, is clearly seen; on either side of it the ventral edges of the ossicles rise up like little rounded teeth (Diagram 9).

Costals, 3 to each ray; in two instances out of the twenty-seven counted there appear to be 4; all of the same width, which is always more than two thirds that of the radial; height from 1 to 2 millim. according to size of specimen. The upper and lower edges of the second costal are straight and parallel; the lower edge of the first costal is curved conformably with the articular facet of the radial; the lines containing the axillary angle of the third costal are concave. The upper and lower edges of the costals are slightly bevelled on the outside, indicating that these ossicles were united by loose suture.

Distichals vary in number in the different specimens, and, to a less extent, in different branches of the same specimen; 19 branches have been observed with 4 distichals apiece, 11 with 5, 2 with 6, 1 with 7, and in the young specimen, 293 Holcroft, one branch has only 3.

Palmars vary quite irregularly from 4 to 10.

The various series of Postpalmars are likewise irregular in number, the observed extremes being 6 and 18, and the average about 14.



DIAGRAMS OF THE STRUCTURE OF *THENAROCRINUS.*

Diagr. 1. The anal plates and lower part of the ventral sac, composed from the evidence of six specimens. R′ = Radianal, × = Brachianal, c = Costals, d = Distichals, p = Palmars. (× 2.)
Diagr. 2. Plates from halfway up ventral sac. (× 4.)
Diagr. 3. Plates from distal end of sac. (× 4.)
Diagr. 4. Edges of plates in ventral sac, to show folding. (× 5.)
Diagrams 2, 3, and 4 are all taken from specimen 57478 *b.*
Diagr. 5. Section of stem showing sutures, large pentagonal lumen and articular radiating striæ. (× 3.)
Diagr. 6. Dissection of dorsal cup. (Nat. size.)
Diagr. 7. Some proximal stem-ossicles of 293 Holcroft, showing alternation of size, and irregularity of growth indicating a radial suture. (× 4.)
Diagr. 8. Weathered arm-ossicles of 138 Mason College, with indications of an axial canal, seen from dorsal surface. (× 6.)
Diagr. 9. Ventral surface of arm, showing rounded elevations, from 57478 *b.* (× 12.)

A rough calculation from these data makes the total number of arm-ossicles 48,290. Parkinson* calculated the ossicles of the arms and pinnules in *Encrinus fossilis*, Blumenbach (=*E. liliiformis*, Lamarck), as 26,660, but half that

* ‘Organic Remains &c.,’ ii. 181 (London, 1808).

number would be more correct. This comparison shows the greater extent of food-collecting surface possessed by the older and non-pinnulate form: the advantage of *Encrinus* lies of course in its greater compactness. Neither of these calculations takes into account the covering-plates, the addition of which would treble or quadruple the numbers.

Anal structures:—Radianal (R′), an irregular pentagon, the greatest width of which is equal to its greatest height; rests on r. post. IB., between post. B. and r. post. B.; supports on its right upper side part of r. post. R., and on its left upper side the Brachianal.

Brachianal (×) rather wider than high, in outline like a radial, the distal edge forms the longest side; rests on post. B and R′; is bounded on left by l. post. R., and on right by r. post. R.; supports in the middle a wide low plate, which we may regard as a second brachianal; and on either side is touched by smaller plates which are probably derived from the tegmen.

This disposition of the anal plates is best shown by the Mason College specimens 138, 144, and 153, and by 431 Holcroft; it is seen, but owing to fracture not so clearly, in 293 Holcroft. The diagram of *Thenarocrinus* that forms fig. 14 of plate xiv. in the first half of Paper II. ('Annals,' ser. 6, vol. v. April 1890) was constructed from the evidence of the British Museum specimen 57478 *a*; since this fossil is much flattened the anal plates, which occur at its extreme edge, are displaced and fractured, so that the diagram, though correct in the more important points, is not absolutely accurate as to details (*cf.* Diagram 6).

The connexion of the ventral sac with the anal plates is seen in specimens 57478 *a* B. M., 138, 144, and 153 Mason College, and in 293 and 431 Holcroft. No one of these specimens shows all the details, besides which they vary slightly, but all conform in essential structure with Diagram 1. The Second Brachianal rests on the first brachianal just as the costals rest on the radials; it is pentagonal and axillary *. The plates of the ensuing distichous series alternate slightly, the suture separating them being a zigzag and the plates consequently hexagonal. The second plate of the right-hand series is axillary, and it is probable that the same is the case with the similar plate on the left. The tetra-

* Dr. P. H. Carpenter (Ann. & Mag. Nat. Hist. [6] vi. pp. 19, 20, July 1890) will not permit the epithet "axillary" to be applied to anything but an *arm*-ossicle giving rise to *arm*-branches. Such restriction of a word so common in scientific description would be vexatious were it not needless. An axil lies where an organ is given off from an axis, and "axillary" should have no deeper morphological significance.

stichous series following would thus correspond to the palmars of an arm. Hitherto the plates have been smooth externally; they now develop ornament: at the same time, by lessening in height and by gradually coming into a line with one another, they exchange their hexagonal shape for a transversely elongate quadrangle. The ornament is produced by the folding of the side-edges of each plate, while the middle remains unaltered, or is raised into a slight hump: the folds of one plate meet those of the plates on its right and left so exactly that in undisturbed parts it is very hard to see the sutures.

The upper part of the sac, in which the foregoing structure is more developed, may be best studied in specimens 57478 *b* and 138 Mason College. The ventral sac is nearly as long as the arms, very wide in its lower part, but contracting above. It belongs to the type described by Prof. H. Trautschold * under the head *Angulosi*, which is the common type in the Fistulata. The raised middles of the broad plates, lying one above the other, form longitudinal ridges, which, as in *Scaphiocrinus multiplex*, Trd., sp., appear to be eight in number. That three of these ridges arise by dichotomy from the brachianal series is certain; that another does is probable; that the others do is possible but uncertain. The depressed tracts between the ridges are occupied by the transversely folded portions of the plates. The anticlinal folds resemble fingers stretching out from the middle of the plate to meet fingers from an adjoining plate; there may be one, two, or three of these fingers on either side of each plate, but the higher numbers are chiefly found in the proximal and distal regions of the sac (Diagrams 2 & 3). The synclinal folds appear as grooves, which are filled with matrix: hence they look like transverse slits proceeding on either side from the suture-line; but wherever the matrix can be cleared away—a task demanding time and trouble—the floor of the groove is seen to be formed by the solid plate. A natural section, produced by fracture along the suture-line, in 57478 *b*, likewise shows that all the appearances are produced by simple folding of the plates (Diagram 4). Nor can pores of any other kind be detected. In general appearance the ventral sac remarkably resembles a wickerwork basket: the beauty of its structure, its large size, and the extreme development of the anal plates suggest "*callipygus*" † as an appropriate specific name.

* "Ueber den muthmasslichen Geschlechtsapparat von *Poteriocrinus multiplex*, Trd.," Festschrift k. Gesell. Naturforscher, Moscow, 1882.

† καλλίπυγος, an epithet of a statue of Venus, derived from κάλλος, beautiful, and πυγή, the posteriors.

The Tegmen is partially visible between the arms and on either side the origin of the ventral sac, in 57478 *a* and *b* and 153 Mason College. The portions observed are composed of small plates of various sizes in which no definite arrangement can be distinguished. The tegmen was evidently flexible, and stretched up the arms, in some cases, if not in all, to the end of the distichals (Pl. X. fig. 5 and Diagram 1).

The Stem is almost perfect in specimen 48049 B. M. Here its length is 19·5 centim., or about $7\frac{3}{4}$ inches. It has a breadth of 5 millim., which at the proximal end widens to 7 millim. The distal end is imbedded in a congeries of fragments which seem to have belonged to radical cirri. It is round except at its extreme proximal end, where it tends to become pentagonal, with its angles, as in all Dicyclica, interradial. The ossicles are only ·25 millim. high at the distal end, *i. e.* 100 run to the inch; they gradually increase in height, till, about halfway up the stem, they are two to the millimetre: here, however, an alternation of size sets in, which increases as the proximal end is approached, so that in that region the large ossicles are twice as high as the small ones. At the same time the ossicles become more ridged, and the alternation of size increases the effect of the ridging. The articular surfaces of the ossicles were, as indicated by specimen 144 Mason College, covered with fine radiating ridges. The lumen was circular or slightly pentagonal with radial angles. In specimen 57478 *a*, where, at 25 millim. from the calyx, the diameter of the stem is 5 millim., that of the lumen is 3 millim.; in 57478 *b*, at 5 millim. from the calyx, where the diameter of the stem is 7 millim., that of the lumen is 4 millim. (Diagrams 5 & 7).

Owing to the large size of the lumen, the stem is often flattened, and this in many cases has produced cracks in the stem. These cracks do not, however, appear to be merely accidental. They are invariably radial in position, and continue for long distances; this is well shown in 48049 B. M. and in Mr. Madeley's specimen. In 48049, although the stem is hardly if at all crushed, two such radial cracks may be traced from the distal end for 15 centim., or nearly 6 inches, along the stem; they are especially clear at the distal end. It seems therefore pretty certain that these cracks represent sutures: in all Dicyclica with a quinquepartite stem the sutures are radial. It is true that a thin section of the column of 57478 *a* does not show them; but here they have probably been obscured by fossilization. On the other hand in uncrushed stems a certain want of continuity in the ridges of the ossicles along radial lines is often observable, as in 293 Holcroft and 138 Mason College (Diagram 7).

The Dudley specimen shows slight longitudinal ridges on its stem, especially at the proximal end; and these as they cross the transverse ridges of the ossicles produce a slight cancellated pattern (Plate X. fig. 7). For the present, at all events, it is best to regard this as a mere individual variation.

General Remarks.

The most interesting feature of this genus is that in which it differs from other Fistulata, namely the low position of the Radianal. Indeed this one point alone separates it from nearly all other Crinoids, and appears of still further importance in connexion with various utterances of Messrs. Wachsmuth and Springer. Criticising the description of *Carabocrinus* by E. Billings, they wrote: "The anal area, ... according to Billings, is composed of three plates, the lower one resting upon the underbasals, which is in itself an anomaly such as is found in no other genus" *. For the same reason they denied the correctness of Angelin's description of *Sagenocrinus*, saying, "Angelin gives the number of basals (parabasals) as six, which is evidently a mistake, nor do we believe that the sixth plate represents an anal plate, as no plate of that kind has ever been observed below the line of radials" †. Again in 1885 they wrote with even more decision, "There is not a single instance of Crinoids known to us where either a radial or an anal plate entered the basal ring" ‡. There does not, however, seem to be any morphological objection to the sinking of an anal plate into the basal circlet, and in fact Messrs. Wachsmuth and Springer have prudently refrained from *à priori* argument. There can at any rate be no manner of doubt that the thing has happened in *Thenarocrinus*, and, rare though it be, there is nothing anomalous about it; on the contrary, the sinking of the radianal, in common with the brachianal and anal series, is in perfect harmony with the views as to the origin of those plates put forward in Paper II.; while the consequent widening of the anal area, enhanced as it is by the width of all the plates of the dorsal cup, is obviously correlated with the large size of the ventral sac, just as was explained on pp. 319 and 330 of the same paper.

But if *Thenarocrinus* is not anomalous, neither is it unique.

* Rev. I. (144), Proc. 1879, p. 367.

† Rev. II. (202), Proc. 1881, p. 376, footnote.

‡ Rev. III. (55), Proc. 1885, p. 277.

Messrs. Wachsmuth and Springer have apparently found out for themselves * by this time that Angelin's description of *Sagenocrinus* was, so far as the number and position of the plates were concerned, perfectly correct: this is not the place to discuss the matter, but the sixth plate in the basal circlet does after all appear to be an "anal."

That the structure of *Carabocrinus* was in all essentials correctly described by Billings, Messrs. Wachsmuth and Springer subsequently admitted †; but with their pronounced views as to the extreme improbability of an anal or a radial descending into the basal circlet, they naturally slurred over the importance of that structure. This was their explanation:—"The small plate within the basal ring, which is only known in this genus, is, we think, a supplementary azygous plate of no fundamental importance, a plate bearing to the regular azygous plate similar relations as the small accessory interradials in some specimens of *Archæocrinus sculptus* to the regular interradials." Now, however, *Thenarocrinus* enables us to look at *Carabocrinus* from a different standpoint; the supplementary plate may very naturally be regarded as a portion of the radianal, just as the radianal itself is a portion of the right posterior radial; so that, were this supplementary plate again united to the radianal, we should have a disposition of anal plates very similar to that which obtains in *Thenarocrinus*.

It was this similarity in a structure so dissimilar to that of all other Fistulata that led me, when discussing the classification of the group, to place *Thenarocrinus* alongside of *Carabocrinus*. It is no doubt conceivable that this structure, peculiar though it is, may have been arrived at along two different lines of descent. There are, however, yet other points of resemblance, in the dichotomous branching of the arms, the number of the costals, and the structure of the column. The only important difference between the two genera lies in the greater breadth and length of the arms in *Thenarocrinus*; but this is no great difference for two forms so widely separated in time and space. The more globular shape and generally radiate ornamentation of the dorsal cup, exhibited by the described species of *Carabocrinus*, go for nothing, for they do not obtain in two specimens of that genus kindly lent me for examination by Dr. G. J. Hinde.

Whether these considerations warrant the establishment of

* W. & S., "Discovery of the Ventral Structure of *Taxocrinus* &c.," Proc. Acad. Nat. Sci. Philadelphia, 1888, p. 357.

† Rev. III. (217), Proc. 1886, p. 141.

a Family CARABOCRINIDÆ, characterized by the presence in the basal circlet of a radianal or part of one, is a different matter. The Fistulata are now so well known that their classification must depend on the question of descent. In the present instance, however, this question is obscured, partly because so few species of the genera in question are known, but chiefly because those genera are early forms but a little way removed from the common parent stock. *Carabocrinus*, for instance, seems related to *Euspirocrinus*, of which genus a species, *E. obconicus*, has been found by Mr. W. R. Billings* in the Trenton Limestone. *Thenarocrinus* also presents some points of resemblance to *Euspirocrinus*, especially in the arms, in the general shape of the dorsal cup, and in the column. But both *Carabocrinus* and *Euspirocrinus* are very closely connected with *Ottawacrinus* and with early species of *Dendrocrinus*. In fact, were we to consider Ordovician forms alone, we should undoubtedly place all these genera in one Family. Clearly, however, this would not be satisfactory; the evolution of that assemblage did not cease, and the question is—Can we discern more than one line of evolution? Certainly there seem to be three divergent lines; and the fact that two of these (the Carabocrinidæ and Euspirocrinidæ) soon appear to reach their termini does not impugn their existence.

Undoubtedly the establishment of a Family Carabocrinidæ would appear more reasonable if we could trace its descent rather further than is at present possible, but among forms reckoned as Fistulata the descendants of *Thenarocrinus* are still to seek. There is, however, a likeness so remarkable that it cannot be overlooked. The resemblance of *Thenarocrinus* to *Enallocrinus* may be superficial, but, except for the anal structures, it is very complete. The plates of the dorsal cup, other than anals, are the same in number and in shape, and the following sentences from the most recent description of *Enallocrinus*† apply almost equally well to *Thenarocrinus*:—"First radials wide, their distal faces usually occupied by a deep lunate excavation in which the second primary and one or two higher radials rest; sometimes, however, truncate." "Rays completely disconnected from the first radials up, and the arms becoming free variously between the first to the fourth bifurcation. Second radials [*i. e.* first costals] perforated by a large axial canal which passes downward; it ramifies within the higher radials, and passes into

* Trans. Ottawa Field Naturalists' Club, ii. no. 2, 1885.

† Wachsmuth and Springer, "*Crotalocrinus*: its Structure and Zoological Position," Proc. Acad. Nat. Sci. Philadelphia, 1888, pp. 387, 388.

the arms, but apparently does not extend to their full length. Arms uniserial, very long, tapering little, bifurcating at lengthening intervals toward the upper parts into very numerous equal branches, the ultimate divisions being extremely attenuate." "Arm-joints shorter than in *Crotalocrinus*, with parallel sutures; those of adjacent branches opposite each other not alternating." "Ambulacral furrows shallow, with covering-plates arranged in the usual way." "Column round, very large, with short joints and thin walls; canal round and of extremely large size."

It is not, of course, any one of these points of resemblance that is remarkable; it is the total effect: the evidence, so to speak, is cumulative. But there are two points in the structure of the Crotalocrinidæ on which Wachsmuth and Springer have laid particular stress.

The reticulate structure of the arms in *Crotalocrinus* depends on the combination of the following characters:—depth of ossicles dorso-ventrally, length of arms, extreme bifurcation at regular intervals, and lateral processes of ossicles. In all these points the arms of *Enallocrinus* resemble those of *Crotalocrinus* except that the bifurcation does not take place at such regular intervals, and the arms are not laterally connected. A development in the direction of such connexion has, however, been demonstrated by Wachsmuth and Springer. "Toward the upper ends of the arm-joints there are more or less conspicuous transverse projections—one from each side of the joint—which are more prominent and elongate at the ventral side. They border the arm-furrow, and give to the arm, when viewed from the side, a pectinate appearance, which is more strongly marked toward the distal ends of the arms." "We have observed these projections on the arms," add Messrs Wachsmuth and Springer, "only in the English specimens. We give it as a generic character, as we think it likely the Swedish ones will show it also when sufficiently well preserved; and because we consider it of some importance, as representing the projections on the arms of *Crotalocrinus* by which these were connected, and thus exhibiting a tendency toward the reticulate structure." Now the arms of *Thenarocrinus* not only resemble those of *Enallocrinus*, and to a less extent of *Crotalocrinus*, in depth, length, and bifurcation, but they show undoubted indications of nascent lateral processes. In their position on the arm, and on the ossicle, and indeed in everything but size, the anterolateral ridges of *Thenarocrinus* resemble the processes of *Enallocrinus*.

The second point to be noticed is the extension of the tegmen over the arms as far as the end of the distichals. There is really nothing very remarkable in this; but it is obviously parallel with the extension of the tegmen in Crotalocrinidæ, and leads up to the apparent inclusion of costals an distichals in the walls of the dorsal cup, on which Wachsmuth and Springer lay so much stress.

All these resemblances point no doubt to certain conclusions. But it is not so long since Messrs. Wachsmuth and Springer published their elaborate paper on the Crotalocrinidæ, in the preparation of which they had the advantage of studying a very large number of specimens including those figured by Angelin. To traverse their arguments and to contradict their conclusions would be presumptuous in one who has not examined their evidence. Till that is done let us be content with the knowledge of this new genus, which I feel it a privilege to introduce to naturalists. For, with its long and finely ringed column, its well-proportioned cup, the delicacy of its ventral sac, and its more than myriad arms, the living *Thenarocrinus* must have been one of the most beautiful and wonderful forms in that paradise of lovely marvels, the Wenlock Sea.

EXPLANATION OF PLATE X.

Fig. 1. Postpalmars of the left-central branch of the left posterior arm of 144 Mason College; seen partly sideways. To show lateral ridging. (× 2.)

Fig. 2. 153 Mason College, posterior view. The oldest specimen. (Nat. size.)

Fig. 3. 57478 *a*, B.M. Chiefly to show the fine branches of the arms. (Nat. size.)

Fig. 4. 48049, B.M. To show general form and stem-characters. (Reduced from $9\frac{1}{2}$ to $7\frac{1}{4}$ inches long.)

Fig. 5. 57478 *b*. To show ventral sac and tegminal plates. (Nat. size.)

Fig. 6. 293 Holcroft. The youngest specimen. (Nat. size.)

Fig. 7. Part of the stem of the Dudley specimen. Showing ornament; see p. 231. (Nat. size.)

Fig. 8. 138 Mason College. To show weathered arms and ventral sac. (Nat. size.)

Fig. 9. Part of the Madeley specimen. To show stem crushed along suture-lines. (Nat. size.)

N.B.—To ensure accuracy all the drawings except Figs. 1 and 7 have been traced from photographs.

XXVIII.—*On the Development of* Pyrosoma. By Prof. W. Salensky *.

Since Huxley's celebrated investigations we have learnt to distinguish two periods in the development of *Pyrosoma*, viz. :—(i.) The evolution from the fertilized ovum of a nurse-like form, which Huxley termed the "Cyathozooid;" (ii.) The formation by a species of budding of a group of four Ascidian-shaped individuals, the Ascidiozooids of Huxley, which must be regarded as the parents of the entire *Pyrosoma*-colony. The discovery of this peculiar method of development has led to the view that in *Pyrosoma* we have a case of metagenesis occurring in the ovum. A few years after the appearance of Huxley's monograph on *Pyrosoma*, the investigation of the development of these interesting forms was undertaken by Kowalewsky, who increased our knowledge in several respects, and especially as regards the finer histological relations of the embryonic processes. The segmentation, formation of the germinal layers, and organogeny of the cyathozooid, as also of the ascidiozooids themselves, were very minutely described by Kowalewsky; and it seemed at the time as if the new observer in the same field would have but few fresh discoveries to make. Nevertheless subsequent progress in the science of comparative embryology has brought certain questions to the front which in Kowalewsky's work are scarcely touched upon. Two such questions, which are of general interest, I shall attempt to answer in this short paper, so far as my own investigations permit me to do so. The first of these concerns the "inner follicle-cells" described by Kowalewsky, for which I now propose the more general name "kalymocytes" †. The part which these cells play in the development of the cyathozooid of *Pyrosoma* has hitherto been a puzzle; the remarkable behaviour of similar cells in the development of the Salps may suffice as a reason for undertaking a fresh examination of *Pyrosoma* and of the metamorphoses of the kalymocytes of the ovum of *Pyrosoma* in particular. The second question which I intend to discuss in these pages refers to the origin and metamorphosis of the mesoderm; and I have selected it because, in the first place, Kowalewsky did not altogether pay sufficient attention to it in his investigations, and, secondly, because the mesoderm-

* Translated from the 'Biologisches Centralblatt,' Band x. Heft 8, June 1, 1890, pp. 225 *et seq.*

† From κάλυμμα, a veil.

question for the Tunicates in general cannot be regarded as having been exhaustively worked out.

1. *The Kalymocytes of the Ovum of* Pyrosoma *and their Function in the Development of the Cyathozooid.*

So far as I am aware, Kowalewsky was the first to observe the occurrence of kalymocytes in the ovum of *Pyrosoma.* Kowalewsky terms them "inner follicle-cells," but recognizes their homology with the so-called test-cells of the Ascidians. He also described the mode of origin of these cells with perfect accuracy, and shows that they are nothing else than follicle-cells which have separated from the follicle-wall and wandered into the space between the latter and the surface of the yolk. From Kowalewsky's figures we can at once see that the kalymocytes ("inner follicle-cells," Kow.) differ in form and structure from the true follicle-cells. As a matter of fact these cells differ so much from the blastomeres, not in form and structure only, but also in the way in which they are affected by staining-reagents, that, even with a low power, they can be very easily recognized in stained preparations.

The kalymocytes appear in the ovum of *Pyrosoma* at a very early stage, and are to be observed in tolerably large numbers even before the commencement of segmentation. With reference to their origin, I can completely confirm Kowalewsky's statements; different stages in the separation of these cells are very easily made out in sections. As regards the structure of these cells, however, Kowalewsky is not altogether accurate. This is explained by the fact that Kowalewsky underestimated the *rôle* of the kalymocytes, and therefore pays them less attention than they actually deserve. The structure of the kalymocytes is very characteristic, although their form varies according to the place in which they are found. They are to be met with in different parts of the ovum—immediately beneath the wall of the follicle, in the interior of the yolk, or between the blastomeres, and they are everywhere distinguished by a different shape, corresponding with their situation. The cells found at their place of origin have a primitive shape, which we may regard as typical. They are pyriform, tapering at one pole and widened at the other. Each cell contains within its tapering portion a nucleus, which, owing to the readiness with which the protoplasm takes a deep stain, is not very conspicuous in coloured preparations. The nucleus is vesicular, and contains a somewhat sparsely developed network of chromatin-fibres. The expanded half of the kalymocyte consists of coarsely granular protoplasm, in which, even in freshly separated cells, one or two vacuoles are discernible. In the kalymocytes which have migrated into the segmentation-nucleus, the vacuoles increase in number as time goes on.

Most of the kalymocytes immediately after their formation wander from their place of origin to different parts of the oosperm. Some enter the yolk, move about there, and reach the lower surface of the segmenting-nucleus; the others wander into the space between the yolk and the follicle-wall, and finally arrive at the outer surface of the nucleus. Since the two kinds of cells differ materially from one another in form, I will deal with them separately.

The migration of the kalymocytes into the yolk first begins at the time of the segmentation of the nucleus, and reaches its height at the period of the formation of the lower wall of the mesenteron. We can convince ourselves, by examination of successful sections, that immediately after the entrance of the kalymocytes into the yolk they undergo important changes in form, as well as in the constitution of their protoplasm. They assume an Amœba-like shape and are much less readily stainable with carmine than the cells which lie on the wall of the follicle. The alteration in the extent to which they are affected by staining-reagents is probably due to the yolk which they absorb by the way. In consequence of the blanching of the protoplasm, the nuclei of the yolk-kalymocytes appear much more distinct than do those of the kalymocytes of the follicle-wall. The number of the kalymocytes found in the yolk is very variable in the different ova. Sometimes we meet with a mass of star-shaped yolk-kalymocytes, which are united together in groups by their pseudopodia. The majority of the yolk-kalymocytes in their movements tend towards the upper pole of the oosperm, that is to say in the direction of the nucleus. We always find the largest numbers in the neighbourhood of the surface of the yolk on which the nucleus lies; and since they invariably appear most numerous at the time of the development of the lower wall of the mesenteron, it is highly probable that they take part in the formation of the latter. This conclusion is supported by the fact that, just at the point where the mesenteric wall is in process of formation, the kalymocytes can very frequently be observed emerging from the yolk. The liberated kalymocytes undergo a change in form, flatten themselves out, lose their pseudopodia, and range themselves alongside the other cells which form the wall of the enteron. The movement of the yolk-kalymocytes towards the germinal disk, however, does not cease with the closure of the mesenteric wall; at any rate, some are always to be found beneath the latter after it is quite complete.

The most important of all the varieties of kalymocytes are those of the nucleus—that is to say, those which come in contact with the nucleus from above. Since these cells stand later on in the most intimate relation to the blastomeres, we cannot describe them otherwise than in connexion with the segmentation. Since the investigations of Kowalewsky, it is well known that the ova of *Pyrosoma* are meroblastic. Before the first constriction appears the kalymocytes have already reached the nucleus. They range themselves on the upper surface of the latter and assume a variety of shapes. In stained sections, owing to the intensity of their colouring, they are very conspicuous. Some of them penetrate into the groove between the two blastomeres; others lie on their upper surface; while yet others actually bore their way into the interior of the blastomeres. The latter variety exhibit the most remarkable phenomena, which have so far hardly been observed in the case of the ovum of any other animal. The penetration of the kalymocytes into the interior of the formative portion of the oosperm can be very readily followed in the first stages of segmentation, even step by step. The significance of this peculiar phenomenon is, however, not so easy to see. The examination of several ova in the first stages of segmentation has led me to the conclusion that the occurrence of kalymocytes in the nucleus is confined to the very earliest stages of segmentation only; after the nucleus has divided into four, the phenomenon entirely ceases. As regards the fate of the immigrant cells, my investigations enable me to state that these cells undergo no material changes within the nucleus. I therefore incline to the opinion that the kalymocytes remain in the nucleus for a short time only, and leave it again without suffering any structural change, and that we must not ascribe to the penetration of these cells into the nucleus any important influence on the development of the cyathozooid.

During the subsequent stages of segmentation the kalymocytes congregate exclusively in the fissures between the blastomeres; they preserve their primitive pear-shaped form for some time, and remain sharply distinct from the blastomeres owing to their size. In proportion as the blastomeres, however, become continually smaller as segmentation proceeds, the difference in size between them and the kalymocytes disappears; at the same time the latter assume a polygonal form, in consequence of the reciprocal pressure of adjoining cells, and grow more and more like the blastomeres. The constitution of the protoplasm of the kalymocytes presents a more lasting characteristic, which distinguishes these cells from the blastomeres. This is, however, not constant, and in time this character too disappears. We have remarked above that vacuoles appear at a tolerably early period in the protoplasm of the kalymocytes; their number continually increases with the progress of development, so that in the stages at which the embryo consists of several hundred cells the protoplasm of the kalymocytes appears as a perfectly transparent viscid mass, traversed in different directions by a finely granular network of threads of the original substance. In consequence of this the kalymocytes of these stages appear paler in stained preparations than was formerly the case. Simultaneously with this the constitution of the protoplasm of the blastomeres also undergoes a change, in that it loses its previous finely granular structure, and appears more and more homogeneous and transparent.

From this we see that the changes of the blastomeres go hand in hand with those of the kalymocytes. In both cases the result is a clarification and liquefaction of the protoplasm. If we consider at the same time that the differences in size between the blastomeres and kalymocytes gradually fade away, it follows that in the final stages of segmentation the two kinds of cells, kalymocytes and blastomeres, of which the segmented nucleus consists, must look precisely alike. As a matter of fact, if we examine a section from the later segmentation-stages of the oosperm of *Pyrosoma*, we find that the embryo consists of a large number of cells of precisely similar structure. Kalymocytes are no longer to be distinguished from blastomeres. Since in the subsequent stages of development all the cells of the embryo take an equal part in the formation of the cyathozooid, we arrive at the conclusion that the cyathozooid is formed from two different elements:—(i.) from the derivatives of the fertilized egg-cell—the blastomeres, which throughout the whole of the animal kingdom alone play the part of formative elements; and (ii.) from the non-fertilized elements—the kalymocytes, which unite with the former and assume the *rôle* of the formative elements.

The processes of development in the ovum of *Pyrosoma* which I have just described, in spite of their peculiarity, are not entirely unique in the series of developmental phenomena which have been discovered in the animal kingdom in recent times. The nearest approach is made by those described by myself in the case of the Salps, which, however, present by no means unimportant differences. Chief among these is the fact that, whereas in the case of *Pyrosoma* both kalymocytes and blastomeres take an equal share in the formation of the embryo, in the case of the Salps the kalymocytes play the most important part in the development, in opposition to the blastomeres, which are of secondary importance. In the development of *Pyrosoma* and the Salps, however, we have to deal with a phenomenon which has already attained a tolerably high degree of perfection; since in both cases the kalymocytes, which in the case of all other animals have no function at all, become all at once of great importance in the formation of the embryo. Somewhere or other the primitive stages of this singular phenomenon must exist, in which the adaptation of the kalymocytes to their new *rôle* of formative elements may be supposed to have begun. My own investigations, as yet unfinished, into the development of certain compound Ascidians (*Circinalium*, *Didemnium*, *Leptoclinium*, *Amaurœcium*), as well as the already known, though but scanty, statements of other authors about the development of this interesting group, lead me to the conclusion that it is in them that we must look for the origin of this remarkable phenomenon, which reaches its culminating point in *Pyrosoma* and the Salps. The kalymocytes of the compound Ascidians take, it is true, as yet no part in the development of the embryo; but they behave towards the blastomeres in precisely the same way as do the kalymocytes of *Pyrosoma* in the first stages of segmentation—that is to say, they penetrate between the blastomeres and remain in that position for some time, without mingling with the blastomeres and taking part in the development of the embryo.

2. *The Development of the Germinal Layers and Differentiation of the Mesoderm.*

The stages of segmentation and germinal-layer formation, the most important in development, are very sharply marked off from one another in the case of *Pyrosoma*. The segmented nucleus consists, as we have already seen, of a mass of similar cells, and appears as a solid cupola-shaped elevation, resting on one pole of the oosperm. The earliest changes of all in the segmented nuclear cap are exhibited in the differentiation of a superficial layer of cells, which are distinguished by their cylindrical shape from the polygonal cells of which the remainder of the mass consists. This superficial layer represents the ectoderm, and in the later stages of development gives rise to the atrial tubes and the nerve-ganglion. The bulk of the embryonic mass consists of the undifferentiated elements of the two other germinal layers, and may therefore be termed the meso-endoderm; before this gives rise to the rudiments of various organs it undergoes a differentiation, resulting in its splitting into two germinal layers, the mesoderm and endoderm. The differentiation of the endoderm occurs tolerably late—not until after the formation of the cœlomic cavities in the mesoderm. The formation of the cœlomic spaces and their metamorphoses are what we now have to consider.

If we examine sections from the nuclear mass, in which mesoderm and endoderm are represented by a still undifferentiated mass of cells, we at once notice in the interior of these sections several lacuna-like cavities which as yet have no connexion with one another. These cavities are the earliest rudiments of the subsequent cœlomic spaces, which convert the solid mesoderm into two cœlomic sacs. Whether or not these cavities are symmetrically arranged from the first I cannot decide with certainty, as I had at my disposal but few embryos in these stages. At any rate they appear to be symmetrically arranged in the following stage, in which the nuclear mass flattens out and assumes the form of a germinal disk. It is very probable that all the isolated cavities coalesce at this period, since the cœlom is now no longer represented by several separate spaces, but by two large cavities lying one on each side of the longitudinal axis of the germinal disk. At much the same time as this important changes also take place in the germinal disk itself; the lower surface of the latter recedes from the upper surface of the yolk, in consequence of which a space is left between the yolk and the germinal disk, which is subsequently transformed into the enteric cavity. The mutual relations of the two spaces, the enteric cavity and the cœlom, can be determined by means of sections; and in successful ones we can clearly see that the two cœlomic sacs open into the cavity of the intestine. In the median line between the two openings of the cœlom, in the axial portion of the germinal disk, there projects into the enteric cavity a longitudinal ridge, which is likewise traversed by a canal. The opening of this canal I was not able to make out; but with regard to the interpretation of the two lateral openings of the cœlomic sacs, their relation to the intestinal cavity points to the conclusion that we have in these openings the homologues of those described by van Beneden and Julin, through which the primitive enteric cavity communicates with the cœlomic sacs. Although

I was not able to discover any connexion between the axial canal of the mesoderm and the enteric cavity, nevertheless the position of this canal renders it extremely probable that we have in it the nearest representative of the chorda dorsalis of the Ascidian embryos. The beautiful investigations of E. van Beneden and Julin have taught us that the notochord of the embryos of *Clavellina* is, in the earlier stages of development, represented by a tube which is situated between the two mesodermic diverticula, and therefore exhibits the same relations as we find in the axial tube of the embryos of *Pyrosoma*. In the case of *Pyrosoma* the tube in question is a transitory structure and lasts but a very short time.

In spite of the similarity between the cœlomic sacs of *Pyrosoma* and those of the Ascidian embryos, to which I have just alluded, the two structures nevertheless exhibit an important difference in their histology. This consists in the fact that, while the cœlomic sacs of the *Pyrosoma*-embryos are bounded by a multilaminar tissue, those of the Ascidian embryos have unilaminar epithelium-like walls. In the later stages of the *Pyrosoma*-embryos, however, this difference is removed; for, in the course of growth, the cœlomic sacs likewise become bounded by a single layer of cells. The two sacs, right and left, are at first precisely similar, and are symmetrically placed with regard to the longitudinal axis of the germinal disk. This condition, however, is of but short duration. As early as the stage of the first appearance of the peribranchial tubes, the two sacs exhibit important differences from one another; with this a second period in the development of the cœlomic sacs is inaugurated, which may be termed the *metamorphosis of the cœlomic sacs*. While the left cœlomic sac has greatly increased in size and forms a spacious cavity, the cavity of the right sac has almost entirely disappeared and appears as a tiny lacuna which adjoins the septum between the two primitive cœlomic spaces. The entire distal portion of the right cœlomic sac is now represented by a solid mass of cells, from the periphery of which some cells are in the act of being liberated. In the stage at which the peribranchial canals deepen and form little blind tubes, the whole of the right cœlomic sac has completely disappeared and has broken up into little cells. The development of the left cœlomic sac, on the contrary, rapidly proceeds. The circumference of the sac increases, and it subsequently divides into two portions: its proximal portion becomes incrassated, and forms a swelling situated beneath the endostyle which is in process of formation; in its further development it plays a very important part in the formation of various mesodermal structures, such as muscles, elæoblast, and probably also the genital organs. The distal portion of the left cœlomic sac, which preserves the form of a tube, becomes the pericardium. This grows forwards, soon reaches the anterior portion of the germinal disk, and, becoming expanded like a club at its anterior end, assumes the shape which is already sufficiently well known from Kowalewsky's description. The lower wall of the expansion of the pericardial sac, which adjoins the endoderm, is differentiated tolerably early as a thickened plate, which represents the rudiment of the heart. The heart itself, which is formed by the invagination of this plate, is not completely developed until the period of the formation of the cyathozooid.

With this I conclude these brief notes on the earliest stages in the development of *Pyrosoma*, and may summarize the chief results of my investigations as follows:—

(i.) The embryo of *Pyrosoma* is formed from both fertilized and unfertilized elements, since not only the blastomeres, but also the kalymocytes, take part in the formation of the cyathozooid.

(ii.) In the differentiation of the germinal layers the nuclear mass first divides into two portions—an ectoderm and a meso-endoderm; of these the latter further differentiates into a multilaminar mesoderm and a unilaminar endoderm.

(iii.) The mesoderm first appears in the form of two typical cœlomic sacs.

(iv.) Of the two cœlomic sacs the left alone undergoes further development, and is subsequently differentiated into an axial mesoderm and a pericardial tube; whereas the right sac breaks up into separate cells, which are afterwards dispersed through the body of the cyathozooid.

Odessa, March 1890.

XXIX.—*On supposed new Species of Land-Mollusca from Borneo belonging to the Genera* Opisthostoma *and* Diplommatina. By Lieut.-Col. H. H. Godwin-Austen, F.R.S., F.Z.S., &c.

[Plate VII.]

In the paper on Bornean Cyclostomaceæ published in the 'Proceedings of the Zoological Society,' 1889, p. 332, I recorded and described all the species that were then known to me. Since that time I have received another small collection through Mr. A. Everett, made in the hills of Borneo by Mr. C. Hose, and I have to thank them both for the further assistance they have thus given to me. We are apparently only beginning to know the richness of the land-molluscan fauna of this great island, so that as it becomes explored in all parts what a wealth of new species we may expect it will produce! Two shells I now describe present a remarkable difference from the hitherto known species of *Opisthostoma* from India and the Malay peninsula in being more or less spined, the first and finest example yet discovered being *O. grandespinosa*, in which the spines are developed in a peculiarly beautiful way. The same variation in Borneo extends to the genus *Diplommatina*, as exemplified in *D. spinosa*. Further exploration by naturalists who know how and where to find these minute shells will no doubt bring to light others equally interesting.

The species of *Diplommatina* now described was sent to me to examine with other species by Mr. Aldrich, of Cincinnati, U.S.A., to whom a collection of Bornean shells had been sent, and a list of which he gave in a paper published in the Journ. Cincinnati Soc. Nat. Hist. April 1889, p. 23. This shell he thought might be *D. concinna*, Adams; but it is not that species, and I have much pleasure in naming it after Mr. Aldrich.

I take this opportunity of giving drawings (Pl. VII. figs. 4, 5) of two species described in my paper quoted above, pp. 342, 343, but which were received too late to include in the plates which illustrated it; they are *Rhiostoma Hungerfordi* and *iris*.

Opisthostoma pulchella, sp. n. (Pl. VII. fig. 1.)

Shell pyramidal, thin, narrowly perforate; sculpture, wavy costulation on a smooth surface; upon the lower whorls this forms the base of sharp, thin, white cirque-like bands standing at right angles to the whorl; on the penultimate and antepenultimate these in the centre are produced into short spines; they are generally found worn off at an early stage of growth; colour ochraceous with a golden tinge, nearly white on the free portion of the whorl; spire conical; apex papillate; suture much impressed; whorls 7 up to the constricted portion, whence the latter part is free and curved outwards from the axis and upwards; aperture circular; peristome double, very thin, much expanded, particularly the outer margin.

Size: major diam. 2·2; alt. axis 2·3 millim.

Locality. Baram district, Borneo (*C. Hose*).

This very beautiful shell is another spined form, a competitor for the admiration of the conchologist with *Opisthostoma grandespinosa*, lately described by me; in this species the spines are not so large and have more the character of raised rings.

Opisthostoma Hosei, sp. n. (Pl. VII. fig. 2.)

Shell pyramidal, very narrowly perforate; sculpture of the upper whorls quite smooth, the free portion of the last being strongly costulate, the ribs near the aperture being in high relief; colour shining ochre; spire conic, flat-sided, apex blunt; suture shallow; whorls 5, flat, the last free, with considerable twist, compressed, producing a keel; aperture circular; peristome widely expanded.

Size: major diam. 1·8; alt. axis 1·6 millim.

Locality. Baram district, Borneo (*C. Hose*).

This is another very distinct form from the same part of Borneo. In the very smooth surface of the first five whorls it is unlike any species with which I am acquainted.

Diplommatina Aldrichi, sp. n. (Pl. VII. fig. 3.)

Shell elongately turreted, rather solid; sculpture strong distant costulation; colour dull ochre; spire becoming rapidly pointed, apex sharp; suture well impressed; whorls 8, convex, the constriction in centre above the aperture, penultimate the largest and rapidly decreasing in size above; aperture ovate-vertical; peristome double, expanded; columellar margin vertical and angulate below.

Size: maj. diam. 1·75; alt. axis 3·75 millim.

Locality. From either the Kusan or Penggiron districts, S.E. Borneo (*William Doherty*).

This shell is identified as *D. concinna*, H. Adams, in "List of Shells from Borneo," published in the 'Journal of the Cincinnati Society of Natural History,' April 1889, p. 25, by Mr. T. H. Aldrich. This gentleman has very kindly sent his specimen to me to examine, and this I find does not agree with Adams's species.

EXPLANATION OF PLATE VII.

Fig. 1. *Opisthostoma pulchella*, sp. n., × 12.
Fig. 2. *Opisthostoma Hosei*, sp. n., × 12.
Fig. 3. *Diplommatina Aldrichi*, sp. n., × 7.
Fig. 4. *Rhiostoma iris*, Godw.-Aust., × 2·5.
Fig. 5. *Rhiostoma Hungerfordi*, Godw.-Aust., × 2·5.

XXX.—*Notes on Longicorn Coleoptera of the Group* Cerambycinæ, *with Descriptions of new Genera and Species.* By
CHARLES J. GAHAN, M.A., Assistant in the Zoological Department, British Museum.

THE extreme difficulty which the systematic treatment of the group Cerambycinæ (Cerambycides vrais, Lacord.) presents has been recognized by every entomologist who has attempted it. Our collections are, I think, still in too incomplete a state to enable this difficulty to be overcome. Without attempting to give a complete revision of the group, I have in the following paper made such notes upon genera and species as will, I hope, help the student in his determinations. I have corrected the synonymy of a good many species, having for this purpose consulted most of the types. To M. René Oberthür, of Rennes, I must in particular acknowledge my thanks, for having so kindly forwarded to me the types of those of Thomson's species which, from their descriptions, I was unable satisfactorily to make out. One of these—*Cleonice vestita*—is quite foreign to the group. It has been redescribed and figured by Mr. Pascoe under the name *Seuthes sericatus*, and undoubtedly belongs to the group Glaucytinæ, in which Mr. Pascoe placed it.

TAUROTAGUS, Lacord.

Taurotagus subauratus, sp. n.

Antennis (♂) corpore plus sesqui-longioribus; capite supra sulco medio elongato impresso; prothoraco apice valde constricto, lateraliter et supra obtuse tuberculato et valde rugoso; elytris pube brunneo-aurata holosericea dense obtectis, apicibus angustim truncatis vel subrotundatis, et ad suturam breviter mucronatis. Long. 44, lat. $12\frac{1}{2}$ mm.

Hab. Abyssinia (*J. C. Bowring, Esq.*).

The unique specimen of this species was in a rather greasy condition; but after soaking in benzole it is seen to have, at least on the elytra, a beautiful golden-brown and rather dense pubescence, giving slight *moiré* reflexions. The head carries above a median longitudinal groove, commencing between the eyes and extending back to the occiput. The antennæ are more than half as long again as the body, with the scape strongly rugose-punctate, and at the same time very minutely and closely punctulate; the third joint is much longer than the scape and only slightly nodulose at the apex; the fifth joint is a little shorter than the third and longer than the fourth. The prothorax is strongly constricted and transversely grooved anteriorly, obtusely tubercled both at the sides and on the disk, and rather strongly and irregularly transversely wrinkled above. Prosternal process strongly arched, subvertical behind. Underside of the head crossed by two transverse grooves separated by a rather narrow ridge.

With antennæ rather long for the genus, the remaining characters of this species seem to point conclusively to its place in *Taurotagus*.

Taurotagus griseus, Guér.

The type of this species (a female specimen) was one of those so kindly sent to me by M. René Oberthür, but was too old and faded to admit of close comparison with other species. I believe, however, that I am right in referring to the species two male specimens—one, from Senegal, in the British Museum collection, the other, from Abyssinia, in Mr. Fry's collection. In these the antennæ are not more than three fourths of the length of the body, with the third joint only about equal in length to the scape. The prothorax is slightly uneven and without any distinct rugosity above. The elytra are about three and a half times as long as the prothorax and are rounded at the apex. The prosternal process, gradually rounded and declivous posteriorly, is feebly tubercled in the middle near its extremity.

The British Museum specimen is the *Hammaticherus cinerarius*, Buq., of Dejean's collection.

CŒLODON, Serv.

The *Prionus cinereus* of Olivier has been incorrectly quoted by Serville, Lacordaire, and others as the type of this genus. The *cinereus* of Olivier, as a reference to his description and figure will easily prove, is a species of *Criodion*, and the habitat he ascribed to it is without doubt correct. The type of *Cœlodon*—an African species described by Serville—must therefore be written *C. cinereum*, Serv. As a synonym of this species we may add *C. servum*, White (*Hammaticherus*). White described his species from a female example of unknown locality. This specimen agrees with a female, of much smaller size, from Masai-land, and with a male from Abyssinia, both of which I have referred to *C. cinereum*, Serv.

The genus may be distinguished from *Taurotagus* by the length and obliquity of the mandibles in the male and the tubercle with which they are each furnished externally near the base. The legs, too, are more elongate and not so robust as in *Taurotagus*. Lacordaire gives as a further difference that the prosternal process in *Taurotagus* is truncate and vertical behind, in *Cœlodon* strongly arched. But in no species of *Taurotagus* that I have seen can the prosternal process be strictly said to be truncate behind. In some of the specimens of *Taurotagus brevipennis* (recently described by me in the 'Transactions of the Entomological Society') the prosternal process approaches this condition; but in others it is merely very strongly arched, and appears somewhat vertical behind. The same is probably the case with *Taurotagus Klugii* of Lacordaire. Specimens of *Hammaticherus Klugii*, Dup., MS., from Natal, while answering in every other respect to Lacordaire's description, disagree with it in having the prosternal process strongly arched and not truncate behind; and in some specimens the prosternal process bears a feeble median tubercle behind. The distinction therefore drawn from the form of the prosternum is of little or no value.

Neocerambyx, Thoms.

Authors have not been in agreement as to the limits of this genus, some restricting it to one or two species, others including in it species that had been previously rejected and placed in *Pachydissus*, the result being that in our present catalogues we have closely allied species placed some in one genus and some in the other, and even the same species occurring in both genera under different names. To avoid this confusion, which makes the determination of species more difficult, I have brought together, under the generic name of *Æolesthes*, most of those species of *Neocerambyx* about the position of which there was a doubt.

The *Cantori* of Hope will be better placed in *Cerambyx*, Serv., than in *Neocerambyx*, where Lacordaire thought it should go. It has as a synonym *C. scabricollis*, Chevr.

Pachydissus gigas, Thoms.,—the largest and one of the most beautiful species of the whole group—seems to me to be best placed in *Neocerambyx*. Unfortunately the male is still unknown. From three female specimens (including the type) I am able to supplement the characters given by Thomson.

Eyes rather wide apart above, with the vertex between them marked by three deep longitudinal grooves—one median, not surpassing the eyes in front; the remaining two oblique, scarcely surpassing the eyes behind, and gradually approaching in front so as almost to meet below between the antennary tubers. The longitudinal smooth space on the middle of the pronotum extends between the anterior and posterior transverse grooves; in its anterior half it is not half as broad as in its posterior, and at its anterior extremity ends in two small diverging tubercules. The elytra are each rounded externally at the apex, cut in somewhat obliquely towards the suture, and there furnished with a very short spine. The anterior cotyloid cavities are slightly open on the outside.

Thomson's specimen is from Borneo; the two in the British Museum are one from Malacca, the other from Java.

Æolesthes, gen. nov.

Head with a central plaque in front, with a median, more or less distinct carina occupying the interantennary sulcus in front, and extending behind almost to a level with the posterior border of the upper lobes of the eyes. At the termination of this carina the vertex bears a shallow foveolate impression. Antennæ in the male much longer than the body, with the third to fifth joints thickened at the apex, with the joints from about the fifth to the eighth usually furnished with a minute spine at their outer apical termination. The same joints in the female more distinctly spined externally, and each also spinosely or denticulately produced at its inner apical termination. Prothorax strongly rugose above, rounded or subangulate and unarmed at the sides in the middle. Elytra clothed with a rich silky pubescence giving *moiré* reflexions; apices truncate, with the angles spinose or dentate. Anterior cotyloid cavities very feebly or not at all angulate on the outside. Prosternal process usually subtruncate behind.

In addition to these characters may be mentioned a groove which crosses the underside of the head from the base of one cheek to that of the other. This groove (in the synopsis given below styled the *intergenal* groove) is usually very distinct, and its direction, whether straight or bowed backwards, is useful in separating some of the species.

The species—some of them common enough in collections—which I have comprised in this genus form a fairly compact group. They are to be recognized by the richness and lustre of their pubescence (with a sheen like that of shot silk) taken in connexion with their roughly wrinkled and unarmed prothorax and their truncated elytra. *Trirachys*, Hope, is the most nearly allied genus, but in this the prothorax is furnished on each side with a conical spine; the third to fifth joints of the antennæ in the male are distinctly (the sixth minutely) spined at their outer apex, and the remaining joints are unarmed.

The species of the present genus have up to now been placed in either *Neocerambyx* or *Pachydissus*, and a good deal of confusion exists in their nomenclature. The following synopsis of their characters may prove useful:—

§ A. Prothorax strongly and more or less regularly transversely wrinkled. Disk usually without a central smooth space.

Antennæ distinctly spined in both sexes. Pronotum with two well-marked longitudinal slightly oblique impressions. Intermediate and posterior femora denticulately produced on each side at their apex .... 1. *Æ. aurifaber*, White.

Joints of the antennæ in the male almost without spines at their outer apical termination. Pronotum with two rather faint longitudinal impressions. Femora without teeth at their apex .... 2. *Æ. achilles*, Thoms.

Antennæ in the male without spines at the outer termination of the joints, with the scape very feebly rugose. Pronotum without longitudinal impressions on the disk or with but the faintest trace of them. Femora without teeth at the apex .... 3. *Æ. Mariæ*, Thoms.

§ B. Prothorax more or less irregularly wrinkled above. Usually with a central smooth space.

Form broad and robust. Intergenal groove directly transverse or very feebly bisinuate. Pronotum with two obliquely longitudinal impressions, limiting a central smooth space. Apices of elytra quadrispinose .... 4. *Æ. ampliata*, sp. n.

Intergenal groove strongly bowed backwards. Pronotum with two obliquely longitudinal impressions, limiting a central smooth space. Apices of the elytra spinose at the suture, dentate externally .... 5. *Æ. induta*, Newm.

As in the preceding, but with the apices of the elytra briefly quadrispinose .... 6. *Æ. textor*, Pasc.

Intergenal groove strongly bowed backwards. Pronotum without longitudinal impressions, but with a small transverse smooth space behind the middle. Antennæ (♂) less than twice the length of the body.......... 7. *Æ. perplexa*, sp. n.

Intergenal groove directly transverse. Pronotum with two obliquely longitudinal impressions, limiting a central smooth space. Sides of prothorax in the male rounded .... 8. *Æ. velutina,* Thoms.

Intergenal groove directly transverse. Pronotum with two obliquely longitudinal impressions, the space between which is rugose and almost completely divided by a median longitudinal groove. Sides of the prothorax in both sexes subangulate in the middle .... 9. *Æ. sinensis,* sp. n.

Pronotum with two obliquely longitudinal impressions, inclosing a smooth space. Sides of prothorax subangulate in the middle. Elytra long compared with the anterior part of the body. Pubescence paler and less dense than usual.............................. 10. *Æ. sarta,* Solsky.

1. *Æolesthes aurifaber.*

Hammaticherus aurifaber, White.
Neocerambyx æneas, Thoms.
Neocerambyx Lambii, Pasc.
Neocerambyx alexis, Pasc.

In the types of *æneas, Lambii,* and *alexis* I could find no structural differences by which any one of them might be distinguished from *aurifaber.* M. Thomson evidently mistook for *aurifaber* another and quite different species, and Mr. Pascoe has described under this name a specimen in which the ridges of the central space of the prothorax are less distinct than in typical examples. The species is from Borneo and Penang, and does not extend to the Duke of York Island, as stated by Mr. Bates, who seems to have shared in the general error concerning the species.

2. *Æolesthes achilles.*

Pachydissus achilles, Thoms.
Neocerambyx æneas, Pasc. (nec Thoms.), Longic. Malay. p. 510.

This is a larger species than *aurifaber*; the vertex of the head is without a distinct median carina, the longitudinal impressions of the pronotum are less distinct, and the femora are not toothed at the apex; but it is in other respects very like that species. In the specimen described by Mr. Pascoe under the name *N. æneas* the ridges on the central space of the prothorax are indistinct. The species is from Borneo.

3. *Æolesthes Mariæ.*

Pachydissus Mariæ, Thoms. Rev. Zool. 1878, p. 2.

This is very like the preceding, but may be distinguished by its greater size, the absence of longitudinal impressions from the pronotum, and the nearly smooth scape of the antennæ. In this, as in the last species, the median carina of the vertex loses its characteristic form, for, instead of being narrow, it is broad and flat and very little elevated; this character by itself is almost sufficient to distinguish either from *aurifaber*, in which the carina is sharp and well defined.

4. *Æolesthes ampliata*, sp. n.

Robusta; prothorace supra irregulariter fortiterque rugoso, spatio medio sulcis duobus obliquis limitato; elytris apice quadrispinosis; capite subtus sulco inter genas recto vel leviter bisinuato.

Long. ♂ 36, lat. 11 mm.

Hab. Duke of York Island.

In colour and style of pubescence resembles most *induta*, Newm., and *textor*, Pasc., but is broader, has the apices of the elytra distinctly spined at each of the angles, and has the intergenal groove of the underside of the head straight or at most very feebly bisinuate. This is the species recorded from the Duke of York Island by Mr. Bates under the name *Neocerambyx aurifaber*, White.

A single female in the British Museum collection; males and females in the collections of Messrs. Bates and Fry.

5. *Æolesthes induta*, Newm.

Hammaticherus indutus, Newm.
? *Cerambyx holosericeus*, Fabr.

This species occurs in Siam, Sumatra, Java, Borneo, the Philippine Islands, &c. I have found a small specimen in Dejean's collection ticketed *Hammaticherus holosericeus*, Oliv. But the *Cerambyx holosericeus* of Olivier is a very different species and belongs to another genus in this group.

6. *Æolesthes textor.*

Neocerambyx textor, Pasc.
Neocerambyx externus, Pasc.
? *Pachydissus ternatensis*, Fairm. Le Naturaliste, 1879, p. 70.

I am doubtful if this species can be regarded as distinct from *induta*. The differences between them are slight, and with a larger series might easily break down. M. Fairmaire's description of *Pachydissus ternatensis* fits exactly the present species, but, as the locality Duke of York Island is given in addition to that of Ternate, I am inclined to think he has mixed up two species—*textor*, Pasc., and *ampliata*, described above.

7. *Æolesthes perplexa*, sp. n.

Antennis (♂) corpore duplo nec æqualibus; prothorace supra irregulariter rugoso, spatio parvo transverso levi pone medium.
Long. 24, lat. 7 mm.

Hab. Siam (*J. C. Bowring, Esq.*).

Intergenal groove distinctly bowed backwards. Antennæ not much more than half as long again as the body. Prothorax irregularly wrinkled above; without longitudinal impressions and with a small transverse smooth space behind the middle of the disk; sides of the prothorax slightly rounded, not at all angulate. Elytra with a rich silky pubescence having a coppery-brown lustre, with darker patches, which in their turn, when brought into certain lights, give bright reflexions; apices with the sutural angles spinose, the outer angles dentate. So closely in colour does the unique specimen of this species resemble Siamese specimens of *induta*, Newm., that at first sight it looks like a small example of the latter. The sculpture of the prothorax, however, on which there is not the slightest trace of longitudinal impressions, is sufficient to distinguish it. In all the specimens of *induta* that I have seen the longitudinal impressions are perfectly distinct, and the central smooth space is longer than broad. It is possible, however, that the unique type of the present species may be an incompletely developed or abnormal example of *induta*.

8. *Æolesthes velutina.*

Pachydissus velutinus, Thoms.
Pachydissus similis, Gahan, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 52.

In the typical example, sent me by M. René Oberthür, the derm is of a reddish-brown colour, which gives to the insect a lighter appearance than that of the majority of the specimens which I had included under the specific name *similis*, and which have a dark brown derm. The prothorax in this species is slightly rounded, but not angulate at the sides; it carries above two distinct longitudinal impressions, inclosing a central smooth space. This space is undivided, except by a very short median depression at its anterior termination.

I am at a loss therefore to explain the signification of the phrase "prothorax . . . . medio biplagiatus" which occurs in Thomson's diagnosis. His expression "frons medio longitudinaliter sulcata" is somewhat ambiguous; it probably refers to the groove between the antennary tubers, but this groove is occupied posteriorly by a feeble median carina which extends back between the eyes. This is no doubt the species figured in the 'Indian Museum Notes' (vol. i. no. 2, pl. v. fig. 3) under the name *Neocerambyx holosericeus*, Fabr.

9. *Æolesthes sinensis*, sp. n.

Prothorace lateraliter in medio subangulato; dorso omnino intricato-rugoso, sulcis duobus obliquis impresso.
Long. 25–30 mm.

Hab. China (*J. C. Bowring, Esq.*).

This species is allied to *velutina* and somewhat closely resembles it; but the sides of the prothorax are somewhat angulate in the middle in both sexes. The median space of the pronotum inclosed between the two oblique impressions is nearly as rugose as the rest of the surface and is almost completely divided by a median longitudinal groove. The elytra are somewhat darker in colour and present a more ruffled appearance than in *velutina*.

10. *Æolesthes sarta*.

Pachydissus sartus, Solsky.

The figure accompanying Solsky's description of this species is inaccurate in making the elytra appear conjointly rounded at the apex. They are described as truncate and somewhat bispinose. If I am right in referring to it a specimen from the Himalayas that I have seen, the species is quite distinct. In this specimen, however, there is no median longitudinal impressed line on the prothorax, and the third and fifth joints of the antennæ are relatively a little longer than Solsky represents them to be. In other respects it agrees exactly with the description.

Plocederus, Thoms.

Plocederus basalis, sp. n.

= *Plocederus chloropterus*, Murray, Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 436.

This species is not, as Murray thought, identical with the

Plocederus chloropterus of Chevrolat. Murray's description of it is very complete. It will be sufficient therefore to point out the differences between it and other allied and very similar species.

From *viridipennis*, Hope, and from *chloropterus*, Chevr., it is distinguished by the very close punctulation of the basal half or third of the elytra; from *chloropterus*, Chevr., it is further distinguished by the oblique lines or grooves forming a "crown-shaped" impression on the disk of the prothorax.

In *P. chloropterus*, Chevr., the prothorax is almost regularly transversely wrinkled above and the ridges are not interrupted by oblique impressions on the disk. The elytra, though more strongly punctulate towards the base, have not the punctures much more thickly spread on this region than towards the apex.

In *P. viridipennis*, Hope, the sculpturing of the prothorax is almost exactly like that of *basalis*; the oblique lines are, however, somewhat more distinct and form a W-shaped impression on the disk. The elytra may be described as somewhat *sparsely* punctulate, with the punctures evenly spread over the whole surface and diminishing in size to the apex. The prosternal process is provided posteriorly with a more or less distinct median tubercle.

It is difficult, from Hope's short diagnosis, to identify his species with certainty. The characters just given are taken from a species from Sierra Leone which Adam White had labelled *viridipennis*, Hope, and which agrees with Hope's description.

Plocederus gabonicus, sp. n.

Niger; elytris metallico-viridis, fusco tinctis; prothorace supra fortiter transversim rugoso, rugis anticis recte transversis, rugis pone medium sinuatis; elytris subtilissime griseo-pubescentibus, versus basin confertim punctulatis, versus apicem minutissime sat denseque punctulatis, apicibus truncatis, angulis dentatis; antennis (♀) corpore vix excedentibus, nigris (scapo badio excepto), articulis a quinto ad decimum apice interne denticulato-productis; pedibus femoribus (basi apiceque exceptis) rufo-testaceis, tibiis basi nigris; processu prosterni medio postice tuberculato.

Long. 30, lat. $9\frac{1}{2}$ mm.

Hab. Gaboon (W. Africa).

The strong and almost quite regular transverse wrinkling of the prothorax uninterrupted by any oblique impressions on the disk, the very close punctulation of the basal part of the elytra, and the median tubercle to the prosternal process will serve to distinguish this species from any of the similarly coloured and allied species.

Plocederus purpuripennis, sp. n.

♀. Niger; antennis pedibusque et abdomine rufescentibus, elytris metallico-purpurascentibus; prothorace supra transversim irregulariterque rugoso; elytris nitidis, minutissime subsparsimque punctulatis; processu prosterni postice in medio obsolete tuberculato.

Long. 26, lat. $8\frac{1}{2}$ mm.

Hab. Natal.

Black, with the antennæ, legs, and abdomen reddish, the elytra purplish metallic and very glossy. Prothorax above transversely and somewhat irregularly wrinkled, without oblique impressions on the disk. Elytra very minutely and somewhat sparsely punctulate, with the punctures almost equal in size and pretty evenly spread over the whole surface; apices truncate, with the outer angles dentate.

The character of the punctuation of the elytra is alone almost sufficient to distinguish this from any of the allied species. The species seems to me to come nearest to *P. viridipennis*.

Plocederus melancholicus (Dupont, MS.), sp. n.

Hamaticherus fucatus, Dej. Cat., nec Thoms.

Piceo-fuscus, subtiliter cinereo-pubescens; capite margine clypei leviter sinuata; prothorace supra irregulariter minus fortiter rugoso, sulcis obliquis obsoletis impresso; antennis articulis a quarto ad decimum apice interne denticulato-productis.

Long. 25–35, lat. $7\frac{1}{2}$–$10\frac{1}{2}$ mm.

Hab. West Africa.

Head with the clypeal margin slightly sinuate; with the frontal plaque almost in the form of a transverse carina. Antennæ with the third joint unarmed; with the joints from the fourth to the tenth each produced at the inner apical termination into a denticulate process. Prothorax acutely spined at the sides, irregularly and not very strongly wrinkled above, with some very faint oblique impressions, marking off a sort of diamond-shaped central area. Elytra dark brown with a tint of red, clothed with a rather faint ashy pubescence; closely and minutely punctured, with the punctures somewhat unequal in size; apices truncate, with the sutural angles briefly spined, the external angles dentate.

This species resembles *P. denticornis*, Fabr.; but in the latter the elytra are brownish black without any reddish tint; the third and fourth joints of the antennæ are each furnished at their inner apex with a sharp and strong spine standing out at right angles, and the remaining joints up to the tenth are produced into sharp spine-like processes. *P. Eminii*, recently described by Mr. Waterhouse, has been compared by him with the present species.

Plocederus fucatus, Thoms.

Thomson was certainly in error in quoting this species as the *fucatus* of Dejean's collection. From his description I have been able to identify three specimens from the Gaboon as belonging to his species, and they are very distinct from the species just described. With a strongly wrinkled and somewhat densely pubescent prothorax, a rather dense yellowish-grey silky pubescence on the elytra, and a rather short and stout form, the species may be easily enough recognized. It is most nearly allied to *P. spinicornis*, Fabr., but may be distinguished by the denser pubescence of the prothorax and elytra. The third joint of the antennæ is moreover very feebly spined or almost unarmed at the apex, whereas in *spinicornis* this joint is distinctly spined at the apex.

Plocederus spinicornis, Fabr.

Lamia spinicornis, Fabr. Spec. Ins. tom. i. p. 224.
Cerambyx denticornis, Oliv. Ent. iv. no. 67, p. 60.

This species, described from specimens in the Banksian cabinet, has apparently been omitted from the Catalogue of Gemminger and Harold. Olivier altered the name for a reason—at the time perhaps valid enough, but now no longer good. It is well to mention that, though Olivier's description is that of Fabricius's species, his figure accompanying it represents a quite different species, which appears to me to be *Prosphilus pilosicollis*, Thoms. *P. pubipennis*, White, is merely a slight variety of *P. spinicornis*, Fabr.

Plocederus consocius.

Cerambyx consocius, Pasc. (*Pachydissus* in Cat. Gemm. and Harold).

This species is very nearly related to *P. humeralis*, White, and the latter again to *P. pedestris*, White. In all three the prothorax is irregularly transversely wrinkled above and armed on each side with a rather short and somewhat blunt spine. The elytra are finely and closely punctured, the punctures on the basal part running together to form a fine rugosity. In *P. pedestris* the elytra, as well as the body, are black, with a very delicate greyish pubescence; the legs and antennæ are rufous; the elytra are very closely punctulate up to the apex. *P. humeralis* is wholly reddish ferruginous, with the exception of the shoulders of the elytra, which are fuscous; it is clothed with a very delicate grey pubescence; the elytra are closely punctulate as far as the apex. *P. consocius* is of a somewhat dull ferruginous colour, with the lateral borders of the elytra somewhat fuscous; the punctulation of the elytra towards the apex is sparser and more minute than in the two preceding, and the apex of the elytra is more distinctly quadrispinose. These differences are perhaps little more than varietal. There are indeed in the British Museum collection two specimens from Southern India which seem to be intermediate in characters between the North-Indian *humeralis* and the Ceylonese *consocius*.

Plocederus obesus.

Plocederus obesus, Gahan, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 51.

Since describing this species I find that one completely resembling it had a short time before been figured in the 'Indian Museum Notes' (vol. i. no. 2, pl. v. fig. 4 *a* and *b*) as the *Plocederus pedestris* of White. The latter species it cannot possibly be, and I am only in doubt whether the species figured is my *obesus* or the *ferrugineus* of Linnæus. Judging from the figure and the localities given I should say it is the former. The insect is stated to be injurious to timber-trees, and at page 91 of the 'Notes' some account of the habits of the larva is given. For the advantage of entomologists in India, and so that a correct determination of the species in question may be possible, I will supplement my short description of *Plocederus obesus*, and point out how it differs from *P. pedestris*.

Length 27–45 millim., or from about 1–1$\frac{3}{4}$ inch; width 9–15 millim.

Clothed with a short but rather dense fulvous-grey pubescence almost concealing the derm beneath it; the latter where rubbed is seen to be of a reddish chestnut or testaceous colour. The antennæ in the male are much longer than the body, ferruginous, with the intermediate joints usually tipped with black at the apex, with the scape finely rugose-punctate, with the remaining joints up to the tenth very minutely granulate, and with the fifth to tenth joints denticulately produced at their inner apical termination. The antennæ in the female are as long as or a little longer than the body, with the third to tenth joints smooth and pubescent and with the fifth to tenth joints denticulately produced, as in the male. Prothorax irregularly transversely wrinkled above, thickly pubescent, with the anterior and posterior borders somewhat blackish; armed at the middle of each side with a strong, sharp, and slightly recurved spine. Elytra with a close fulvous-grey pubescence, with usually the sutural line and the extreme lateral margins black; very closely and regularly punctulate throughout; apices truncate, with the angles briefly spinose.

From *pedestris* this species can be readily distinguished not only by its size, colour, and dense pubescence, but more especially by the strong sharp spine with which each side of the prothorax is armed; the *rugæ* of the pronotum also are more numerous and more wavy in appearance.

Massicus Fryi, sp. n.

Pube brevi fulvo-grisea sat dense obtectus; capite supra inter oculos sulco brevi longitudinali; antennis (♂) corpore duplo longioribus, scapo transversim rugoso et ad apicem intus subangulato, articulis tertio quartoque incrassatis; prothorace lateraliter in medio valde rotundato, supra irregulariter corrugato, antice et postice transversim sulcato; elytris subelongatis, pube pallidiore subcinerea, sub humeris subglabris, fuscis, apicibus truncatis, angulis suturalibus breviter spinosis; processu prosterni postice valde prominente et utrinque leviter tuberculato.

Long. 50, lat. $12\frac{1}{2}$ mm.

Hab. Borneo. In the collection of Mr. Fry.

Amongst known species (*Cerambyx*) *venustus*, Pasc., seems most nearly allied to the present one. Though appearing to be congeneric, the differences between the two species are well marked. In *venustus* (♂) the scape of the antennæ is not angulate at the apex, but carries there a cicatrice limited by a short and not very sharp carina; the third joint is a little longer than the scape or fourth joint; the fifth to eighth joints each bear a small spine at their outer apical termination. The prothorax is only slightly rounded at the sides, and above it is almost regularly transversely wrinkled. In the present species the scape is slightly angulate at the apex on the inner and inferior face, carries no distinct carina, and is subequal in length to the third joint, the latter not being longer than the fourth; not one of the joints of the antennæ is spinose at the apex on the outer side, though the joints from the sixth to the tenth are, as in *venustus*, denticulately produced at their inner apex. The prothorax is fully rounded in the middle at the sides, is narrowed at the base, and still more at the apex; the whole space above between the anterior and posterior transverse grooves is covered with numerous rather short and irregular ridges *. Mr. Fry had placed this species in the genus *Massicus*, and I have no doubt that this is the best place for it.

[To be continued.]

XXXI.—*Descriptions of new Species of African* Lycænidæ, *chiefly from the Collections of Dr. Staudinger and Mr. Henley Grose Smith.* By W. F. Kirby, F.L.S., F.E.S., &c.

A large number of African Lycænidæ have been kindly sent over to Mr. H. Grose Smith by Dr. Staudinger to be figured in 'Rhopalocera Exotica,' several of which have already been published in that work or will appear immediately. By far the larger number, however, cannot be figured for some little time, and I therefore publish descriptions, pending the appearance of the figures. Nearly all belong to genera which have already been more or less fully treated of in the section of our work devoted to African Lycænidæ.

Genus Aslauga, gen. nov.

Wings short and broad, very densely scaled; anterior wings strongly curved outwards in the middle of the hind margin; posterior wings with a concavity on the inner margin at the anal angle. Anterior wings with the subcostal nervure five-branched, the first two branches emitted near together before the end of the cell and parallel, the other three short and emitted near the apex of the wing; the third and fourth parallel, running into the costa before the apex, the fifth running to the hind margin just below the apex.

Aslauga marginalis.

Exp. 1 inch.

Male.—Upperside tawny, with the hind margins and the costa of the anterior wings rather broadly brown.

* Since writing the above I have seen a second male specimen in the possession of Mr. Oliver Janson. In this the prothorax is much more regularly transversely wrinkled, and in that respect presents little difference from *venustus*, Pasc.

Underside uniform yellowish tawny.

Body brown, abdomen tawny (antennæ wanting).

Hab. Sierra Leone.

In the collection of Mr. Henley Grose Smith.

Allied to *Liphyra vininga*, Hew., which is evidently congeneric.

Allotinus similis.

Exp. $1\frac{1}{6}$ inch.

Upperside as in *A. zymna*, Westw., but posterior wings less produced.

Underside: Anterior wings white, grey towards the costa and hind margin, with two grey, transverse oval spots in the cell and two white submarginal festooned lines towards the hind margin. Posterior wings pearly grey, with six or seven white transverse lines formed of connected lunules.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Pseuderesia cellularis.

Exp. $1\frac{1}{4}$ inch.

Male.—Upperside rich tawny, the base and costa of the anterior wings and the inner portion of the posterior wings irrorated with brown; apical third of anterior wings and the hind margins of all the wings rather broadly bordered with black. Anterior wings with some small spots towards the base, a very large one at the end of the cell, and a few others towards the dark border, from which the larger ones are hardly separated.

Underside: Anterior wings with the costa, apex, and hind margin blackish, densely irrorated with yellow; the lower part of the base is of a dull black, the disk being fulvous; the spot at the end of the cell is well marked; there is an oblique row of large connected spots towards the apex, beyond the cell, and a row of small, sagittate, submarginal black spots before the fringes. Posterior wings dirty yellow, with a circle of five large round spots near the base, having a smaller one in the centre; besides these, there is a large one on the middle of the costa and a small one on the middle of the inner margin; hind margin preceded by a festooned black line, within which is a row of large spots.

Female.—Upperside similar, but of a paler fulvous, with narrower borders, and with fewer traces of the submarginal black spots.

Underside of a clearer yellow, with the spots and black markings smaller; on the posterior wings the central spot in the circle is absent.

Hab. Cameroons.

In the collection of Dr. Staudinger.

Allied to *P.* (*Liptena*) *parva*, Kirb.

Pseuderesia paucipunctata.

Exp. $1\frac{1}{4}$ inch.

Female.—Upperside tawny; anterior wings with the apex blackish, from two thirds of the length of the costa to two thirds of the length of the hind margin, beyond which the border is continued as a narrow line to the hinder angle. Posterior wings with the fringes blackish. A large spot at the end of the cell on all the wings.

Underside tawny yellow, with the costa and apex of anterior wings and the whole of the posterior wings irrorated with brown; besides the spots closing the cells, there is one in the cell of the anterior wings and a smaller one above the cell of the posterior wings. Posterior wings with very indistinct traces of four submarginal dusky spots, one towards the tip and the other three towards the anal angle.

Hab. Cameroons.

In the collection of Dr. Staudinger.

Possibly an extreme variety of *P. Petreia*, Hew. (of which *T. Preussi*, Staud., is a synonym), which seems to vary considerably in depth of colouring and in the extent of the dark border on the posterior wings, and to a less extent in the number of spots.

Pseuderesia turbata.

Exp. a little over an inch.

Male.—Upperside reddish tawny, the costa and tip of anterior wings and the hind margins rather broadly brown.

Underside paler tawny. Anterior wings with two black spots in the cell, the costa irregularly black, throwing out a broad band at the end of the cell; the paler apex is cut off by another oblique irregular band, and the costa and the space between this band and the hind margin are likewise spotted with black; fringes black, and a submarginal black line on the upper part of the wing. Posterior wings more buff; two spots on the costa above the cell, one large spot above, and two in the cell, which is itself closed by a black line, and three spots below the cell; the rest of the wing is marked with large irregular black blotches. The black fringes are preceded by a zigzag black line.

Hab. Cameroons (*Preuss*).
In the collection of Dr. Staudinger.
Allied to *P. parva*, Kirb., and *P. petreia*, Hew.

Pseuderesia similis.

Exp. a little over an inch.

Female.—Upperside nearly as in *P. turbata*, but the costa of the posterior wings brown for two thirds of its length.

Underside: Anterior wings red; costa black for one third of the breadth of the wing to beyond the cell; then the reddish space runs up, separating it from the apical area, which is marked with two much dentated grey lines; the border itself is grey, edged within by a black line on its upper half. Posterior wings grey, with a black spot on the costa, two very large subcostal spots, three in the cell, the last linear, closing it, and three below; the marginal area is occupied by three rows of black zigzag spots separated by two rows of grey ones. Fringes grey, edged within by a black and then by a grey line.

Hab. Cameroons (*Preuss*).
In the collection of Dr. Staudinger.
This might be the female of *P. turbata*, but the marginal markings of the posterior wings beneath are very different.

Pseuderesia debora.

Exp. $1\frac{1}{10}$ inch.

Male.—Upperside dull black, the incisions scaled with white. Posterior wings with a large orange blotch extending from the second submedian nervule to the inner margin just above the anal angle.

Underside: Anterior wings more of a slate-colour; costa and hind margin dusted with grey, inner margin paler, with a whitish blotch at the hinder angle; three red spots placed obliquely near the apex of the wings. Posterior wings dull black dusted with grey; a broad red band formed of three nearly connected spots crosses the middle of the cell, but does not extend to the costa or inner margin; within this is a row of smaller spots, three red and two black, placed alternately, and at the base is another red spot; beyond each of the upper and lower red spots of the band stands a black spot, and after these another row of three disconnected red marks, a large one near the costa, a line closing the cell, and a small spot below; beyond the line is another large red spot; beyond these is a series of seven red spots edged within with black ones (and slightly edged with black on the outside too), one on the costa, three connected spots, placed much nearer the hind margin, and another series of three connected spots, running towards the anal angle.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Pseuderesia dinora.

Exp. $1\frac{1}{4}$ inch.

Upperside reddish tawny (lighter in the female than in the male), with the base and costa blackish and the apex of anterior wings broadly, and the hind margin below and that of the posterior wings rather narrowly, black; cell of the anterior wings closed by a large round black spot, not separated from the black colour of the costa; that of the posterior wings closed by a short black bar.

Underside: Anterior wings mostly black, costa irrorated with pale yellow in patches; apex with a large yellow blotch, from which smaller yellow spots extend down the hind margin; disk towards the hinder angle with a large fulvous blotch, spotted and irrorated with black.

Posterior wings grey, yellow at the base and with a yellow blotch at the tip; between this and the anal angle is a thick black, festooned, submarginal line, enclosing three small yellow spots; within this are two large red spots, and within these an angulated row of seven large spots from the costa to the inner margin; the third is red and adjoins a black spot, within which again is a large black spot closing the cell; in the cell is a small spot, and there are two or three more large and small ones towards the costa, and again towards the inner margin.

In the female the markings are rather more suffused, and one of the large spots on the costa of the posterior wings near the base adjoins a red dot.

Hab. Cameroons.

In the collection of Dr. Staudinger.

Very distinct from the other species of the group of *P. parva* by the three large red spots on the underside of the posterior wings.

Durbania gerda.

Exp. 1 inch.

Female.—Upperside orange-tawny, hind margins slightly scalloped. Anterior wings paler on the disk, with a brown spot at the end of the cell, the costa slightly irrorated with brown; the apical area with a brown shade running downwards parallel to the hind margin, which it does not touch, except at the apex; fringes marked with a blackish interrupted line at their base, swelling into more distinct spots at the extremities of the nervures. Posterior wings nearly uniform in colour; fringes slightly speckled with blackish.

Underside: Anterior wings rather paler than above, irrorated with black on the costa above the cell; a large brown spot at end of cell; at one third of the distance between this and the apex are a series of four oblong spots placed obliquely, two larger and darker ones on the costa, nearly connected, and two others below; marginal area irrorated with brown, and with a submarginal row of long blackish spots on a paler ground, dusted with grey; fringes preceded by a broken blackish line, most continuous below. Posterior wings brownish tawny, with rather indistinct markings; two dusky spots above the cell, two below, and one at the extremity; beyond the cell are two festooned lines of connected lunules, the outermost preceding a more continuous series of darker lunules, the space between dusted with grey; a series of blackish spots at the extremities of the nervures.

Body tawny above; legs and antennæ black, spotted with white.

Hab. Barombi (*Preuss*).

In the collection of Dr. Staudinger.

Allied to *D. aslauga*, Trim.

Larinopoda sylpha.

Exp. about 1 inch.

Semitransparent white, with iridescent ashy borders along the costa of the anterior wings and all the hind margins, ceasing at the anal angle of the posterior wings; the costal border of the anterior wings sends off a projection at the end of the cell, most strongly marked in the female.

Antennæ black, ringed with white; club long, slender, pointed; legs and under surface of abdomen yellow.

Sexes nearly similar.

Differs from our figure of *L. muhata*, Dew., ♂ (Rhop. Ex. Afr. Lyc. pl. ii. figs. 1, 2), by the absence of the black spot on the posterior wings.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Larinopoda opaca.

Exp. rather over an inch.

Opaque white, with rather broad brown border on the costa of anterior wings and on the hind margins of all the wings; a large oval spot at the end of the cell of the posterior wings; on the under surface the border does not quite reach the hinder angle of the anterior wings. Fringes grey, with a blackish line at the base, separated from the broad border by a whitish submarginal line.

Legs yellow; abdomen white: antennæ black, ringed with white; club black, tipped with yellow.

Hab. Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Tingra lavinia.

Exp. $1\frac{1}{4}$ inch.

Male.—Upperside white, with rather large black spots on the costa towards the apex of fore wings, at the ends of all the cells, and at the ends of the nervures on all the hind margins, and one nearer the base above the cells; under this, on the anterior wings only, is occasionally another spot in the cell on the underside; extreme base of the wings slightly stained with yellow; apex of anterior wings slightly bordered with ashy above.

In the collections of the British Museum (Gaboon) and Dr. Staudinger (Ogowe).

Allied to *T. torrida*, Kirb., but a larger, paler, and broader-winged insect.

Tingra laura.

Exp. $1\frac{1}{4}$ to $1\frac{1}{2}$ inch.

Male.—Upperside white, tinged with tawny at base. Anterior wings: costa irrorated with black, tip ashy to the lowest submedian nervule, its upper part edged within with three black spots, nearly lost in the ashy colouring; another spot at end of cell, two small ones in the cell, on one side only, and two on the disk opposite the lowest part of the border. Posterior wings with a spot on the costa above the cell, and another at its extremity; other spots on the under surface showing faintly through.

Underside white, tinged with yellow on the costa and at the apex of the anterior wings, and on the posterior wings, chiefly at base and tip; hind margins spotted with black on the nervures. Anterior wings with a row of spots above the cell (only one distinct, the costa being irrorated with black), one at the end of the cell, and two submarginal rows at the apex, the outermost (nearly straight) of three larger, and the innermost (oblique) of four smaller spots. Posterior wings with a small spot at base of cell, a large one on the costa above the cell, a small one below the cell, and another at its extremity, beyond which is an angulated row of six spots running from the costa, and a shorter row of three between the upper ones and the apex.

Female.—Upperside white; apex of anterior wings rather broadly ashy, but this colour ceases on the hind margin at the lowest median nervule; a conspicuous black spot at the end of the submedian nervure, and of all the nervures of the posterior wings except the first branch of the subcostal; the only other distinct spots on the upperside are those at the ends of the cells and a small one in the cell of the anterior wings, but some of the others are also slightly indicated.

Underside white, the ends of the nervures marked with small black spots. Anterior wings with a row of four small subcostal spots, two spots in the cell besides the larger one at its extremity, and another in the fork of the two lower median nervules. Posterior wings with a large spot above the middle of the cell, a small one at the base of the cell, a large one at its extremity, and one in the fork of the nervures below; a submarginal row of six small spots, angulated outwards in the middle, commencing with a spot larger than the others on the costa.

Antennæ black, tipped with tawny in both sexes.

Hab. Lagos.

In the collection of Dr. Staudinger.

Tingra fatima.

Exp. $1\frac{1}{4}$ inch.

White, slightly stained with orange at the base of the costa. Anterior wings with the apex dark ashy to below the upper submedian nervule; a large black spot at the end of the cell of all the wings.

Underside white, with black discoidal spots, and a black line at the base of the fringes; within it is a second on the upper half of the anterior wings.

Hab. Cameroons.

In the collection of Dr. Staudinger.

The sexes do not differ.

Teriomima decipiens.

Exp. rather more than 1 inch.

Upperside white, costa (narrowly, but most broadly towards the base) and apex, as far as the upper branch of the submedian nervure, ashy.

Underside more inclining to yellowish, with two submarginal yellow stripes in the male and one in the female; fringes of anterior wings edged with a black line, as far as the ashy patch of the wing extends on the upper surface.

Antennæ black, slightly spotted with white; club long and rather slender.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

The sexes hardly differ.

Teriomima delicatula.

Exp. rather under an inch.

Male.—Upperside white, the apical third of the anterior wings ashy. Posterior wings with a few small marginal dots.

Underside tinged with yellow on the posterior wings and on the costa and apex of the anterior wings. Anterior wings with a row of ashy spots on the costa, an oblique row on the inner side of the yellowish apical shade, and a spot at the end of the cell and a small dot within it. Posterior wings with a spot in the cell, spots above and below, and a streak at the end of the cell, and two rows of small obsolete spots nearer the hind margins.

Antennæ black, ringed with white; club long and rather slender.

Hab. Usugara.

In the collection of Dr. Staudinger.

Closely allied to *T. subpunctata*, Kirb., but with the spots much smaller, less numerous, and differently arranged.

Teriomima serena.

Exp. about 1 inch.

Upperside yellow; apex of anterior wings black, from two thirds of the length of the costa, curving round the hind margin to the hinder angle, where the border ends in a point. Posterior wings rather narrowly bordered with black from below the tip to the anal angle.

Underside paler, posterior wings inclining to whitish; anterior wings with a row of black dots on the costa and one at the end of the cell; all the hind margins with the ends of the nervures marked with black, which forms a nearly continuous line towards the apex of anterior wings; no discoidal spot on posterior wings.

Antennæ black, the shaft ringed with white.

The sexes hardly differ.

Allied to *T. tenera*, Kirb., but differs from all the allied species by the continuous *narrow* border to the posterior wings.

Hab. Sierra Leone (*Preuss*).

In the collection of Dr. Staudinger.

Teriomima modesta.

Exp. rather over an inch.

Male.—Upperside uniform smoky brown; fringes rather paler, spotted neither above nor below.

Underside clearer brown, with white spots. Anterior wings speckled with white at the base; two spots in the cell, above the second is the first of a row of two or three subcostal dots, followed by a transverse row of four larger spots; two submarginal rows of spots (four in each) on the upper half of the wing; below these are two larger ones in a single line; the first spot of the inner series is preceded by a small subcostal dash; the second and third spots of the outer series have a small dash on the outside, and the fourth spot of the outer series is the smallest, being reduced to a dash. Posterior wings with two large spots on the costa, two in the cell, and a third (double) closing it; two more rather irregular series of spots below the cell and a double row of submarginal spots, some of the lower ones of the outer row with smaller adjacent dashes on the outside.

Antennæ black, spotted with white on the underside; the club long, gradually formed, and tipped with tawny.

Hab. Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Differs from *T. adelgitha*, Hew., in the unspotted fringes and upper surface.

Teriomima cordelia.

Exp. nearly an inch.

Upperside purplish blue, shading into dusky towards the apex of the anterior wings; fringes blackish. Thorax clothed with rich purple or green hairs.

Underside brown, speckled with tawny at the base and costa of the anterior wings and on the basal half of the posterior wings. Anterior wings (on their upper two thirds) with two, and posterior wings with three rows of submarginal lines or nearly connected crescents of tawny dusting.

Head with a tawny line within each eye; antennæ black, ringed with white; club gradually formed, tipped with tawny; legs tawny, banded with brown.

Hab. Cameroons (*Preuss*), Ogowe (*Bokh.*).

In the collection of Dr. Staudinger.

Allied to *T. dispar*, Kirb., and *T. melissa*, Druce, but differs from the former and apparently also from the latter in the markings of the underside.

Teriomima dubia.

Exp. $\frac{9}{10}$ inch.

Male.—Upperside brown, distinctly suffused with purple, and with or without a whitish spot beyond the end of the cell of the anterior wings.

Underside brown, with two or three tawny spots or markings in the cells and an indistinct double row of submarginal tawny markings; the white spot as above on anterior wings, and an interrupted, rather indistinct, tawny stripe running beyond the cell on the posterior wings.

Antennæ black, ringed with white; club tipped with orange. Body rich purple and coppery green in some lights.

Hab. Sierra Leone and Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Perhaps a variety of *T. melissa*, Druce.

Epitola badura.

Exp. $1\frac{1}{3}$ inch.

Male.—Anterior wings rather pointed; posterior wings rounded.

Upperside deep blue. Anterior wings with the costa (broadly), apical third, hind margin, and a basal stripe on the lower part of the cell black; inner margin with a few coppery-green scales. Posterior wings with the costa broadly and hind margin narrowly black.

Underside greyish brown, with a row of submarginal lunules of greyish dusting, within which is a broader stripe of the same kind; across the wings runs an irregular series of lines and zigzags of greyish dusting.

Hab. Cameroons.

In the Hewitson Collection of the British Museum as the male of *E. cercene*, Hew.; and in that of Mr. H. Grose Smith.

Allied to *E. dunia*, Kirb., but of a deeper blue and without the oblique pale zigzag line on the underside of the anterior wings.

Epitola Staudingeri.

Exp. $1\frac{1}{3}$ inch.

Male.—Upperside bright blue. Anterior wings with the costa, apex, and hind margin narrowly black; a very large oblong black blotch projects into the wing from the lower part of the hind margin, filling up the whole space nearly to the cell, from the inner half of the upper discocellular nervure to below the lowest branch of the median nervure. Posterior wings blue, with the costa, inner margin, and fringes black.

Underside uniform greyish brown, without markings. Legs brown, ringed with grey.

Hab. Sierra Leone (*Preuss*).

In the collections of Dr. Staudinger and of Mr. P. Crowley.

Epitola zelica.

Exp. $1\frac{1}{4}$–$1\frac{1}{3}$ inch.

Upperside light blue, with a purplish shade in some lights. Anterior wings with the costa above the cell and the apex broadly blackish brown, the dark colour diminishing triangularly to the hinder angle. Posterior wings with the costa above the cell, the inner margin, and the hind margin (narrowly) blackish brown.

Underside white, with an obsolete straight pale yellowish line and two or three obsolete zigzag lines between this and the cell. In the female these indistinct markings are wanting, and there is only a blackish line at the base of the fringes of the anterior wings, which is also present in the male.

The sexes do not differ otherwise.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Allied to *E. zerina*, Hew., but in that species the upperside is of a deeper blue and the underside is much more heavily marked.

Epitola Henleyi.

Exp. $1\frac{1}{2}$ inch.

Upperside black and deep violet-blue, the blue portions of the wing broken up into spots by black spaces, especially along the nervures.

Underside brown; a pale space on the inner margin of anterior wings, from which two rows of pale submarginal spots run towards the costa—the outermost row formed of three nearly contiguous spots; the innermost row of three spots, of which the two upper ones are contiguous, separated from the third. Posterior wings with traces of two paler bands, parallel to the hind margin.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Upperside hardly distinguishable from *E. hyetta*, Hew., with which a specimen of *E. Henleyi* from Calabar is placed in the Hewitson Collection of the British Museum; but the underside is very different.

Epitola catuna.

Exp. 1–$1\frac{1}{4}$ in.

Male.—Upperside deep purplish blue, with rather broad blackish margins, the nervures narrowly black; fringes grey.

Underside greyish brown. Anterior wings darker at the base to beyond the cell; at the end of the cell stands an obsolete grey spot; the darker portion of the wing is bounded by a row of obsolete grey spots, much expanded on the inner margin; on the hind margin is a row of obsolete grey lunules, dividing into two rows on the upper half of the wing. Posterior wings with three submarginal rows of broad obsolete grey lunules, the innermost most indistinct.

Antennæ and legs very slightly ringed with white, only the extreme tip of the former tawny.

Hab. Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

Resembles *E. hyetta*, Hew., on the upperside, and the group of *E. cercene*, Hew., below.

Epitola doleta.

Exp. $1\frac{1}{6}$ inch.

Male.—Upperside blackish brown, with bright blue markings. Anterior wings with scattered blue markings towards the base of the cell, a short bar just beyond the middle of the costa running obliquely outwards, and a band running nearly to the hind margin between the median and submedian nervures. Posterior wings with the whole space between the upper part of the cell and the submedian nervure filled up with blue nearly to the hind margin.

Underside as in *E. catuna*; in one specimen the paler markings are almost entirely obsolete.

Hab. Sierra Leone (*Preuss*).

In the collection of Dr. Staudinger.

Perhaps the male of *E. cephena*, Hew., which it somewhat resembles on the under surface.

Epitola perdita.

Exp. rather over an inch.

Male.—Anterior wings rather pointed, with the hind margin oblique. Posterior wings oblong, nearly rectangular.

Upperside black. Anterior wings rich blue from below the cell to the inner margin. Posterior wings with a large blue patch filling up two thirds of the lower part of the wing, but nowhere extending to the margins.

Underside: Anterior wings slate-colour, with a pale grey spot at the end of the cell and two more, nearly connected, near the hinder angle; apex reddish, edged by a submarginal coppery-green line from near the apex to the middle of the hind margin. Posterior wings reddish, shading into buff towards the base, with a submarginal row of silvery-green lunules, edged with black within and (less distinctly) without. A Y-shaped series of silvery-green markings edged with black lines, not extending to the costa, across the middle of the wing.

Hab. Cameroons.

In the collection of Mr. H. Grose Smith.

Epitola (?) *barombiensis.*

Exp. rather more than an inch.

Anterior wings obtusely pointed at the apex, with the hind margin very convex. Posterior wings rounded.

Upperside purplish blue. Anterior wings with the costa, apex, hind margin, and nervures black; cell black, with irregular purplish markings towards the base; inner margin but thinly scaled with purple. Posterior wings with the costa and inner margin broadly and the hind margin more narrowly black.

Underside grey, a dark brown cloud extending from the base of the inner margin obliquely to beyond the cell; thence, after an interruption, it spreads more broadly over the whole apical portion of the hind margin, except where it is slightly interrupted towards the costa before the apex. Posterior wings speckled with smoky brown, darkest on the hind margin, where it shades into a broad border, ill-defined towards the base and not extending to the anal angle.

Hab. Barombi, Cameroons (*Preuss*).

In the collection of Dr. Staudinger.

MISCELLANEOUS.

Leaf-winged Locust. By J. J. Quelch, B.Sc.

Of all the many varied and really wonderful contrivances to be met with in nature tending towards the protection of various harmless creatures which are preyed upon by other forms, perhaps none are as wonderful as, certainly none are more remarkable than, the condition of the anterior pair of wings in certain of the Locustidæ, such as *Pterochroza* and other closely allied forms. In many genera of the family the front wings are elongated and narrow, like the wings of the grasshoppers, and are not only coloured green, like the ordinary leaf of a plant, but are furnished with a large subcentral vein like the midrib of a leaf, with small veins springing therefrom. In *Pterochroza* and the other special forms referred to, of which a few different examples have lately been added to our museum collection, the leaf resemblance is carried to a most perfect degree. In shape they are ovate, and generally, as in the common elm-leaf, the one side is somewhat wider than the other, according to the depth of the curve of the central vein, which is thickened like a midrib. From this side-veins pass off in all directions, branching and reticulating, exactly as in the case of the leaf of an ordinary dicotyledonous plant. The colouring of the wings is even more remarkable, the tint varying according to the species. In one the shade varies from reddish brown or reddish yellow to a dull purple, and closely resembles the shades to be found on the young leaves of many of the forest-trees, and more especially on the mora (*Mora excelsa*). In another the tint is of a deep green, which is said to fade away gradually on continued exposure to light after the death of the insect. In a third it is of a very pale yellowish brown, much like the colouring on an old and fading leaf about to fall from the plant; while in a fourth it is a dull dead brown, like that of a sere and fallen leaf.

As though to give a more complete naturalness to the already seemingly quite natural leaves, variably sized spots of brown or yellowish white are sparsely scattered about the surface, just as are to be found so commonly upon leaves.

Observations upon the growth, life-history, and habits of these forms are much needed; but the specimens seem to be extremely rare—though it is much more likely that, inhabiting the foliage of trees and bushes, they are seldom, and then only accidentally, discovered. It is suggestive that the forms in the museum were only obtained when they had strayed into houses in or by the forest on the Mazaruni River.—*Journal of the Royal Agricultural and Commercial Society of British Guiana*, June 1890, p. 141.

On the Histological Constitution of certain Nematodes of the Genus Ascaris. By M. Léon Jammes.

Naturalists who have studied the histology of the Nematodes up to the present time have asserted that the layer named by them *granular layer* was not cellular in the adult. Leuckart, however, thought that there existed an epithelial layer formed by very small elements, situated internal to and close against the muscle-cells.

In the investigations in which I am engaged, on certain species of Nematodes, and in particular *Ascaris megalocephala*, *A. lumbricoides* (calf), and *A. suilla* (Dujardin), I have never been able to establish the existence of this layer. With the aid of the histological apparatus in use at the Faculty of Sciences of Toulouse I have long sought in the granular layer for any traces of an ectoderm. The granular layer is limited on one side by the cuticle, on the other by the muscular layer.

But, on the other hand, these researches have brought to light certain particulars relating to the granular layer: transverse sections at the horizon of the œsophagus show the continuity and structural identity of the œsophageal nervous ring and of the granular layer. Both are made up of fibrils interspersed with cells. The fibrils of the nervous ring on arriving at the body-wall bend inwards and distribute themselves between the cuticle and the muscular layer; after this the nervous system and the muscular layer affect connexions so fine that it is impossible to assign their exact limits.

Longitudinal sections at different horizons show little beds of cells in the granular layer, often disposed in several rows but never forming a continuous epithelium.

These cells present various appearances: rarely cubic, sometimes rounded, most often flattened parallel to the body-wall, they bear a variable number of prolongations. It is these prolongations which contribute to give the layer its fibrillar and felted aspect in the sections.

No intercellular substance is ever found between them.

The cells of the granular layer are stained a uniform violet by chloride of gold, whilst this reagent colours the cuticle rose and purple. The external segmentation as revealed by this infiltration does not correspond, at least in the adult, with any internal metamerization.

The great similitude of structure of the granular layer and of the nervous system leads us to think that the granular layer represents the ectoderm. This latter would differ much in its constitution from the ectoderm of other Metazoa; it would be made up, in effect, of neuro-epithelial elements, and the nervous system described by authors would only be a condensation of this mass at different points in the body.

However, this idea needs corroborating by embryological researches, in which I am now engaged.—*Comptes Rendus*, July 7, 1890, p. 65.

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XXXII.—*Notes on Slugs, chiefly in the Collection at the British Museum.* By T. D. A. Cockerell.

The following notes result from a study of various species of slugs, many of them new or hitherto ill-understood, which I have been able to examine recently. Most of the specimens referred to are in the British Museum, though some few are in private collections. I have to thank Mr. E. A. Smith for affording me every facility at the Museum; and I am also greatly indebted to Mr. W. G. Binney for the opportunity of examining many species of American slugs.

I. *Ariolimax*, *Anadenus*, and *Prophysaon*.

This group of *Arion*-like slugs has not been very well understood, partly, no doubt, because of the difficulty of obtaining specimens of the species. I have been fortunate in seeing quite a large series of forms, which I tabulate as follows:—

A. Sole not differentiated into parts; respiratory orifice anterior; genital orifice close to right eye-peduncle.

(1) No caudal mucus-pore.... Gen. *Prophysaon*, Bld. & Binn., 1873.

Sect. *a. Fasciati.* Body with dark dorsal band.

i. Jaw ribbed .... *P. fasciatum*, Ckll.
ii. Jaw striate, not ribbed. *P. humile*, Ckll. (præc. var.?)

Sect. *b. Cærulei.* Body without dorsal band, reticulation comparatively simple .... iii. *P. cæruleum*, Ckll.

Sect. *c. Typici.* Body with a pale dorsal line.

iv., v. Ochreous species. *P. pacificum*, Ckll., and *P. flavum*, Ckll. (præc. var.?).

vi., vii. Greyish species. *P. Andersoni*, Coop., and *P. Hemphilli*, B. & B. (præc. var.).

(2) With a caudal mucus-pore. Gen. (præc. subg.) *Phenacarion*, Ckll., 1890.

i. Back with no dark band.
P. foliolatum, Gould.

ii. Back with a dark band.
P. Hemphilli, W. G. Binn.

B. Sole differentiated into parts; respiratory orifice nearly median or slightly posterior.

(1) No caudal mucus-pore.

(1*a*) Genital orifice close to right eye-peduncle; back keeled.
Gen. nov. *Anademulus*, Ckll.
i. *A. Cockerelli*, Hemph.

(1*b*) Genital orifice not close to right eye-peduncle; back not keeled.
Gen. *Anadenus*, Heyn., 1863.

Sect. *a. Sulcati.* Body with deep transverse sulci.
i. *A. Jerdoni*, G.-Aust.

Sect. *b. Altivagi.* Body with oblique fine sulci.
ii. *A. altivagus*, Theob.
iii. *A. modestus*, Theob. (præc. juv. ?).
iv. *A. Schlagintweiti*, Heyn.

(Sect. ? v., vi. *A. Blanfordi*, G.-A., *A. insignis*, G.-A., not seen by me.)

(2) With a caudal mucus-pore; genital orifice not close to right eye-peduncle .... Gen. *Ariolimax*, Mörch, 1860.

Sect. *a. Maximi.* Large species.
i. *A columbianus*, Gould. (California to British Columbia.)
ii. *A. californicus*, Cooper. (California.)
iii. *A. costaricensis*, Ckll., nov. (Costa Rica.)

Sect. *b. Parvuli.* Smaller species.
iv. Sole mottled .... *A. niger*, Coop.
v. Sole not mottled.. *A. Hemphilli*, W. G. B.

(Also of this genus: vi. *A. Andersoni*, W. G. B.; vii. *A. Hecoxi*, Weth., spp. dub.)

Later on I shall have to publish some rather copious notes on the American species; meanwhile it will be useful to note :—

1) *Prophysaon humile.*—I do not feel certain that the character of the jaw is really specific; it may be an aberration, but this cannot be settled until we have a series of specimens to examine. I have placed the type specimen in the British Museum.

(2) *Prophysaon flavum.*—The difference between the sole of this and *pacificum* observed may be partly due to postmortem contraction. Possibly *flavum* is a variety of *pacificum.*

(3) *Prophysaon Andersoni*, Coop., has priority over *P. Hemphilli*, B. & B., and I cannot detect any specific difference between them. *P. Andersoni*, W. G. B., belongs to *Fasciati*, and is *P. fasciatum*, Ckll.

(4) *Phenacarion* is very near to *Prophysaon*; indeed it is most difficult to separate *P. foliolatum* and *Pr. Hemphilli* specifically. I have not seen any good material of *Phen. Hemphilli*, W. G. B., but it appears to be a distinct species. If *Phenacarion* is not kept as a genus and *Proph. Hemphilli* is regarded as distinct from *Andersoni*, then *P.* (*Phen.*) *Hemphilli* will require a new name.

(5) *Anadenulus Cockerelli.*—I at first referred this species, of which I saw the types, to *Anadenus*; but it is really distinct enough to be separated from it, besides being American, while the true *Anadeni* are Asiatic. The genital orifice in true *Anadenus* is quite a long way from the right eye-peduncle, as in *Ariolimax.*

(6) *Ariolimax columbianus* and *californicus* are hardly to be separated as species; *californicus* is more keeled and has a narrower sole. *A. Hecoxi*, a third species from the United States, has never been described, and cannot be recognized. Mr. Binney informs me it is a large species.

(7) *Ar. Andersoni*, W. G. B., is a doubtful species, probably a variety of *A. niger*. The "foliated appearance" is not specific, as it occurs also in *A. niger.*

Ariolimax costaricensis, subsp. nov.

A. californicus, subsp.—Length 68 millim. (in alcohol), mantle 27 millim. long, respiratory orifice 19 millim. from anterior border; sole 17 millim. broad. Colour dark olivaceous. Back well keeled for about 18 millim., keel inclined to be flexuose. General form of *californicus*. Sole transversely wrinkled-sulcate, especially lateral areas. Rugæ like *californicus*, about 17 rows on each side of body, counting from dorsum to sole. Mantle rather finely granulose. Caudal pit distinct. Jaw dark, ribbed.

The alcohol in which they have been is coloured yellow.

Hab. Costa Rica (*Mr. Janson*). Four specimens in British Museum.

Anadenus Jerdoni, G.-Aust.

Godwin-Austen's type of this extraordinary slug, from Cashmere (coll. Jerdon), is in the British Museum; I made the following notes supplementary to the original description:—Jaw dark, not greatly curved, with about twelve strong ribs. Body with transverse deep sulci, stronger than the longitudinal ones. Mantle broadly ovate. Colour entirely greyish ochreous. Respiratory orifice 28 millim. from anterior border of mantle. Mantle 38 millim. long. Slug about 90 millim. long. External genital orifice beneath anterior right border of mantle, 9 millim. from base of right eye-peduncle and 5 millim. from edge of sole. Sole with median and lateral areas not strongly differentiated. This species departs considerably from the ordinary type of *Anadenus*.

Anadenus altivagus, Theob.

Two specimens from Simla (*Theobald*) in British Museum, from which I made the following notes:—

Length 47 millim. Mantle oval, 22 millim. long, unicolorous, granulose; respiratory orifice 14 millim. from anterior border. Sole very broad, lat. 18 millim.; median area, lat. $6\frac{1}{2}$ millim., thus nearly the same width as either lateral area. Sole finely transversely wrinkled. Reticulations on body numerous and small, more longitudinal than transverse —*i. e.* oblique lines run from dorsum downwards and backwards, and these are connected by numerous longitudinal lines and reticulations between them. The oblique lines are about eight or ten on each side. Colour dull ochre, spotless; neck grey above.

Another specimen in British Museum, from Sikkim (coll. Schlagintweit), is evidently also *altivagus*, but is 74 millim.

long; sole lat. $23\frac{2}{3}$ millim.; median area, lat. $10\frac{1}{2}$ millim., thus broader than either lateral area; lateral areas granulose.

Anadenus modestus, Theob.

With the Sikkim *altivagus* in the British Museum is the small specimen referred to by Godwin-Austen (Land and Freshwater Moll. India, 1882, p. 54). It has the oblique lines on the back characteristic of section *Altivagi*, and also the flattened tail. It is $19\frac{1}{2}$ millim. long; mantle 8 millim. long, respiratory orifice slightly posterior, *i. e.* 5 millim. from anterior border. Sole, lat. $5\frac{1}{2}$ millim., median zone broader than either lateral. Colour dull greyish ochreous, with lateral black marbling on mantle (representing broken-up lateral bands) and black lateral bands, irregular in outline, on body. This is very possibly the young of *A. altivagus*, but it is also apparently Theobald's *modestus*. Heynemann described a similar form as the young of *Schlagintweiti*. If the young of *altivagus* is striped, no doubt the young of a species so closely allied as *Schlagintweiti* would be similar, and the immature slugs might be very hard to distinguish specifically. There can be no doubt, supposing these striped slugs are juveniles, that Theobald's *modestus* is the young of *altivagus* or *Schlagintweiti*.

Anadenus Schlagintweiti, Heyn.

Colour grey, slightly olivaceous, becoming white beneath mantle posteriorly. Neck and head dark above. Sole narrower than in *altivagus*, median area approximately of equal width to either lateral area. Mantle 24 millim. long, respiratory orifice slightly anterior to middle. Back with flatter rugæ than in *altivagus*, but pattern of reticulation the same. These notes are from a specimen in the British Museum marked "Coll. Schlagintweit, Simla to Sulsanpor [Sultanpur, in G.-A. Moll. Ind.], Himalaya," and, apparently in Dr. Heynemann's writing, "*Anadenus Schlagintweiti*."

Another specimen in the British Museum from Kulu, Himalaya (*Schlagintweit*), is also *Schlagintweiti*, but has the sole more wrinkled and the median area narrower; colour also darker, but the white below mantle conspicuous.

A. Schlagintweiti is exceedingly closely allied to *altivagus*, but it may be a good species. It is easily distinguished by its different coloration.

II. The Tandonia Section of *Amalia*.

The keeled slugs, referred by modern authors to the genus *Amalia*, Moquin-Tandon, were divided by Lessona and Pollonera in 1882 into groups—Pirainea, the group of *A. gagates*, and Tandonia, the group of *A. carinata* and *A. marginata*. A third group, having an incomplete keel, is *Malinastrum*, Bourg. (= *Subamalia*, Poll., 1887). The Tandonia section is credited by Pollonera with twelve species, but several of them are very closely allied—not more distinct, indeed, than other races almost universally considered varieties. Probably the number of species will be greatly reduced when it becomes possible to compare living examples and dissect fresh specimens of all of them.

I give here a list of the recorded forms, with notes:—

Amalia marginata (Drap.).

Known by its small spots and banded mantle. There is a specimen in the British Museum from Waldeck, received from Dr. Heynemann, from which I made the following notes:—

25 millim. long (in alcohol), narrower than *carinata*, and hardly arched. Sole ochrey; median area hardly twice as broad as one lateral area. Keel straight, ochreous. Body ochreous at sides, bluish grey dorsally, with a peppering of dark grey points all over (except under mantle and on sole). Mantle with lateral dark bands fading away anteriorly.

This is quite a distinct species and quite different from the English slug, *carinata*, Leach, usually called *marginata*. I have never seen an English example of true *marginata*, nor can I find any evidence of its occurrence in the British Islands by searching the literature. The figure and description by Rimmer (Land and Freshwater Shells of British Islands, 1880) belong to the true *marginata*, but they are copied apparently from the French, and have actually no reference to an English slug. Heynemann (Die nackt. Landpulm. des Erdbodens, 1885) gives *A. marginata* as British, but he was probably misled by British authors. Roebuck ('Science Gossip,' 1884, p. 78) records var. *rustica* from Gloucestershire; but it is probable—I think practically certain—that he had not the true *rustica*, Mill., as understood in France *, but a variety of *A. carinata*.

* Kreglinger, 1870, gives *rusticus*, Mill., as a synonym of *L.* (*Lehmannia*) *marginatus*, Müll.

A. pyrrichus, Mab., is a form of *marginata*, and var. *rufula*, Moq.-Tand. (Moll. de France, pl. ii. fig. 4), also belongs here.

A. rusticus, Mill., 1843, appears to be another form of the same species as given by Moquin. *L. carinatus* of Daniel, Heidelberg list (Quart Journ. Conch. vol. i. p. 113), may be true *marginata*, and not Leach's species. Var. *mongianensis*, Paul., from Calabria (near Mongiana), is probably referable also to *marginata*.

Amalia marginata, form *pyrrichus* (Mabille).

Amalia marginata, form *rufula* (Moq.).

Amalia marginata, form *rustica* (Mill.).

Amalia marginata, var.? *mongianensis*, Paulucci, 1879.

Amalia Reuleauxi, Clessin, 1887.

Amalia Reuleauxi, form *punctata*, Cless.

I have not seen a sufficient description of *Reuleauxi*, but it seems allied to *marginata*.

Amalia carinata (Leach).

1820. *Limax carinatus*, Leach, Moll. of G. B. pl. viii. fig. 3.
1823. *Limax Sowerbyi*, Fér. pl. viii. D.
1840. *Limax carinatus*, J. E. Gray, Man. of Land and Freshwater Shells Brit. Is., by W. Turton, new ed. pp. 115, 116, fig.
1844. *Limax carinatus*, Brown, in text (*Sowerbii* on plate), Ill. Rec. Conch. Gt. Brit. and Irel. pl. lviii. fig. 6, pl. lix. fig. 14.
1863. *Limax Sowerbyi*, L. Reeve, Land and Freshwater Moll. Brit. Is. p. 17, fig. 1.
1866. *Limax Sowerbii*, R. Tate, Land and Freshwater Moll. Gt. Brit. fig. 13.
1875. *Limax Sowerbii*, S. P. Woodward, Man. of the Mollusca, 3rd ed. fig. 124.
1882. *Milax Sowerbyi*, Locard, Cat. Gen. des Moll. viv. France.
1883. *Amalia marginata*, Roebuck, Journ. of Conch. April, p. 40.

The above (excepting the second and the last two) are references to British figures of this species, all representing Leach's species, and not Draparnaud's *marginata*. The slug has been elsewhere described by several authors, but the bibliography here given will suffice for present requirements. The older authors correctly referred it to *carinata*, but the reference to *marginata*, "Müller" or "Drap.," has been universal in England of late years, and needs correcting. *Limax marginatus*, Müller, is not even an *Amalia*.

Leach's type, marked "*Limax carinatus*, given by R. Latham," is still in the British Museum*; it is a rather large pale specimen.

A. carinata is easily known from *marginata* by its dark sulcus on the mantle and the usually dark-reticulated body. There is in the British Museum a specimen of *A. carinata* from Ecuador, collected by Mr. Buckley; doubtless it is an introduced species in that country. It is rather remarkable that the species has not yet been introduced into North America.

Amalia carinata, form *Sowerbyi* (Fér.).

Férussac's *Sowerbyi* is simply a form of *carinata*, bright-coloured and with strong markings.

Amalia carinata, form *bicolor* (Ckll.).

Amalia marginata, var. *bicolor*, Ckll. Sci. Goss. Aug. 1887, p. 187.

Sides black, keel and sole orange.

Ealing, Middlesex.

Amalia carinata, form *fuscocarinata* (Ckll.).

Amalia marginata, var. *fuscocarinata*, Ckll. Nat. World, Sept. 1886, p. 179.

Keel coloured like the rest of the body.

Bedford Park, Middlesex.

Amalia carinata, form *rustica* (Roeb.).

Amalia marginata, var. *rustica*, Roeb. Sci. Goss. 1884, p. 78; Journ. of Conch. Oct. 1885, p. 363.

Colour grey, without any admixture of brown or yellow.

This is apparently not *rustica*, Mill.

* The British Museum also possesses specimens of *Amalia carinata* from the following localities in England:—Comm. Docks, London, S.E. (*J. E. Daniel*); S. Shields (*R. Howse*); near London (*J. E. Harting*); Bedford Park, Chiswick (*T. D. A. Cockerell*); and a few others without locality precisely given. One big specimen of *A. carinata* is marked "*L. carinatus* and var. *pallida* (J. E. Daniel)." I cannot ascertain that any var. *pallida* of the species has been described. The specimen from Ecuador, presently to be mentioned, was collected by Mr. Buckley, purchased of E. Gerrard. It is 36 millim. long, mantle $12\frac{1}{2}$ millim. long, sole pale ochrey, median area twice as broad as either lateral area. It differs in nothing from those found near London. Among the Bedford Park lot is a specimen of form *nigrescens*.

Amalia carinata, form *nigrescens* (Roeb.).

Amalia marginata, var. *nigrescens*, Roebuck, MS., Ckll., Nat. World, Sept. 1886, p. 179.

Dark grey or nearly black, without an internal shell.

Middlesex and Surrey.

This is an extreme dark form, and, curiously enough, though several specimens have been carefully dissected by two or three conchologists, no shell has been found present. *Limax Ehrenbergi*, Bourg., a form of *L. flavus*, is similarly said to have no shell.

Amalia fulva (Paulucci).

Amalia carinata, Leach, subspecies.
Limax carinatus, Risso, 1826.
Milax carinatus, Locard, Cat. Gen. Moll. France, 1882.

The southern form of *carinata*, known as *carinata*, Risso, has been considered a distinct species from that of Leach by Locard and others; but it appears to be only a subspecies at best. Risso's name is later than Leach's, so it cannot be used according to the law of priority. *A. argillaceus*, Gass., 1856, has been quoted under *carinata*, Risso, but it is really a synonym of *carinata*, Leach.

A. marginata, var. *fulva*, Paulucci, 1879, belongs to the southern slug, being the young or a slight variety, and I have adopted this as the earliest available name for the subspecies.

Amalia fulva, form *typus* (Less. & Poll.).

Amalia fulva, form *pallidissima* (Less. & Poll.).

Amalia fulva, form *insolita* (Less. & Poll.).

Amalia fulva, var. *oretea* (Less. & Poll.).

Amalia fulva, var. *casertana* (Less. & Poll.).

For these varieties see Lessona and Pollonera's excellent monograph of the Italian slugs.

Amalia Eichwaldii (Kal.).

Amalia carinata, Leach, subspecies.
Krynickillus Eichwaldii, Kaleniczenko, Bull. Soc. Imp. Nat. Mosc. 1851, tab. vi. fig. 1 *a*, *b*.

The figure represents a small pale brown slug with a conspicuous yellow keel. No sulcus visible on mantle. Body dark-reticulate.

Amalia Pacomei (Florence).

Milax Pacomei, Florence, Bull. Soc. Mal. France, 1889, p. 326.

A doubtful species; perhaps a form of *A. fulva.*

Amalia Hessei, Bttg.

Amalia carinata, Leach, subspecies.

A small slug from Corfu, having the markings on the mantle ω-like. This ω-like marking is not a specific character, as it is more or less visible on *carinata, marginata, oretea, baripus,* and *pallidula.*

Amalia pallidula, subsp. nov.

Amalia carinata, Leach, subspecies.

Length (in alcohol) 17 millim.; mantle, length $6\frac{1}{4}$ millim.; sole broadish, diam. 3 millim. Colour entirely pale ochrey, or back and mantle more brownish, mantle-sulcus slightly brown. Head pale ochrey, tentacles greyish. Mantle broad, squarish-blunt before and behind. Body narrowish, very strongly and highly keeled. Reticulations by strong grooves, forming flattened elongate-squarish rugæ, interstitially smooth and shiny. Sole with the median area not twice as broad as either lateral area, pale ochrey, unicolorous. Respiratory orifice well posterior. Grooved striæ in median area of sole as numerous as in lateral areas. Keel not flexuose. Tail flattened laterally, not at all attenuate. A delicate subtransparent species.

Described from two specimens in the British Museum, presented by Dr. J. E. Gray.

Habitat unknown, but probably South European.

Allied to *A. gracilis, A. Kobelti,* and *A. Hessei,* and perhaps only to be regarded as a variety of one of them.

Amalia Kobelti, Hesse.

Amalia carinata, Leach, subspecies.

A unicolorous yellow species from Greece.

Amalia gracilis, Leydig, 1876.

Smaller than *carinata*, and mantle without black sulcus-marking. *A. cibiniensis*, Kim., is a synonym.

Amalia gracilis, form *budapestensis* (Hazay, 1881).

Hazay's figure represents an elongate slug, nearly unicolorous palish sepia, tail quite tapering, head and tentacles blackish or grey.

Amalia baripus (Bourg.).

Milax baripus, Bourg. Moll. Nouv. Lit. ou peu connus, 1863–1868, pl. xxxii. figs. 7–10.

Hab. Syria.

Bourguignat's figure represents a small pale bluish *Amalia*, keel pale, head and tentacles pale violaceous; mantle with the sulcus and a posterior median short line or band black.

Amalia cristata (Kal.).

Krynickillus cristatus, Kal. Bull. Soc. Imp. Nat. Mosc. 1851, tab. v. figs. 1 *a*, *b*.

Kaleniczenko figures a pale reddish-ochre slug; head and neck blackish; no sulcus visible on mantle. Tryon's "*cristata*, Kal.," seems more like *Eichwaldii*.

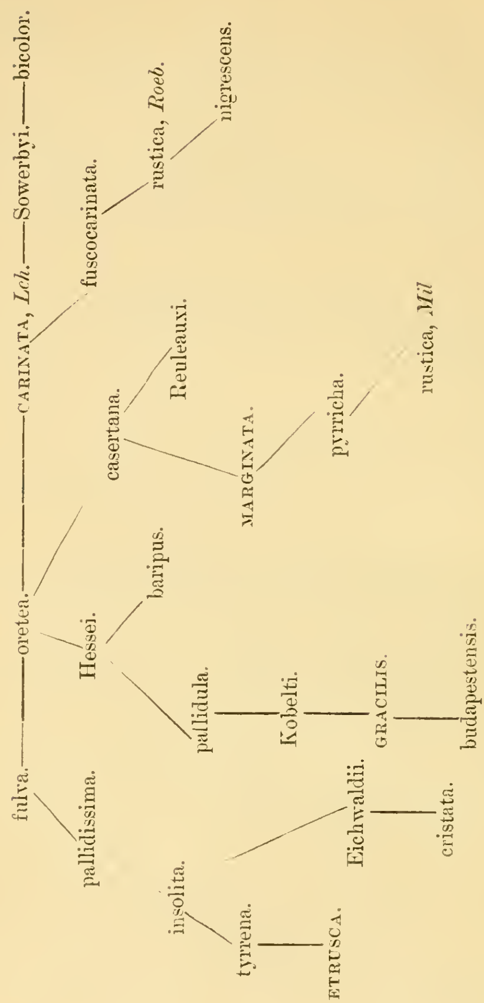
Kaleniczenko gives *Limax megaspidius*, Blainv., as identical with *cristatus*; but *megaspidius*, as attested by the original of Férussac's fig. 4, pl. vi., in the British Museum, is a young albino *Limax maximus*.

Amalia tyrrena, Less. & Poll.

Amalia etrusca, Issel.

Two Italian species, fully described in Lessona and Pollonera's monograph.

To sum up, I give here a table showing the relationships of the various forms as nearly as I can make them out.



3 Fairfax Road, Bedford Park, Chiswick, W.,
August 24, 1890.

XXXIII.—*On the Relationship of the Rodentia to the Marsupialia.* By Dr. A. FLEISCHMANN *.

THE group of the Rodents includes a great number of multifarious forms; generally small and active animals, they are able to adapt themselves to the most different conditions of existence over wide limits, and in consequence of the flexibility of their requirements they people the surface of our planet in astonishing quantity. Their palæontological range extends back to the commencement of the Tertiary period. It is remarkable that even then there were forms living in great numbers which have maintained their full power of existence with but trifling changes to the present day. In the strata which furnish us with the knowledge of those times, however, remains of gigantic Rodents are preserved which flourished side by side with smaller allied forms, but owing to unfavourable conditions soon disappeared again. Now we have along with families of almost universal distribution others whose dwelling-places are limited to particular regions, and the last giant among the Rodents, the *Capybara*, leads a solitary existence in the marshy plains of the South-American rivers.

It might be thought that a group of animals with a history extending so far back in time and showing such remarkable conditions of geographical distribution and so elegant a bodily structure would have induced many naturalists to come forward as its historiographers. But from the study of the literature this expectation appears to be a deceptive one.

It is true that we can cite abundanee of works upon the systematic arrangement of this class and the relationship of the different species and families founded upon the structure of the teeth. If we leave out of the account the special researches which have been made upon the typical experiment-animals of our laboratories, the guinea-pig and the rabbit, anatomical investigations upon the constitution of the different systems of organs have been, since the time of Pallas, very rarely extended to the whole group. And if the knowledge of the soft parts must be characterized as quite unsatisfactory, the want of works on the phylogenetic history of these animals is still more to be regretted.

Leaving out of consideration the various attempts to refer the Rodents to a certain place in the system, we have here to

* Translated from the 'Sitzungsberichte der königl. Preussischen Akademie der Wissenschaften zu Berlin,' March 20, 1890, pp. 299–305.

cite only a work of M. Schlosser's 'On the Rodents of the European Tertiary, with Considerations upon the Organization and Developmental History of the Rodents in general" ('Palæontographica,' Bd. xxxi.). Schlosser is the first and only naturalist who, from the standpoint of the modern theory of evolution, has submitted the palæontological remains of the animals in question to a remarkably thoroughgoing treatment, and then made an attempt at a phylogenetic arrangement under close consideration of the skeletal and dental structure of the recent forms. Deductions from very numerous facts led him to the hypothesis that the Rodentia are directly related to the Marsupials. From my own investigations I regard this conception as quite irrefutable; but unfortunately Schlosser was led, half a year after the publication of his exemplary work, to recall his fine demonstrations and even to characterize them as untenable.

Since that time the question has rested completely, for, owing to the little sympathy that many zoologists have with palæontological results, Schlosser's work appears to have become known only to a few.

By some investigations in developmental history I was led several years ago to give more attention to the question of the genealogical relationships existing between the different classes of Mammalia, and I now venture to put forward a brief report upon the results at which I have arrived with respect to the Rodentia.

As the relationship of the Mammalia is determined customarily by the nature and number of the teeth, I will commence my statement with the dentition of the Rodents. The remarkable parallel in dentition between Marsupialia and Rodentia has already been repeatedly dwelt upon without any careful inquiry whether we have here a mere analogy or an actual homology indicative of direct relationship. The course of conversion, according to my observations, which agree well with previous statements, may be traced from the kangaroo-like Marsupials to the true Rodents, the analogous lateral branches of *Phalangista* and *Phascolomys* furnishing opportune evidence of the former intermediate forms. The dentition of *Phalangista vulpina* shows in the upper jaw two canines and six incisors, of which the middle ones are the largest, the lateral the smallest. In the lower jaw there are two large chisel-shaped incisors, the alveoli of which extend as far as to the first molar. Behind the two large incisors there are four smaller ones; there are therefore six incisors in the lower jaw, diminishing in size posteriorly, so that the third pair appears only in the form of very diminutive points which fall out early in life, but the second pair is long retained. In *Hypsiprymnus* two incisors in the lower jaw work against six in the upper, and of the latter the first pair have grown considerably stronger, while the second and third pairs are of inferior size. In *Phalangista* the six incisors stand in an elegant horseshoe-like curve on the margin of the broad premaxillæ; but in *Hypsiprymnus* the snout has become narrower, the premaxillæ being laterally compressed. Then the four smaller incisors curve more towards the middle, in order to function, as opposed to the upper teeth, in tearing off plants. A large series of skulls of *Hypsiprymnus* shows in what different ways this purpose can be attained. But the four teeth are too weak to be retained with advantage in adaptive groups; hence they undergo the same fate as the corresponding teeth in the lower jaw of *Phalangista*. In this way it seems to me that the typical dentition of the Rodents with its two pairs of incisors has been produced. The transformation of the enamelled and root-bearing incisor into the persistently growing gnawing-tooth furnished with an enamel plate on one side only may also be easily traced in the stem of the Marsupialia. In the group of the Lagomorpha the dentition shows conditions which accord well with my speculations. In the upper jaw, behind the gnawing-teeth, the second pair of small incisors is quite pressed towards the median plane; they are also changed and have acquired the power of persistent growth. The gnawing-teeth themselves, in both the upper and the lower jaw, also have very short alveoli and a slight curvature.

Notwithstanding the undoubtedly important part which the dentition plays in rapid systematic diagnosis I do not think that the notion of a direct blood-relationship can be founded with sufficient certainty upon the similarity of the dentition alone. Therefore I will adduce further proofs.

The horizontally inward projection of the angle in the lower jaw of the Marsupials is well known as a very convenient and striking character. If the Rodents be phylogenetically related to the Marsupials this structure must also be still recognizable; and in fact the comparison of many skulls has shown me that the often-described bending of the posterior angle of the mandible in Rodents, which occurs in variable degrees in different sections of the order, is derivable in a direct series from what is found in the Marsupials. I affirm most decidedly that Rodentia and Marsupialia manifest their relationship by the homologous behaviour of the angle of the mandible. In Muridæ, Sciuridæ, and Myoxidæ this peculiarity is particularly clearly marked, although it has been somewhat changed by the secondary influence of the musculature there inserted; it does not prevail, however, throughout the whole group, and is always absent in the Hystrichidæ, Subungulata, Octodontidæ, Lagostomidæ, and Leporidæ.

This modification, however, may be referred back to conditions within the Marsupial series, for among them many forms have lost a distinct mandibular angle, such as, for example, *Phascolarctos*. Then the lower jaw, if looked at from the side, appears as a band dilated posteriorly into a triangular plate. Nevertheless the contour of the margin and the pits and bony ridges occurring on the outer surface of the end of the jaw betray the previous history of the part by very intelligible tokens. Even in true Marsupials we find evidence of the endeavour to bring the mandibular angle from the inwardly directed horizontal position into a more vertical one and into the same plane as the ascending branch. In Rodents all desirable steps of the retroversion have been retained, in the end giving origin to the great increase of the surface of the posterior extremity of the mandible.

Side by side with this we recognize a reduction of the coronoid process; very strongly developed in the Marsupials, it is retained in all the Rodents which possess an inwardly projecting mandibular angle, but it becomes small until it nearly disappears in Rodents with a broad mandibular plate.

As I conceive the origin of the dentition of the Rodentia to have passed through stages such as the living survivors of the leaping and climbing Marsupials still display in model, the dentition of their ancestors must have gradually lost the omnivorous character and become herbivorous; consequently the direction of movement of the lower jaw must also at the same time have become modified.

In point of fact this transformation may be still recognized from the position and form of the *condylus glenoidalis* in the lower jaw, which passes from the transverse direction general in the omnivorous Marsupials into a position parallel to the sagittal plane; and, in accordance with this, the *cavitas glenoidalis* on the squamose part of the temporal, which in the Marsupials attains no great extension, becomes gradually longer so as to pass on to the jugal arch and become a long groove-like excavation.

The occurrence of the change of food may be further inferred from the constitution of the digestive organs in the Rodentia. I indicate now only the form and structure of the stomach. Whilst in most Rodents this possesses a pretty simple structure and form, it becomes more highly complicated in the Muriform animals. Even in the common domestic mouse the division of the stomach into two halves, of which that on the left has horny epithelium and that on the right glandular mucous membrane, is very striking. In the Hamster these divisions of the stomach are visible externally, and in the field-mice with persistently growing molars, which are the most specialized, we also find the greatest complication in the structure of the stomach, as, indeed, has already been fully described by Retzius.

The Marsupials possess a true cloaca, and their lineal relations, the Rodents, agree with them pretty directly in this respect. For the former possession of such an arrangement is always manifested by the fact that the external orifices of the urogenital apparatus and the anus are placed close together, so that they nearly touch and are surrounded by common sphincters. In a mature embryo of the beaver I found them close together in a common naked and somewhat sunken area.

In Marsupials the two cornua of the uterus open by separate apertures into the vagina; in the Rodents the same condition prevails, and its homological significance is not destroyed by a short fusion of the two cornua in some few Rodents.

The greatest number of teats is attained in the Marsupialia, Rodentia, and Insectivora. Taking into consideration the circumstance that the occurrence of rudimentary teats in other divisions of the Mammalia indicates reduction from a previous more abundant endowment, the numerous teats of the Rodents should indicate the primitive organization of those animals. Moreover, Gegenbaur has shown that the milk-glands of the Rodentia are in perfect homology with those of Marsupials.

The structure of the larynx is directly connected with that of the Marsupials, as already indicated by Mayer in 1829; and R. Owen has long since stated that the brain of the Rodentia agrees with that of the Marsupialia in essential points. Not only the external form, but the internal structure is homologous in both. In common also there are the poverty of convolutions, the want of a well-developed *corpus callosum*, the strong development of the vermiform body in the cerebellum, and the free position of the *corpora quadrigemina*.

On the spinal cord the spinal nerves are arranged as in Marsupials; the lumbar region especially, according to Jhering's investigations, presents the greatest similarity.

But what particularly confirms me in adhering to the assertion that the Rodents are related to the Marsupials in a direct line consists in the numerous and striking similarities which occur in the two groups during embryonic development. If the yelk-sac of the opossum during its uterine existence is of considerable extent, and at the moment of birth considerably exceeds the allantois in size, so also in the Rodentia, *e. g.* rabbits and squirrels, the yelk-sac continues comparatively large during the whole period of pregnancy and the allantois small. In both groups the same course of development may be recognized, except that by the fusion of the allantochorion with the uterine mucous membrane, that is to say by the formation of a discoidal placenta, the function of the allantois is greatly increased. But the original conditions of the phylogenetic history may be inferred from the volume of the yelk-sac equalling that of the allantois for a long time.

A disciform vascular area with a cordifugal *sinus terminalis* upon the yelk-sac appears in perfectly homologous development in Marsupials, rabbits, and squirrels. The long persistence of an ecto-entodermal proamnion, which in the opossum is retained until birth, is likewise demonstrable in the above-mentioned Rodents. The inversion of the germinal layers in the Muridæ and Subungulata is to be regarded as a modification of a certainly very simple ancestral uterine development.

When considered from the phylogenetic standpoint all the organs of the Rodentia show themselves to be directly derivable from the type of the Marsupialia, and without any logical difficulty we may recognize step by step in the existing forms the stages which render the transformation of long-inherited arrangements intelligible. This fact has not struck me alone; it has forced itself directly upon every naturalist who has studied the different organs of the Rodents from the point of view of comparative anatomy, and I can only lay claim to the merit of having tested the correctness of the various scattered statements and combined them into a simple theory.

In the present report I have only expressed my views as to the phylogeny of the Rodentia without referring to other Mammalia. But I would not thereby convey the impression that I have occupied myself with that group alone; on the contrary, I have also taken other divisions into the range of my investigations, and have been led, with regard to the Insectivora and Bats, to the conclusion that between these two groups and the Marsupialia with Carnivoroid dentition there exists a very intimate relationship, which may be confirmed both anatomically and embryologically. Upon this subject, as upon the phylogeny of the Carnivora, I shall venture hereafter to report to the Academy.

XXXIV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 18. *On the Bathybial Fishes of the Arabian Sea, obtained during the season* 1889-90. By A. Alcock, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

CONTENTS.

§ 1. Sketch of the Hydrography and Zoology of the Dredging Stations.
§ 2. Notes on the Fishes, with Descriptions of new Species.

§ 1. *Sketch of the Hydrography and Zoology of the Dredging Stations.*

The bathybial fishes which the 'Investigator' has to record from the Arabian Sea number nineteen specimens, of fifteen species, thirteen genera, and six families, all of which were obtained in two hauls of the trawl at the following stations:—

Station 104.—11 A.M. to 4 P.M., 3rd May, 1890.

Lat. 11° 12′ 47″ N., long. 74° 25′ 30″ E., off the Elicapeni Bank, in the Laccadive Sea. Depth 1000 fathoms. Temperature at the surface 83° Fahr., at the bottom 38°·6 Fahr. Bottom olive mud, with 2·15 per cent. of shells of Foraminifera, chiefly *Globigerina* and *Pulvinulina*.

Besides nine species of fishes, the trawl contained numerous specimens of Sponges (including *Hyalonema* and *Poliopogon?*), Alcyonids, Actinids, Turbinolid Corals (*Caryophyllia*), Echinoids (including *Phormosoma*), Asteroids, Holothuroids (including *Deima*), and Crustaceans (chiefly Penæids).

Station 105.—7 A.M. to 12 noon, 5th May, 1890.

Lat. 15° 02′ N., long. 72° 34′ E., about 75 miles west of the Goa coast, Laccadive Sea. Depth 740 fathoms. Temperature at the surface 83° Fahr., at the bottom 44° Fahr. Bottom coral-mud, with 12 per cent. of Foraminifera shells.

Besides six species of fishes, the haul brought to light a very large number of Crustaceans (Isopods, Penæids, Palæmonids, Crangonids, Homarids, Pagurids, Galatheids and Homolids); Actinids, Turbinolid Corals; Astropectinids, Ophiurids, Echinoids (including *Asthenosoma*), Holothuroids;

and Gastropod and Lamellibranch Mollusks; besides some curious green-coloured *Fucus*-like ova (?) adherent to the last.

By the Laccadive Sea is meant the basin which intervenes between the west coast of India and the parallel series of ridges whose peaks form the bases of the shoals and atolls of the Laccadive Archipelago.

It is a long narrow basin, open to the south and closing in gradually to the north, its boundary here being the Angrias Bank, in lat. 16° 30′ N. It slopes steeply from east to west, its greatest depths, which are not much over 1100 fathoms, being close to the Laccadive Islands, which individually rise abruptly from the bottom. The nature of the bottom on the Indian side is, as would be expected, determined by detritus from the land; but on the Laccadive side the bottom consists almost entirely of coral-mud, with a variable proportion—from 2 to 12 per cent.—of Foraminifera shells.

§ 2. *Notes on the Fishes, with Descriptions of new Species.*

The bathybial fishes collected in the Laccadive Sea are remarkable for their large size.

At twenty stations in the Bay of Bengal and neighbouring waters the 'Investigator' has taken deep-sea fishes; and on contrasting them with these from the Laccadive Sea, the superior bulk of the latter is strikingly manifest. Among the *Macruri*, comparing mature females, the two specimens from the Laccadive Sea measure respectively 22 and 19¼ inches, and weigh respectively 1·5 and ·65 lb.; while the two largest specimens from the Bay of Bengal measure respectively 14¼ and 11 inches, and weigh respectively ·23 and ·15 lb. The Ophidiids from the Laccadive Sea are also larger and heavier. Again, the longest deep-sea Physostome taken in the Bay of Bengal measures but 16 inches, against the 21 inches of the longest Physostome from the Laccadive Sea; while the average length of the Bay of Bengal specimens of this suborder is under 9 inches, against an average length of nearly 14 inches of the Laccadive Sea specimens.

The occurrence in the deep waters of the Arabian Sea of forms hitherto known from the depths on the one hand of the Mid-Atlantic, and on the other hand of the North Pacific, is a further illustration of the wideness of distribution of true bathybial fishes.

The following is the list of the fishes:—

Family **Ophidiidæ.**

Monomitopus, gen. nov.

Agrees with *Sirembo*, Blkr., as diagnosed by Dr. Günther in the 'Catalogue of Fishes,' vol. iv. p. 373, except that the pseudobranchiæ are rudimentary.

1. *Monomitopus nigripinne.*

Sirembo nigripinnis, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 384.

I described this species from a single, rather mutilated specimen from the Andaman Sea; but with a well-preserved and larger specimen from the Arabian Sea (Station 105) I find that the pseudobranchiæ, instead of being "thick and fleshy," as originally stated, really consist of two small pinnules only, on each side, parts of the opercular muscles having been mistaken for thickened pseudobranchiæ in the first specimen. The complete radial formula is

B. 8. D. 95–100. A. 85–88. C. 8. P. 28. V. 1.

Neobythites, Goode & Bean.

2. *Neobythites pterotus.*

Neobythites pterotus, Alcock, Ann. & Mag. Nat. Hist. Sept. 1890, p. 210.

A large female specimen, 11¼ inches long, from Station 104, from which I am able to make the following corrections in the original description:—Eight branchiostegals; snout obtusely pointed; basal third of anal fin scaly.

Paradicrolene, Alcock.

3. *Paradicrolene Vaillanti.*

Dicrolene introniger, Vaillant, nec Goode and Bean; Vaillant, Exp. Sci. 'Travailleur' et 'Talisman,' Poiss. pp. 258-262, pl. xxiii. fig. 2.

From M. Vaillant's most excellent and exhaustive description I have no difficulty in identifying this Ophidiid. But though I can only dissent with diffidence from such an experienced ichthyologist, I cannot concur in his opinion that this fish is identical with *Dicrolene intronigra* of Messrs. Goode and Bean. Apart from numerous minor points of disagreement, the *Dicrolene* type is stated to have only seven branhiostegals.

Our single specimen is a female $10\frac{1}{2}$ inches long, with the radial formula

B. 8. D. 106. A. 78. C. 6. P. dextra 18/6.
P. sinistra 18/9. V. 2.

It was taken at Station 105, 740 fathoms.

Dermatorus, gen. nov.

Allied to *Porogadus*, Goode & Bean, and to *Bathyonus*, Gthr.

Body compressed, with long tapering tail. Head with well-developed muciparous cavities and spiniferous bones. Snout depressed, with jaws conterminous in front. Eye of moderate size. Mouth very wide; villiform teeth in bands in the jaws and palatines, few and scattered on the vomer. No barbel. Gill-openings very wide; eight branchiostegals; four gills; well-developed gill-rakers. Pseudobranchiæ quite rudimentary. Scales small, deciduous. Lateral line indistinct. Ventral fins contiguous; each consists of a single simple filament. No pyloric cæca.

4. *Dermatorus trichiurus*, sp. n.

Snout depressed, pointed. Head-bones and opercles with numerous acute spines. Body compressed, elongate, low—its height being from $\frac{1}{11}$ to $\frac{1}{12}$ of the total—ending in a long lash-like tail.

B. 8. D. $160+x$. A. $140+x$. C.? P. 16 (?). V. 1.

Head symmetrically cuneiform, its muciferous cavities well developed, opening externally by large pores, and bounded by salient spinigerous crests; its length is between $\frac{1}{6}$ and $\frac{1}{7}$ of the total, its height a little more than the length of its postorbital portion, its breadth not quite half its length. A strong, acute, erect spine at each anterior orbital angle, and diverging backwards from it, on each side, two irregular rows of acute recumbent spines, the last spines of the rows situated respectively at the exterior occipital and the post-temporal angles; operculum with a strong sharp spine above; preoperculum with a double border, and each border with three rather distant spines radiating from its angle; an obliquely reclining humeral spine.

Snout not overhanging the mouth, depressed, rounded from side to side, its dorsal and ventral profiles meeting at a very acute angle; its length is $\frac{2}{7}$ that of the head, equal to the width of the interorbital space, and $\frac{1}{3}$ greater than the major diameter of the eye.

Eye situated high up, the supraorbital border entering the dorsal profile.

The posterior nostril much larger than the anterior.

Mouth-cleft extremely wide, the maxilla, which is much expanded behind, measuring $\frac{2}{3}$ of the head-length; jaws conterminous, with sharp dentary edges and rudimentary labial folds. Villiform teeth in narrow bands in the jaws and palatines, scattered and obsolescent on the wide V-shaped head of the vomer. Tongue very small, papilliform.

Gill-openings very wide, the membranes entirely free; four gills with narrow laminæ; gill-rakers well developed on all the arches, those on the outer side of the first arch, to the number of twenty, very long and bristle-like. The pseudobranchiæ are reduced to two small lamellæ on each side.

Small deciduous scales on the body and at least the posterior half of the head; there are apparently twenty rows between the vent and the dorsal fin.

In the fresh state there is a thick subcutaneous layer of mucus, as in *Bathyonus*. Lateral line undistinguishable.

The dorsal fin begins immediately behind the vertical through the gill-opening, the anal immediately behind the vent, which is a head-length distant from the gill-opening. Pectorals narrow, pointed, as long as the rostrorbital portion of the head. The ventrals arise close together, just behind the pectoral symphysis; each consists of a simple filament as long as the postrostral portion of the head.

Stomach siphonal; intestine long (half the total), much coiled; no pyloric cæca. Air-bladder small.

Colours in the fresh state:—Transparent grey; oro-pharyngo-branchial membrane and parietal peritoneum intense black.

A single female specimen 7 inches long, with the end of the tail missing.

Station 104, 1000 fathoms.

Family Macruridæ.

MACRURUS, Bloch.

Subgenus MACRURUS (Bloch).

5. *Macrurus Hextii*, sp. n.

B. 6. D. $\frac{2}{10}$/110 circ. A. circ. 110. P. 21–22. V. 7.

L. lat. circ. 130. L. tr. $\frac{5}{\frac{1}{29 \text{ circ.}}}$.

The length of the head is half that of the entire trunk or $\frac{1}{5}$

of the total, and just in excess of the greatest height of the body. The tail is rather abruptly constricted; its greatest height, behind the vent, is about $\frac{3}{4}$ that of the trunk, and behind this it rapidly diminishes.

Snout faintly trihedral; its length is equal to the major diameter of the orbit and to the width of the flattened interorbital space at its middle, and all but $\frac{1}{4}$ of the length of the head.

Nostrils very large, the anterior subtubular in appearance.

Mouth quite inferior; the maxilla almost reaches the vertical through the middle of the orbit. Teeth in broad villiform bands in both jaws, and in the lower an inner row of moderately and in the upper an outer row of considerably enlarged, conical, acute teeth.

Barbel about $\frac{3}{4}$ as long as the eye.

Gill-membranes broadly united, thick, coriaceous; attachment of first branchial arch to opercle broad.

Body and head, except the glosso-hyal region, covered with rather deciduous spinigerous scales; those on the body uniformly large and deeply imbricating. There are five rows between the first dorsal fin and the lateral line. A scale from the dorsal half of the trunk is $\frac{1}{4}$ of an inch high by $\frac{1}{5}$ of an inch broad, with a shallow, triangular, non-imbricate area bearing about twenty-eight close, parallel, longitudinal series of small, equal, close-set, semierect spinelets.

First dorsal spine rudimentary; the second slightly prolonged, its front edge faintly crenulated in its basal, sharply serrated in its distal half. The interval between the first and second dorsal fins is equal to the length of the base of the first, or a little more than the length of the snout. The pectorals measure rather more than half the length of the head. Ventrals with the first ray slightly prolonged, reaching to the origin of the anal.

Stomach siphonal; intestine very long, much coiled. Fourteen or fifteen large long pyloric cæca. Liver large, both lobes almost equally developed. An air-bladder.

Colours in the fresh state:—Chocolate, with blackish fins; oro-pharyngo-branchial membrane and parietal peritoneum black.

One specimen—a female with gravid ovaries—measuring 22 inches in length and weighing (after preservation in spirit) $1\frac{1}{2}$ pound.

Station 104, 1000 fathoms.

6. *Macrurus Wood-Masoni*, sp. n.

B. 6. D. $\frac{2}{9}$/100 circ. A. circ. 105. P. 21. V. 8.

L. lat. circ. 130. L. tr. $\frac{4}{\frac{1}{22 \text{ circ.}}}$.

The length of the head is nearly $\frac{2}{3}$ that of the entire trunk, or between $4\frac{1}{2}$ and $4\frac{2}{3}$ in the total. The greatest height of the body is not quite $\frac{3}{4}$ the length of the head. The tail is long and tapering.

Snout trihedral, with strong median and lateral tubercles; its length slightly exceeds the major diameter of the orbit, which is almost $\frac{1}{4}$ the head-length.

The width of the interorbital space in the middle is equal to the vertical diameter of the orbit.

Mouth completely inferior; the maxilla reaches a short distance behind the vertical from the anterior border of the orbit. Small conical acute teeth in broad bands in both jaws.

Barbel a small papilla, not equal in length to the vertical diameter of the posterior nostril.

Gill-membranes broadly united.

Body and head, except the glosso-hyal region, covered with rather deciduous spinigerous scales; those on the body of a uniform size and deeply imbricate. There are four and a half rows between the first dorsal fin and the lateral line. A scale from the dorsal half of the trunk is $\frac{1}{4}$ of an inch high by $\frac{1}{5}$ of an inch broad, and bears about twenty short, longitudinal, parallel series of small, equal, semierect spinelets.

First dorsal spine rudimentary; the second with numerous close-set recumbent barbs along its front edge. The interval between the first and second dorsal fins is double the length of the base of the first, or equal to the length of the post-orbital portion of the head. Ventrals with the outer ray slightly prolonged, reaching to the origin of the anal.

Stomach siphonal; the much-coiled intestine measures considerably more than the entire fish in length; eleven or twelve long large pyloric cæca. A large spongy air-bladder.

Colours in the fresh state:—Chocolate, with blackish fins; oro-pharyngo-branchial membrane and parietal peritoneum black.

One specimen—a female with gravid ovaries—measuring $19\frac{1}{4}$ inches in length.

Station 104, 1000 fathoms.

Bathygadus, Gthr.

7. *Bathygadus longifilis*, Goode & Bean.

Bathygadus longifilis, Goode & Bean, Proc. U. S. Nat. Mus. viii. p. 599; Günther, Zool. 'Challenger' Exp. xxii. p. 157.
Hymenocephalus longifilis, Vaillant, Exp. Sci. 'Travailleur' et 'Talisman,' Poiss. pp. 218–221, pl. xxiii. fig. 1.

A large female specimen, $11\frac{3}{4}$ inches long, with gravid ovaries.

It has the radio-squamal formula

B. 7. D. 11 140 circ. P. 15. V. 8.
L. lat. circ. 150. L. tr. circ. 25 through vent.

The fourth branchial cleft exists, though it is not apparently functional. The stomach is siphonal; the intestine coiled, with about twenty-two large long pyloric cæca. The liver and spleen are very large, and the air-bladder is well-developed.

A smaller male (?) specimen, 8 inches long, with the same radio-squamal formula and with the barbel measuring more than $\frac{2}{3}$ the length of the head.

Station 105, 740 fathoms.

Physostomi.

Family **Scopelidæ**.

Scopelengys, gen. nov.

Apparently nearly allied to *Scopelus*, Gthr., and to *Nanobrachium*, Gthr.; but as the single specimen for which the generic distinction is claimed is entirely denuded of its integuments down to the muscles, its exact position among the Scopelidæ cannot be accurately defined at present.

Head and body compressed. Eye small. Mouth very wide; the maxilla dilated behind. Acute villiform teeth, in bands uncovered by the lips in the jaws, and in the palatines and vomer. Gill-openings very wide; gill-covers complete. Pseudobranchiæ rudimentary. Dorsal fin near the middle of the body, short; an adipose dorsal. Anal fin short. Caudal forked. Pectorals well developed. Ventrals with eight rays. [Scales, if present, very deciduous.] No air-bladder. Pyloric cæca present in moderate number.

8. *Scopelengys tristis*, sp. n.

B. 8. D. 12. A. 13. P. 15. V. 8.

Head and body rather elongate, compressed. Eye situated high up, very small; its major diameter is a little more than $\frac{1}{3}$ the length of the snout, which is about $\frac{1}{3}$ the length of the head, which is not quite $\frac{1}{3}$ the total without the caudal. Mouth wide, its cleft very oblique, approaching the vertical, with the lower jaw projecting in repose; the maxilla, which is widely dilated behind, measures more than half the length of the head; the premaxilla is a stout bone, firmly attached to the maxilla, which it equals in length. Acute villiform teeth, in rather broad bands uncovered by the lips in the premaxillæ and mandible, in narrow bands in the palatines, and in a small patch on each side of the head of the vomer; no teeth on the tongue.

Gill-openings very wide; gill-covers complete; long close-set gill-rakers on the first arch. Pseudobranchiæ rudimentary, consisting of three or four small lamellæ on each side.

The dorsal fin begins above the origin of the ventrals; the whole fin is included in the anterior half of the body measured with the caudal. Adipose dorsal rather large, fimbriated. The anal fin begins a little more than a snout-length behind the posterior limit of the dorsal. Caudal forked. Pectorals entire, about as long as the maxilla, and reaching just beyond the origin of the ventrals; they arise close to the ventral profile.

Eight large pyloric cæca. No air-bladder.

Colours in the fresh state apparently uniform black throughout.

One specimen, $6\frac{3}{4}$ inches in length.

Station 104, 1000 fathoms.

Family **Alepocephalidæ**.

BATHYTROCTES, Gthr.

9. *Bathytroctes squamosus*, sp. n.

Snout short. Eye very large. The entire head uniform intense black; apparently some scales on the opercles.

B. 7. D. 17 (18). A. 17 (18). C. circ. 35. P. 10.

V. 9. L. lat. circ. 50. L. tr. $\frac{5}{\frac{1}{9}}$.

Head with its ventral profile almost horizontal, its dorsal profile forming a continuous curve synchronous with an arc of a circle of 56°; its length is $3\frac{5}{6}$ in the total measured without the caudal, and just over the greatest height of the body. Snout with the tip formed by a prominent knob at the symphysis of the lower jaw; its length, including the mandibular element, is less than its breadth and about $\frac{2}{3}$ the major diameter of the eye. Nostrils large, situated high up, above the anterior angle of the orbit. Eye very large; its major diameter, which is obliquely ascendant from before backwards, is a little more than $\frac{1}{3}$ the length of the head; interorbital space gently concave, $\frac{1}{3}$ that diameter of the eye.

Mouth-cleft wide, approaching the transverse; premaxilla short and slender; the broad maxilla, composed of three longitudinal plates, of which the innermost (uppermost) is movable, reaches just behind the level of the mid-orbit, and includes the mandible in repose, except anteriorly, where the latter strongly projects. Small, even, acute, uniserial teeth, recurved in the premaxillæ, mandible, palatines, and vomer, procurrent or procurved in the maxillæ. Tongue large. A row of pores along the limb of the mandible.

Gill-openings very wide, the membranes entirely separate; fourth gill-cleft occluded; gill-rakers long and close-set on the first three arches, longest on the first. Pseudobranchiæ large and coarse. Scales large, deciduous, except on the lateral line, where they are adherent and also perforated or bifid. There are pittings in the skin, which look like scale-folds, on the opercles.

The dorsal fin begins just behind the origin of the ventrals, which are situated in the vertical through the middle of the body measured without the caudal. The anal begins in the vertical through the third dorsal ray. Both these fins have fleshy succulent bases, and the rays increasing in length regularly and steeply to the fourth, and then decreasing as regularly but more gradually to the last. Caudal symmetrically forked. Pectorals long and narrow; their longest rays equal the length of the head behind the anterior nostril, and in repose almost touch the bases of the ventrals. Ventrals broad, reaching slightly beyond the vent.

Stomach large; intestine coiled in a spiral; five or six large pyloric cæca.

Colours in the fresh state:—Head uniform deep black, body pinkish brown, fins transparent grey; oro-pharyngo-branchial membrane and entire peritoneum black.

A heavy female specimen, $10\frac{1}{4}$ inches long, with gravid ovaries, the mature ova measuring $\frac{1}{8}$ of an inch in diameter.

Station 105, 740 fathoms.

The stomach contained a large Penæid.

This species differs from all described *Bathytroctes* and from all hitherto known Alepocephalidæ in possessing (apparently) scaly opercles; but, apart from the need of actual demonstration on this point, the affinities are so clearly indicated that one would hardly wish to separate the species from a family still so incompletely known on the ground of this one peculiarity.

Narcetes, gen. nov.

Closely allied to *Bathytroctes*, Gthr.

Head naked. Body rather elongate, compressed, covered with scales of moderate size. Eye rather small. Mouth wide; the maxilla extending beyond the vertical through the middle of the orbit. Fine teeth in premaxillæ, maxillæ, mandible, palatines, and vomer, those in the premaxillæ and mandible pluriserial; no teeth on the tongue.

Gill-openings wide; gill-covers complete; seven branchiostegals; four gills, with narrow laminæ; gill-rakers long. Pseudobranchiæ present. No adipose dorsal fin. Caudal forked. Pyloric cæca in moderate number. Ovaries with an oviduct.

10. *Narcetes erimelas*, sp. n.

B. 7. D. 15–16. A. 12. C. circ. 35. P. 10–11.
V. 9. L. lat. 68.

Head broad, pyramidal, its length $3\frac{1}{8}$ to $3\frac{1}{4}$ in the total without the caudal; body elongate, its greatest height, just behind the gill-opening, about $5\frac{1}{3}$ in the same standard, and gradually diminishing to the caudal peduncle.

Head-bones sculptured, especially the operculum and preoperculum, both of which have their border augmented by a semimembranous corrugated fringe.

Snout nearly as broad as long, depressed, rounded from side to side, its dorsal and ventral profiles meeting at an acute angle; its length is a little over $\frac{1}{3}$ that of the head, and more than half as long again as the eye. Nostrils very large.

Eye rather small, its major diameter $5\frac{2}{5}$ in the head-length, and not quite equal to the width of the deeply concave interorbital space.

Mouth wide, oblique; the maxilla reaches conspicuously behind the vertical through the posterior border of the orbit. The premaxilla is a short strong bone; the maxilla is composed of three longitudinal plates, of which the innermost (uppermost) is movable; the mandible is very strong and broad, and its under surface is excavated for a wide mucous channel which opens by six large circular pores on each side.

Teeth small, even, uniform, acute; those in the jaws standing, uncovered by the lips, outside the mouth; those in the premaxillæ and mandible recurved, quadriserial anteriorly, and laterally triserial in the former, biserial in the latter; those in the maxillæ uniserial, procurrent or procurved; those in the palatines uniserial, incurved; those in the vomer recurved, in a group of two or three on each side. Tongue large, toothless.

Gill-openings very wide; gill-membranes entirely separate; gill-covers large, complete; gill-rakers decreasing in size from the first arch to the fourth, those on the first arch being close-set, finely pointed, and as long as the eye; fourth gill-cleft rather wide; gill-laminæ very narrow, the individual lamellæ extremely delicate. Pseudobranchiæ large.

Head naked; body covered with deciduous scales of moderate size. The lateral line runs straight along the middle of the body.

The dorsal fin begins almost in the vertical through the origin of the ventrals, which are situated a snout-length behind the vertical through the middle of the body measured without the caudal. The anal fin begins two rows of scales behind the vertical through the hinder limit of the dorsal.

No adipose dorsal. Caudal symmetrically forked. Pectorals and ventrals well developed, broad, fragile.

Stomach very large, with thick walls thrown into deep longitudinal folds; the organ must be widely distensible in correlation with the wide mouth. Intestine coiled in a spiral; ten very large pyloric cæca in a bunch. No air-bladder. Ovaries with an oviduct.

Colours in the fresh state:—Head, iris, body, fins, oro-pharyngo-branchial membrane, and entire peritoneum deep black.

Two female specimens, measuring respectively $13\frac{1}{2}$ and $9\frac{1}{2}$ inches.

Station 105, 740 fathoms.

Both specimens when brought on board were in a cataleptoid state, the whole muscular system being quite rigid, and cutaneous excitation eliciting no responsive movement.

I have separated this fish from *Bathytroctes* chiefly on account of the pluriserial teeth in the premaxillæ and mandible.

Platytroctes, Gthr.

11. *Platytroctes apus*, Gthr.

Platytroctes apus, Günther, Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 249; and Zool. Chall. Exp. xxii. p. 229, pl. lviii. fig. A.

One specimen, 6 inches long, answering in every respect to Dr. Günther's description, except that the eye is larger in this specimen, being $\frac{2}{5}$ the length of the head and nearly twice as long as the snout.

Station 105, 740 fathoms.

Aulastomatomorpha, gen. nov.

Head naked. Body elongate, covered with minute hardly imbricate scales. Anterior bones of the head produced into a long tube terminating in a narrow mouth. Margin of the upper jaw formed equally by the premaxillæ and maxillæ. Uniserial teeth, in the jaws only. Eye large. Gill-cover apparently complete. Gill-opening wide below, contracted above, and not surpassing the level of the pectoral fin; four gills with narrow laminæ. Pseudobranchiæ almost rudimentary. Dorsal fin belonging to the caudal portion of the body; no adipose dorsal. Anal fin very long. Caudal forked. Pyloric cæca few, small. No air-bladder.

12. *Aulastomatomorpha phospherops*, sp. n.

B. 5? D. 21. A. 41. P. 7. V. 6.

Body elongate and compressed, surrounded from the mid-dorsal line behind the nape to the mid-ventral line behind the vent by a continuous thick succulent fold of the integuments, like, but not so wide as, that of *Platytroctes*; its greatest height, including this fold, is a little more than $\frac{1}{6}$ of the total without the caudal.

Head low and rather depressed, its length $3\frac{1}{6}$ in the total without the caudal; produced anteriorly into a long tubular snout, at the end of which is the small mouth; completely invested by a thick spongy or fungus-like poriferous skin, of a brilliant snow-white reflexion, and probably luminous in function. This covering is continuous round the branchiostegal rays and opercles with the equally thick velvety membrane which lines the external parietes of the gill-chambers, and it sends a fold backwards to the base of the pectoral on each side.

The snout is a little less than half the length of the head, or $6\frac{2}{3}$ in the total without the caudal.

The eyes are very large and extremely prominent; the major diameter of the globus oculus is slightly over $\frac{1}{4}$ the head-length, but owing to the encroachment up to the margin of the cornea of the broad posterior orbital fold, the diameter of the exposed "eye" is only a little more than $\frac{1}{5}$ of the same standard; the true (bony) interorbital space is less than half the diameter of the eye in width.

Nostrils situated high up, above the anterior orbital angle. Mouth at the extreme end of the tubular snout, small, the jaws apparently with limited motion. The upper jaw, which projects slightly beyond the lower, is formed in its anterior half by the premaxilla, in its posterior half by the maxilla. Minute, acute, recurved teeth in a single row in the premaxillæ and mandible; no teeth in the maxillæ.

Gill-openings very wide below, contracted above, and not surpassing the level of the pectorals. Gill-covers apparently complete; their constituent bones, including the branchiostegal rays, though well calcified, are extremely thin and fragile, and are completely concealed within a continuous uniform investment of confluent external skin and internal mucous membrane. Four gills, with narrow laminæ and coarse lamellæ; the fourth gill-cleft wide; gill-rakers well developed on all the arches, moderately long on the first, short on the fourth and fifth. Pseudobranchiæ rudimentary, consisting of four or five delicate short lamellæ on each side.

Body covered with minute, hardly imbricate, cycloid scales, about $\frac{1}{40}$ by $\frac{1}{30}$ of an inch respectively in the shortest and longest diameters. The lateral line traverses the middle of the body uninterruptedly.

The dorsal fin begins slightly in advance of the posterior fourth of the body measured without the caudal; the length of its base is shorter than the snout; its rays, like those of the anal, increase gradually in length from before backwards, the longest being not quite equal to the major diameter of the bulbus oculus. The anal begins an eye-length behind the vertical through the middle of the body as above limited, and ends a short distance behind the vertical through the posterior limit of the dorsal; its longest rays slightly exceed the longest dorsal rays. Caudal symmetrically forked, its rudimentary rays very numerous, both dorsally and ventrally. Pectorals narrow, rather more than $\frac{1}{3}$ of the head in length. Ventrals short, arising immediately behind the vertical through the middle of the body, as above limited, and reaching just behind the vent.

Stomach subsiphonal; intestine long, coiled in a spiral; four small pyloric cæca, arranged in a ring. No air-bladder. Reproductive glands very large, apparently discharging in the male (?) through a well-developed post-anal papilla.

Colours in the fresh state:—Head snow-white, iris black, body chocolate, fins blackish grey; oro-pharyngo-branchial membrane and entire peritoneum intense black.

One specimen, apparently a male near maturity, measuring 11 inches in length.

Station 104, 1000 fathoms.

This fish differs from all described Alepocephalids in having the pseudobranchiæ quite rudimentary and the anterior bones of the head produced into a snout like that of *Aulastoma*; but its affinities are quite clearly Alepocephalid.

Family Halosauridæ.

HALOSAURUS, Johnson.

13. *Halosaurus affinis*, Gthr.

Halosaurus affinis, Günther, Ann. & Mag. Nat. Hist. 1877, vol. xx. p. 444; and Zool. Chall. Exp. xxii. pp. 241, 242, pl. lix. fig. B.

Two specimens, measuring respectively $18\frac{3}{4}$ and 19 inches in length, answer the diagnosis of this fish.

The radial formula is

B. 11. D. 11–12. A. circ. 200. P. 13. V. 1/8.

There are nine large pyloric cæca, arranged in a row like the teeth of a comb along the first $\frac{3}{4}$ inch of the intestine, and embracing the ascending limb of the stomach.

Station 104, 1000 fathoms.

14. *Halosaurus Hoskynii*, sp. n.

Closely allied to the preceding.

B. 10. D. 11. A. circ. 175. P. 13. V. 1/8.

Head naked, its length $\frac{1}{8}$ of the total, and exceeding the distance between the gill-opening and the base of the ventral fin by about an eye-length.

Length of the snout $2\frac{1}{5}$ in that of the head, the preoral portion being not quite a half of the whole.

The major diameter of the eye equals the width of the interorbital space, and is contained $7\frac{1}{2}$ times in the head-length and just over 3 times in the length of the postorbital portion of the head.

The maxilla does not quite reach the vertical through the anterior margin of the orbit.

The pterygoid band of teeth is very broad and not continuous with the palatine band.

Eight moderately long gill-rakers on the middle of the first arch, besides some small ones above and below.

Scales extremely deciduous, those on the lateral line larger and more adherent than the rest, measuring $\frac{1}{4}$ of an inch in diameter; with a small central perforation; thirty between the gill-opening and the vent.

The dorsal fin begins rather more than an eye-length behind the level of the ventrals.

Seven large pyloric cæca in a longitudinal row embracing the ascending limb of the stomach.

Colours in the fresh state:—Body and fins uniformly dark sepia-brown.

Two female specimens, 20 and 21 inches long.

Station 104, 1000 fathoms.

I have thought it sufficient to indicate simply the diagnostic points of this species, which I have named after the accomplished hydrographer in charge of the Survey.

Family **Murænidæ.**

Group *Anguillina.*

Promyllantor, gen. nov.

Allied to *Congromuræna.*

Body stout, with the muscular and osseous systems well developed. Tail about as long as the trunk. Muciferous cavities of the head well developed. Eye rather small. Cleft of the mouth narrow, not extending behind the middle of the eye. Villiform teeth in broad bands in the jaws and in a broad confluent patch on the palate. Tongue free. Nostrils lateral. Gill-openings widely separate; four gills with wide clefts. No scales. Pectoral and vertical fins well developed, the latter confluent. The dorsal begins some distance behind the occiput.

15. *Promyllantor purpureus*, sp. n.

The head is $\frac{1}{6}$, the tail a snout-length over half the total; the body is massive, its greatest height equals the length of the postorbital portion of the head.

Head with its muciferous cavities highly developed, low, broad, inflated, ending in a broad, pointed, swollen snout, which is twice the length of the eye or $\frac{1}{4}$ the total length of the head, and conspicuously prominent beyond the mouth. Eyes circular, set high up on the side of the head, deep beneath a small transparent area of skin, a diameter and a half apart.

Anterior nostril a short wide tube situated inferiorly at the tip of the snout. Posterior nostril a large circular foramen just above the anterior orbital angle.

Mouth subrostral; its angle reaching slightly behind the vertical through the anterior border of the orbit; the jaws completely hidden by the very thick inflated lips. Villiform teeth in broad bands in the jaws, and in a broad, confluent, triangular patch covering the palate. Tongue free.

Gill-openings small, widely separated foramina, hardly larger than the eye; four gills with narrow laminæ and coarse lamellæ and wide clefts; no gill-rakers.

Integument thick, coriaceous, scaleless, investing the vertical fins and completely concealing their rays. The lateral line traverses the middle of the body.

Vertical fins confluent; the dorsal begins a distance behind the occiput equal to the length of the postrostral portion of the head, or just behind the level of the tips of the pectorals when laid full back. The anal begins immediately behind the vent. Pectorals small, pointed, equal in length to the rostrorbital portion of the head.

Stomach with a *cul-de-sac* of moderate size; intestine wide, little convoluted; liver large, indistinctly lobated, embracing the œsophagus. Air-bladder very large, with very thick spongy walls and a small central cavity.

Colours in the fresh state:—Body and fins uniform purple-black.

One female specimen, 17 inches long, with mature ovaries.
Station 104, 1000 fathoms.

I am greatly indebted to Professor Wood-Mason for counsel and advice.

XXXV.—*On the Ophidian Genus* Pseudoxyrhopus, *Gthr.* By G. A. Boulenger.

A curious snake from Madagascar was described by Jan in 1863 under the name of *Homalocephalus*, which name, being preoccupied in entomology, was changed by Günther to *Pseudoxyrhopus* in 1881. Jan placed his new genus among the Coronellines and next to *Lamprophis*, which is regarded by Günther as related to the Lycodonts, a view which I share; Günther, on the contrary, was inclined to place it "with the larger and more-developed Colubers." But the remarkable dentition of the lower jaw does not appear to have been noticed by either author, an omission which accounts also for the fact that other species of the same genus have been described under the generic names of *Xenodon* (Peters), *Liophis* (Günther), and *Coronella* (Boulenger). This mandibular dentition points to affinity with the Lycodonts, near which I would place *Pseudoxyrhopus* in the system, with the following definition:—

Maxillary teeth 16 to 18, the two posterior strongly enlarged and separated from the preceding by an interspace; anterior mandibular teeth much larger than the posterior and increasing in size to the fifth, sixth, or eighth. Head scarcely distinct from neck; eye small, with round pupil. Body cylindrical; scales smooth, without pits, in 17 to 25 rows. Tail rather short; subcaudals all or part in two rows.

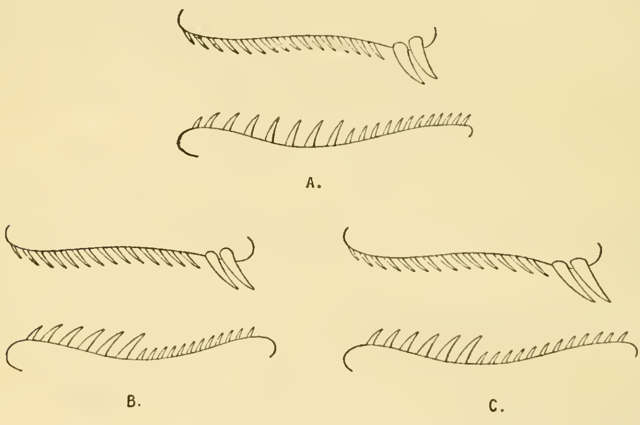


Figure showing the dentition of:—A. *P. microps*; B. *P. quinquelineatus*; C. *P. imerinæ*.

Five species are known, which differ in the following characters:—

A. Scales in 25 rows; frontal as broad as long; rostral just visible from above; two labials entering the eye; ventrals 207–225; subcaudals 45 .... *P. micrcps*, Gthr.

B. Scales in 21 rows; frontal a little longer than broad; two labials entering the eye.
  - *a.* Rostral just visible from above; ventrals 155; subcaudals 35 .... *P. heterurus*, Jan.
  - *b.* Portion of rostral visible from above at least half as long as its distance from the frontal; ventrals 142; subcaudals 45–47 .... *P. quinquelineatus*, Gthr.

C. Scales in 19 rows; frontal longer than broad; portion of rostral visible from above half as long as its distance from the frontal; two labials entering the eye; ventrals 137–146; subcaudals 40–47 .... *P. imerinæ*, Gthr.

D. Scales in 17 rows; frontal a little longer than broad; three labials entering the eye; ventrals 162; subcaudals 42 ...... *P. punctatus*, Ptrs.

All agree in the following points:—Supraocular not more than half the width of the frontal; loreal longer than deep; one præ- and two postoculars; temporals 1 + 2; anal divided.

List of the Species.

1. *Pseudoxyrhopus microps.*

Pseudoxyrhopus microps, Günther, Ann. & Mag. Nat. Hist. (5) vii. 1881, p. 359, fig.

Betsileo.

2. *Pseudoxyrhopus heterurus.*

Homalocephalus heterurus, Jan, Arch. Zool. Anat. Phys. ii. 1863, p. 286, and Icon. Ophid. xvii. pl. iv. fig. 2 (1866).

Madagascar.

3. *Pseudoxyrhopus quinquelineatus.*

Liophis quinquelineatus, Günther, Ann. & Mag. Nat. Hist. (5) vii. 1881, p. 359, fig.

Betsileo.

4. *Pseudoxyrhopus imerinæ.*

Coronella microps, Boulenger, Ann. & Mag. Nat. Hist. (6) i. 1888, p. 104, pl. v. fig. 4.
Liophis imerinæ, Günther, Ann. & Mag. Nat. Hist. (6) v. 1890, p. 71.

Imerina.

L. imerinæ is the adult of the previously described *C. microps*, which name, however, is preoccupied by *Pseudoxyrhopus microps*, Gthr.

5. *Pseudoxyrhopus punctatus.*

Xenodon punctatus, Peters, Mon. Berl. Ac. 1880, p. 221, pl. —. fig. 3.

Stated to be from Brazil, but its habitat will probably prove to be Madagascar. I am indebted to Dr. Paul Matschie, of the Berlin Museum, for a sketch of the dentition of the type specimen, which shows the fourth and fifth mandibular teeth enlarged.

XXXVI.—*A New Theory of* Pterichthys. By A. Smith Woodward, F.Z.S.

The missing link between the Chordata and some of the non-Chordate phyla below has long been sought in vain among the organisms revealed by palæontology. The almost invariable destruction of soft tissues during fossilization evidently constitutes the chief obstacle to the quest; and it still seems most probable that none of the intermediate types developed hard skeletal parts such as could be preserved under ordinary conditions. There is, however, one anomalous group of early Palæozoic skeletons which has been almost invariably referred to in this inquiry, *i. e.* the tribe comprising *Pterichthys*, *Bothriolepis*, *Cephalaspis*, and their allies. At the time of their first discovery the superficial aspect of these skeletons at once led to their comparison with the contemporaneous Eurypterids, then believed to be Crustaceans; somewhat later they entered the heterogeneous order of "Ganoid" fishes; still further investigation led to a suggestion that they might possibly be a primitive armoured form of Marsipobranch fish; and a few years ago *Pterichthys* and *Bothriolepis* were compared by Cope* with the shielded types of Tunicates, e. g. *Chelyosoma*.

Quite recently an attempt has been made to show that this gradual growth of ideas has proceeded in a wrong direction; and a well-known investigator of the morphology of Arachnida, Mr. William Patten, now claims † to justify, on philosophical grounds, the first impressions of the earliest collectors. In the modern acceptation of the term, Trilobites and Merostomata are Arachnids; and it is in this direction, according to

* E. D. Cope, "The Position of *Pterichthys* in the System," Amer. Nat. vol. xix. (1885), pp. 289–291, with figs.

† W. Patten, "On the Origin of Vertebrates from Arachnids," Quart. Journ. Micr. Sci. vol. xxxi. (1890), pp. 359–365, fig. 13.

Mr. Patten, that naturalists must seek the ancestors of the Chordate phylum.

However plausible the theory and however convincing the arguments deduced from the morphology and embryology of existing types, we venture to think that *Pterichthys* and *Bothriolepis* cannot be cited as having any distinct bearing on the subject. More especially does it seem clear that the dermal plates in the fossils just mentioned cannot be interpreted as the homologues of certain plates of the Arachnids, in the manner the author supposes; and when it is suggested that the so-called dorsal shield of *Pterichthys* is on the hæmal aspect of the animal, an ichthyologist, at any rate, is unable to regard the statement as anything beyond unjustifiable speculation.

In the first place, Mr. Patten gives outline-sketches of the anterior hæmal shield of a Trilobite and compares it with corresponding outlines of the dorsal ("hæmal") shield of *Pterichthys* and *Bothriolepis*. Unfortunately, however, the latter are copied from old erroneous figures, the inaccuracy of which was pointed out some time ago in these pages by Dr. R. H. Traquair *. The agreement in general size and shape is first insisted upon; but that, it must be admitted, is a circumstance of very secondary importance. In the second place it is stated that, like that of the Trilobite, the "cephalothoracic" shield of *Pterichthys* and *Bothriolepis* exhibits a cervical suture, proving the concrescence of vagus segments; but the groove in question is shown by overwhelming evidence to be nothing beyond a superficial slime-canal, evidently connected with the sensory system. The same remark applies to the inner of the "great semicircular sutures extending parallel with the edge of the shield around the front and sides," which is another point of supposed similarity insisted upon; the so-called outer semicircular suture represented in *Pterichthys* (evidently after Pander) does not exist. The "ocular plates" and "facial suture" certainly are in part comparable; and there is some fanciful resemblance of the median plates to the median lobes of a Trilobite, but the comparison does not appear very satisfactory.

Having thus disposed of what is *assumed* to be the hæmal shield, Mr. Patten remarks that the "neural surface of *Pterichthys*, or the neural surface of a true fish," has "the median cranial plates arranged in pairs, terminating in a posterior unpaired plate," corresponding to the coxal plates

* R. H. Traquair, "On the Structure and Classification of the Asterolepidæ," Ann. & Mag. Nat. Hist. [6] vol. ii. (1888), pp. 485–504, pls. xvii., xviii.

and the metasternum of Scorpions and Merostomata. Again we fail to find any justification for this statement in Dr. Traquair's restoration, the accuracy of which we have been able to verify in every respect. Moreover, when the conclusion is reached that "since their eyes are situated on the hæmal surface . . . *Pterichthys*, *Bothriolepis*, &c. are nearer related to the Arachnids than to the Vertebrates," it is obvious that some of the most fundamental characters in the skeleton of the first-named genus have been overlooked.

Even in the dorsal shield itself there are features inexplicable except on the supposition that it covered the neural aspect of an organism provided with a typical vertebrate brain. The plate between the eyes, for example, exhibits a deep pit on its visceral surface identical in position with that which few will deny received the pineal body in several early shielded types (e. g. *Coccosteus*), which are proved to be vertebrates by the discovery of the axial skeleton of their trunk. But the characters of the tail of *Pterichthys*, now well known, seem to the present writer absolutely conclusive of the relations of the neural and hæmal aspects. As shown by Dr. Traquair, this tail is fish-like in every respect; it has ridge-scales and a median fin on the border that continues the convexity of the eye-bearing shield, and the pointed extremity of the tail is turned upwards towards this border. Moreover, at least one specimen in the British Museum proves that there was a large terminal fin extending chiefly on the convex border of the extremity. Such structures are unparalleled in any known group except that of the fishes; and when they do occur here the produced body-lobe of the heterocercal tail is invariably directed towards the neural aspect, while the ridge-scales and median fin, when present only on one border, are without exception on the same aspect.

A tail of a closely similar character is also known in the allied family of Cephalaspididæ, and it seems to the present writer proved beyond doubt that all the organisms of this type are true Chordata, while many probably reach the phase to which the term Vertebrate is now commonly restricted. Indeed, as nearly all the special points noticed by Mr. Patten result from a consideration of insufficient or inaccurate data, it seems needless to follow him further in his wide generalization as to the arrangement of the exoskeleton and eyes in the lower vertebrates. There is much parallelism in the skeleton of totally distinct groups that yet remains to be explained; and it seems quite as philosophical to us to infer, from the known anatomy of a cockle, that the valves in the extinct *Spirifer* were lateral shields, as to interpret mere superficial resemblances in the armour of *Pterichthys* and Eurypterids as homologies.

XXXVII.—*Notes on the Palæozoic Bivalved Entomostraca.—No. XXIX. On some Devonian Entomides**. By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plate XI.†]

Introduction.

Since the publication of the paper (in 1879 ‡) on the Devonian Entomides (the so-called "Cypridinen") of Germany, these little fossils have been frequently noticed by observers and writers, and their true generic position has been generally accepted. The lists of synonyms for the species here noticed will supply the more important references.

A very extensive series of specimens has been obtained of three species by Mr. W. A. E. Ussher, F.G.S., in Devonshire; and from among them a selection has been made for illustration (see Pl. XI. figs. 1–4).

A very interesting species from the Eifel district has been described by Mr. J. M. Clarke, of Albany, New York, under the appropriate name of *Entomis variostriata*; and he has kindly sent me some examples to examine and illustrate (see figs. 5–8 in the same Plate).

Entomis serratostriata.—At page 516 of the 'Versteinerungen rhein. Schicht.-Syst. Nassau,' by G. and Fr. v. Sandberger, 1850–56, it is stated that *Cypridina serratostriata*, Sand., had been met with at Petherwin, in Cornwall. In his Presidential Address for 1857 General Portlock expressed his doubts as to "*Cypridina serratostriata*" having been found at South Petherwin, in Cornwall, or in the corresponding beds of the Pilton group in North Devon; and stated that "Mr. Godwin-Austen informs me that he saw it, in company with Mr. F. Rœmer §, in beds which he considers higher in the series" (Quart. Journn. Geol. Soc. vol. xiii. p. lxxxix).

In Dr. Bigsby's 'Thesaurus Devonico-Carboniferus,' 1878,

* No. XXVIII. appeared in the Ann. & Mag. Nat. Hist. for October 1889.

† This Plate has been drawn with the aid of a grant from the Royal Society for the illustration of the fossil Ostracoda.

‡ Ann. & Mag. Nat. Hist. ser. 5, vol. iv. pp. 182–187, pl. xi.

§ Dr. Ferd. Rœmer tells me (in letter of September 30, 1889) that this was his late brother Fr. Adolph Rœmer, of Clausthal; also incorrectly referred to as "Ferd. Rœmer," Ann. & Mag. Nat. Hist. ser. 4, vol. xi. (1873), p. 414.

"Petherwin" is mentioned, at p. 27, among several localities for *Cypridina* (*Entomis*) *serratostriata*, Sandb.*

In the Quart. Journ. Geol. Soc. vol. xxiii. (1867) pp. 618 and 670, Mr. Etheridge refers "*Cypridina serratostriata*" to the English Upper-Devonian (Petherwin), probably on MM. Sandberger's authority.

The occasion and circumstances of the first discovery of "*C. striatostriata*" in South Devonshire are given in detail by Fr. Adolph Rœmer in the report of a geological excursion which he had made with Mr. R. A. C. Godwin-Austen, from Newton-Bushel to West Ogwell, Chudleigh, and other localities (see the 'Neues Jahrbuch f. Min. &c.,' Jahrg. 1853, pp. 810–818). At page 812 this little fossil (now known as *Entomis serratostriata*) is mentioned as occurring in a series of red schists near Bickington, at the south-eastern foot of the Ramshorn Down—a locality quite distinct from those mentioned by Dr. E. Kayser † as yielding the same fossils ‡, during a tour in Devon after the Meeting of the Geological Congress in London in 1887.

Pursuing his researches in South Devon, Mr. Ussher, making the Official Geological Survey of the district, found that the *Entomis*-slates (equivalent to the mis-named "Cypridinen-Schiefer") "occur in the area between Kingsteignton and Bishopsteignton, on each bank of the Teign, where the characteristic *Posidonomya* and *Entomis*, with an occasional imperfect Trilobite (perhaps *Phacops*), have been found in them. On the other side of the Teign alluvium from Knowles Hill, Newton-Abbot . . . . to Highweek and Houghton, their occurrence is similarly proved by fossil evidence. They are recognizable by similar characteristics near Ilsham and Anstey's Small Cove.

"In Whiteway Farmyard greenish-grey clay-slates were identified as 'Cypridinen-Schiefer' by Kayser, who mentions the occurrence of numerous examples of *Posidonomya venusta* as well as *Trimerocephalus* (cf. *cryptophthalmus*) in them. At

* My friend Mr. W. A. E. Ussher tells me that he sees no reason why Entomides should not occur at South Petherwin; for the Petherwin beds are Upper Devonian and somewhat similar in places to the Livaton beds (between Bickington and Bovey), and they are correlated with the Pilton beds; he also regards them as being correlative with the zone of *Rhynchonella letiensis* in the Ardennes.

† "Ueber das Devon in Devonshire und im Boulonnais," Neues Jahrb. f. Min. &c., 1889, vol. i. part 2, p. 185.

‡ On the road from Ugbrooke Park to Lewell (near Chudleigh), and at Whiteway Farm, about 3 miles south-east of Chudleigh. These places are north-east of the Bovey valley; Bickington is south of that valley.

Goodrington red clay-slates contain *Posidonomya venusta* and *Entomis serratostriata.*

"The faulted inliers of Upper-Devonian slate in the Culm-measure area between Bickington and Bovey-Tracey contain beds of different lithological type, all of which have their analogues in the Chudleigh district and in the Upper-Devonian tract between Rydon Farm and Abbotskerswell, south of Newton-Abbot. Though they probably represent the 'Cypridinen-Schiefer' for the most part, there are beds at and near Livaton and Woodhouse which may belong to a higher horizon." (Quart. Journ. Geol. Soc. vol. xlvi. (1890) p. 513.)

In the specimens collected by Mr. Ussher for H.M. Geological Survey I detected (*ibid.* p. 514) from—

"Whiteway Farm: some small oblong Ostracoda (? *Primitiæ*)" and *E. Richteri*, sp. nov.*, rare.

"About a quarter of a mile north-north-west of Whiteway Farm: *Entomis serratostriata* (Sandberger), good and abundant.

"South bank of the Teign, west of Combe-Cellars: *Entomis*, very obscure.

"Kingsteignton Railway-cutting, near Hackney: *Entomis serratostriata*, numerous.

"Knowles Quarry, Newton-Abbot: *Entomis serratostriata* and *E. gyrata* (Richter).

"East side of Knowles Hill, Newton-Abbot: *Entomis serratostriata* and *E. gyrata.*

"North of Greenaway Place, near Newton-Abbot: *Entomis serratostriata*?

"Castle-Dyke Quarry, near Highweek: *Entomis gyrata*, abundant; *E. serratostriata,* rare.

"West of Western House, near Highweek: *Entomis serratostriata.*

"By road west of Western House: *Entomis gyrata.*

"East Ogwell: *Entomis serratostriata.*

"West of Livaton: *Entomis serratostriata*, rare.

"Lane near Lenda Mill, near Livaton: *Entomis serratostriata*, obscure.

"Anstey's Cove Cliff: *Entomis serratostriata*, numerous.

"West end of Goodrington village: *Entomis serratostriata*, squeezed and obscure."

* This was given as *E. Sandbergeri* from N.N.W. of the farm, *loc. cit.*

Description of the Species.

1. *Entomis* † *serratostriata* (Sandberger). (Pl. XI. figs. 1 *a*, *b*, 2 *a*, *b*.)

"Cytherinen-Schiefer," G. Sandberger, Neues Jahrb. f. Min. &c., 1842, p. 226.

Cypridina ‡ *serratostriata*, G. Sandberger, Jahrb. Vereins Naturk. Nassau, 1845, pp. 120, 121, and 123, pl. i. figs. 6 and *; et *Cypridina dimidiata*, G. Sandberger, *ibid.* p. 123; "coll. et litt."

Cypridina serratostriata, Bronn, Index Palæont. 1848–49, part i. p. 387, part ii. p. 560; et "*Cytherina dimidiata*, Sandb., *in litt. et specim.*" p. 387.

Cytherina striatula et *C. hemisphærica*, Richter, Beitrag Palæont. Thüring. Waldes, 1848, pp. 19, 20, pl. ii. figs. 5–17.

Cypridina serratostriata, G. and C. L. Fr. von Sandberger, Verstein. rhein. Schichten-Syst. Nassau, part i. 1850, p. 4, pl. i. figs. 2, 2 *a–i*. (Including *Cytherina striatula* and *hemisphærica*, Richter, in the synonymy.)

Cypridina serratostriata, Fr. Rolle, Neues Jahrb. &c. 1851, p. 663.

Cypridina serratostriata, Bronn and Ferd. Rœmer, Lethæa geognost. 3rd edit. vol. i. (1851–56), part ii. (1852–54), p. 532, pl. 9^3. figs. 10 *a–d*. (*Cytherina striatula* et *C. hemisphærica*, Richter, are included in the synonymy.)

Cypridina serratostriata, F. A. Rœmer, Beitr. geol. Kenntniss nordwestl. Harzgeb. part i., Palæontographica, vol. iii. 1854, p. 42, pl. vi. figs. 15 *a*, *b*.

Cypridina? serratostriata, Jones, in Morris's Catal. Brit. Fossils, 1854, p. 104.

Cypridina serratostriata, Richter, Beitrag Paläont. Thüringer Waldes, Denkschr. Math.-naturw. Classe k. Akad. Wissensch. Wien, vol. xi. 1856, p. 121, pl. ii. figs. 20–29.

Cypridina globulus, Richter, *ibid.* p. 122, pl. ii. figs. 30–32.

Cypridina serratostriata, F. A. Rœmer, Verstein. Harzgebirges &c., Palæontographica, vol. xiii. 1863, p. 232.

Entomis of the Cypridinen-Schiefer, Jones and Kirkby, Geologist, vol. vi. 1863, p. 460; Report Brit. Assoc. Newcastle (for 1863), 1864, Trans. Sect. p. 80.

Cypridina serratostriata, Ferd. Rœmer, Geognost. Beobacht. im Polnischen Mittelgebirge, Zeitschr. deutsch. geol. Gesell. 1866, pp. 673 and 690, pl. xiii. figs. 4, 5 (the fig. 5 gives a squamose appearance to the sculpturing, somewhat like Richter's figs. 21–25, 30, and 32, Denkschr. 1856).

Cypridina serratostriata, Richter, Das Thüringische Schiefergebirge, Zeitschr. deutsch. geol. Ges. vol. xxi. 1869, List of Thuringian Palæozoic Fossils, pp. 390 and 391.

Cypridina serratostriata, Ludwig, Ueber die Gliederung devon. Format. &c., Neues Jahrb. &c., 1869, p. 674.

Cypridina serratostriata, Richter, Zeitschr. deutsch. geol. Gesell. vol. xxi. 1869, p. 768, pl. xx. figs. 3–10.

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† For an account of *Entomis* and its synonyms see "Monograph of the British Carboniferous Entomostraca," Palæont. Soc. 1884, pp. 82–84.

‡ Not the *Cypridina* of Milne Edwards, as explained in the 'Monograph of the Tertiary Entomostraca,' Palæont. Soc. 1856, p. 9.

Entomis serratostriata (Sandberger), Jones, Ann. & Mag. Nat. Hist. ser. 4, vol. xi. 1873, p. 414.
Entomis globulus (Richter), Jones, *ibid.* p. 415.
Richteria serratostriata, Jones, Neues Jahrb. f. Min. &c., 1874, p. 180 (see Ann. & Mag. Nat. Hist. September 1879, p. 183).
Cypridina (*Entomis*) *serratostriata*, Bigsby, Thesaur. Dev.-Carbonif. 1878, p. 27.
Richteria (*Entomis*) *serratostriata*, Bigsby, *ibid.* p. 28.
Entomis serratostriata, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. iv. 1879, pp. 182–187, pl. xi. figs. 1, 3, 5, 7, 13–17.
Entomis serratostriata, Jones, *ibid.* ser. 5, vol. xii. 1883, p. 245, pl. vi. figs. 4 and 5.

Owing to the usually bad state of preservation in which these little Ostracodous valves and carapaces occur, both from loss of the test and the pressure they have suffered in various directions, they rarely present perfect conditions for description and figuring (see pl. xi., Ann. & Mag. Nat. Hist. September 1879, for various examples). The English specimens, now figured, form no exception, but are variously modified, with the nuchal sulcus misplaced in figs. 1 and 2, and nearly or quite extinguished in figs. 3 and 4 of other species. Other specimens have indications of the sulcus in its proper mid-dorsal position; and in size these English examples correspond with the German *. The best preserved as to outline have the normal oval shape and the delicate, raised, longitudinal striæ, which usually appear to be pitted, but are sometimes pimpled, along the underside, as seen also in pl. xi. (1879), figs. 1 *b*, 5 *b*, and 7 *b*; the pits or pimples having different interstices, according to age and state of preservation. The raised lines converge at the ends of the valves, as in pl. xi. (1879), figs. 1 *a*, 5 *a*, and 7 *a*. On these lines, in *hollow* impressions of the valves, *pits* (Pl. XI. figs. 2 *a*, 2 *b*) occur, and these have evidently been left by little prickles once existing on the valves; and in *raised* casts (of the convex valves) there are minute *tubercles* or *pimples* (Pl. XI. figs. 2 *a*, 2 *b*), instead of small pits, and evidently the bases of broken prickles, small setæ, or bristles, once fringing the thin longitudinal ridges.

2. *Entomis Richteri*, sp. nov. (Pl. XI. fig. 3.)

Entomis Sandbergeri (Richter), Jones, in Quart. Journ. Geol. Soc. vol. xlvi. 1890, p. 514.

This at first sight looks like an exaggerated form belonging to the species last described. Its much larger size (2 × 1·4

* These latter were figured in pl xi., 1879, with an amplification of 18 diameters; the former are × 30 diam. in Pl. XI.

millim.) and coarser ridges, however, are strong distinctions. It has been much modified, the ridges having been squeezed up into sharp edges ; and at the same time the upper margin seems to have been flattened and broken and the sulcus nearly obliterated. At one time I thought that it might match Richter's *E. Sandbergeri*, taking into account his bad drawings; but I cannot now reconcile the two forms, however much they may have been modified by pressure, particularly as the ridges are spiral in Richter's fig. 17, pl. xx., Zeitschr. deutsch. geol. Ges. 1869, and they are simply longitudinal and somewhat convergent at the ends in Pl. XI. fig. 3. As it is larger and more roundly oval (proportionally higher) than *E. serratostriata,* with fifteen instead of about thirty ridges, and therefore belonging to the *thick-wrinkled* group, I separate this form as *Entomis Richteri*, after my deceased friend Dr. Reinhard Richter, who interested himself for many years in the discovery and elucidation of many forms of the Devonian Entomides in the neighbourhood of Saalfeld. This specimen, from Whiteway Farm, is unique.

3. *Entomis gyrata* (Richter). (Pl. XI. fig. 4.)

Cytherina, Richter, Beitrag Paläont. Thür. Waldes, 1848, p. 46, pl. vi. fig. 212.

Cypridina gyrata, Richter, Denkschr. Akad. Wissensch. Wien, vol. xi. 1856, p. 122, pl. ii. figs. 33, 34; and Zeitschr. deutsch. geol. Gesell. vol. xxi. 1869, p. 769, pl. xx. figs. 13. 14 (bad figures).

Richteria (Entomis) gyrata, Bigsby, Thesaur. Dev.-Carbonif. 1878, p. 27.

Entomis gyrata, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. iv. 1879, pp. 185–187, pl. xi. figs. 4, 8, 10–12, and 18 (From Dr. Richter's typical specimens.)

Entomis gyrata, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. xii. 1883, p. 245, pl. vi. figs. 3 *a*, 3 *b*. (Uralian.)

We know from G. West's careful figures (above referred to) of Dr. Richter's own specimens what *E. gyrata* really is, with its curious subconcentric wrinkling, which reminds us (as Richter has noticed) of the delicate markings of our finger-tops. The specimen before me, from Castle-dyke Quarry, Devon, has its wrinkles, ridges, or costulæ wide apart and squeezed into sharp edges, and therein it differs from the type; but the *pattern* appears to be essentially the same. When perfect the valve was about 1 millim. long by 0·7 millim. high, which is rather smaller than the German and Uralian specimens. Rather than propose a new specific standing for this unique specimen I place it with *E. gyrata*, on account of the plan of the ornament, though badly preserved. It may possibly be a *variety* of that species.

4. *Entomis variostriata*, J. M. Clarke.
(Pl. XI. figs. 5–8.)

Entomis variostriata, Clarke, Neues Jahrb. f. Min. &c., 1884, vol. i. p. 184, pl. iv. fig. 3.

Mr. J. M. Clarke, of Albany, New York, found this species rather abundant in the *Intumescens*-Kalk, belonging to the lower part of the Upper Devonian, at Bicken, Westphalia. The specimens he described in his paper when he was in Germany were from 2 to 2½ millim. long; but the only examples that he could lately send for examination and figuring are smaller, though plentifully distributed in two little pieces of the rock from Bicken. These carapaces are subglobular, or, rather, subovate, with a high convexity in the middle (1·8 millim. in fig. 8); glossy black and of many sizes, scattered through a dull black limestone, and leaving glossy impressions. They vary from 1·6 × 1·3 millim., 1·4 × ·76 millim., 1·2 × ·9 millim., to ·6 × ·4 millim., and smaller. The sulcus, as noticed also in Mr. Clarke's description, loses its simple furrow-like shape in some cases by having its sides unequally raised or by being represented only by a central pit; in the small (probably young) state, fig. 7, the sulcus is not well developed; and the other conditions may also belong to stages of growth. The ornament is essentially a concentric series of thin, raised, interrupted lines, like those of *Entomis gyrata* (see figs. 4 & 5). In fig. 8 *a* they are quite concentric to the central pit, but with a somewhat angular or lozenge-like contour; in fig. 6 *a*, however, they are curved at one end of the valve and longitudinal at the other. Between these raised striæ are numerous delicate, transverse, flexuous, and branching lines, starting from the lower or underside of the linear wrinkles or costulæ, and dying out before they quite cross the interspaces (fig. 6 *b*). The variability of the ornament has been very appropriately recognized as characteristic of this German species.

EXPLANATION OF PLATE XI.

Fig. 1. *Entomis serratostriata* (Sandb.). *a*, hollow impression of left valve, × 30 diam.; *b*, ornament of the same, × 75 diam. From N.N.W. of Whiteway Farm.

Fig. 2. *Entomis serratostriata* (Sandb.). *a*, convex cast of right valve, × 30 diam.; *b*, ornament of the same, showing ridges and pimples, × 75 diam. From N.N.W. of Whiteway Farm.

Fig. 3. *Entomis Richteri*, sp. nov. Left valve, somewhat crushed, × 30 diam. From Whiteway Farm.

Fig. 4. *Entomis gyrata* (Richter), variety. Left valve, imperfect, × 30 diam. From the Castle-Dyke Quarry.

Fig. 5. *Entomis variostriata*, Clarke. Left valve, × 30 diam.

Fig. 6. *Entomis variostriata,* Clarke. *a,* right valve, showing both sulcus and striæ to be modified, × 30 diam.; *b,* striæ and interstitial ornament, × 75 diam.
Fig. 7. *Entomis variostriata,* Clarke. Right valve of a young individual, × 30.
Fig. 8. *Entomis variostriata,* Clarke. *a,* right valve of a large specimen, with a central pit representing the sulcus; and the striæ modified, × 30 diam.; *b,* ventral profile of the same, × 30 diam.

Figs. 5–8 from Bicken, Westphalia.

XXXVIII.—*Notes made during the present Year on the Acceptance or Rejection of Insects by Birds.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

As I consider that the question of the immunity from destruction of certain insects by birds is still far from being an ascertained fact, I have again made notes this year on the effect produced by offering various insects and their larvæ to the occupants of my aviaries. These are as follows:—

Indoor Aviaries.

1. Cockateels, Budgerigars, and Australian Zebra-Finches.
2. Pekin Nightingales alone.
3. Whydah-birds, Weavers, American Nonpareils, Saffron-Finches, St.-Helena Seed-eaters, Green Singing-Finches, Canary.
4. Mannikins, Waxbills, and Blue Robins.

Conservatory.

5. Cage containing White-eared Persian Bulbul.

Outdoor Aviaries.

1. Chaffinches, Hen Bullfinch, Great Tit, Blackbird; all in good-sized cages.
2. Chaffinches, Greenfinches, Redwings; all flying freely about.
3. Large cages containing Blackbird and Fieldfare.
4. Buntings, Bullfinches, Linnets, Goldfinch, Canaries, Siskins, Indigo-Finch, and Australian Zebra-Finches; all flying freely about.

Altogether thirty-six species, most of them flying about in large aviaries fitted up with natural branches and growing shrubs and trees.

I made my first observation on the 27th April, when I turned full-grown females of the two spiders *Tegenaria domestica* and *Dysdera Cambridgei* into the aviary containing the Blue Robins, Waxbills, and Mannikins. Not one of the birds showed the least fear of them (the smallest birds, as a matter of fact, do not fear the largest British spiders), but the cock Blue Robin flew down at once and devoured each as soon as it began to run.

On the 1st of May I obtained a number of larvæ of the cockchafer (*Melolontha vulgaris*), and on the 1st, 2nd, and 3rd of the month I gave examples to the Fieldfare, Blackbirds, Redwings, Blue Robins, Pekin Nightingales (*Leiothrix luteus*), Bulbul, and Great Tit; the Blackbirds, Bulbul, and Great Tit ate theirs immediately, the Blue Robins killed but did not relish theirs, the other birds ignored the larvæ.

On May 4th and throughout the summer hundreds of the two white butterflies *Ganoris rapœ* and *brassicœ* have been eaten with great satisfaction by the Blue Robins, Yellow Hammer, Nonpareils, Indigo-Finch, and Chaffinches.

On the 1st and 19th June I turned larvæ of *Hyponomeuta padella* into my outside Finch aviary and into the Blue-Robin aviary; the Indigo-Finch ate one or two but did not relish them; the other birds ignored them *.

On June 9th and 10th I offered soldier-beetles (*Telephorus*) to the Blue Robins and Chaffinches, which appeared to eat them with pleasure; yet, after this date, although I repeatedly offered this beetle to them, both species refused to touch it.

On the 19th June I obtained the first specimens of *Eristalis tenax* and turned them into my three largest aviaries: the Blue Robins, Orange Weavers, and Nonpareils examined this fly, but would not eat it, although last year the Nonpareils ate a considerable number; the Indigo-Finch, however, at once flew down, seized and ate the flies with pleasure.

About the middle of the month my hen Blue Robin went to nest and the cock became most attentive to her, carrying every insect to her until her eggs were hatched, when he transferred his attentions to the young. On the 27th June, however, previous to the hatching of the eggs, I found a large gravid female of the gooseberry-moth (*Abraxas grossulariata*), which, when thrown into the aviary with the Indigo-Finch and Buntings, feigned death and so escaped notice: I there-

* It will be remembered that this larva was much enjoyed by a specimen of *Carpodacus* formerly in my possession.

fore took it out and threw it into the Blue-Robin aviary; the cock bird immediately flew down, seized it, and was so much pleased with its flavour that, although the hen begged for it, he would not give it up, but devoured it himself. The young birds were hatched during the first week of July, but only one was eventually reared; this nestling was almost entirely fed upon flies, spiders, large and small (including numerous full-grown females of *Tegenaria atrica*, one of the most repulsive-looking of our British species), white butterflies, numerous examples of *Pterostichus madidus*, moths (including *Agrotis saucia* and *Zeuzera æsculi*), mealworms and small earthworms: the only moth I was doubtful about was the wood-leopard (*Zeuzera æsculi*); the old birds ate several specimens, but I did not see them disgorge them for the benefit of the young.

On the 16th August I obtained a full-grown caterpillar of *Cerura vinula*, a specimen of which, it will be remembered, was greedily eaten some years ago by my Nightingales. I turned it into the Blue-Robin aviary, and the hen flew down, seized it in the middle, and carried it to the ground, then started back suddenly as if stung (possibly the larva had ejected acid into her mouth or eyes); she then examined it curiously, pecked at it cautiously, springing back after each peck, and finally flew away. The cock and young bird now flew down and examined it, the former pecking it and jumping back several times, evidently half afraid of it; then both flew away, and I took it out. It was quite uninjured, so I turned it into the next aviary, when the Weavers and Nonpareils flew down and formed a circle round it; they walked round and round with outstretched necks for two or three minutes, the hen Nonpareil alone venturing to peck it once; then all flew away simultaneously. The caterpillar never once put itself into what is supposed to be a "terrifying attitude," but crawled like a great gaudily-coloured slug along the ground. I now turned it in with the *Leiothrix*, and they jumped round and pecked at it, but found it too tough a morsel; I do not think they were a bit afraid of it. I next offered it to one of my Blackbirds, but he sidled away along his perch and looked in a contrary direction. Lastly I put the caterpillar into the cage containing a Great Tit, and he flew down at once, seized and tore it to pieces, eating it with relish.

At first sight it would appear that, judging by these experiments, the caterpillar of *Cerura vinula* enjoyed almost perfect immunity from destruction; but when we consider that the birds which rejected it were, with the exception of the Blackbird, only those which would never come in contact with it in a state of nature, and that the bird of all others which would be most likely to come across it was the very one which showed no fear of it, but devoured it with avidity, the protective character of the caterpillar, consisting chiefly in its violent contrasts of colour (for the one experimented with never exserted its tentacles, even when violently pecked), ceases to be of any very great advantage to it.

On the 25th August I obtained larvæ of *Spilarctia lubricepeda*, which one of my Blackbirds ate directly they were thrown into his cage*.

My experiments this year have convinced me that the tastes of birds not only differ in individuals of the same species, but that the same individuals in consecutive years vary as to their likes and dislikes; in the second place they have confirmed the opinion, based upon previous experiments, which I expressed in my last paper, viz. that no insectivorous bird has the least fear of the largest British spider (doubtless if one offered a *Mygale* to a Waxbill or Goldcrest the bird would be alarmed); thirdly that, as already shown, the imago of *Abraxas grossulariata* is far from being distasteful, although the larva is distinctly so to many, if not to all, insect-eaters; lastly, that caterpillars and birds do not share with human beings the notion that the line of beauty is terrifying when seen in a large moth-larva. If a caterpillar gets a dig in the back from the beak of a bird it doubles up just as a human being would from a blow on the opposite side of his body; it does not do it to terrify the bird, but simply because it is in pain.

XXXIX.—*Revision of British Mollusca.* By the Rev. Canon A. M. Norman, M.A., D.C.L., F.R.S., F.L.S., &c.

[Continued from p. 91.]

Order IV. PULMONATA.

It is only in a few cases that I have thought it necessary to make observations on the species of Land and Freshwater Mollusca, nor have I, with few exceptions, given the varieties. These will be found in 'British Conchology;' and very much has been written since on the subject in the 'Journal of Conchology,' to which journal it is only requisite to refer those who are interested in the subject.

* This larva has since been eaten with satisfaction by a Chaffinch.

Suborder I. GEOPHILA.

A. Monotremata.

Fam. 1. **Testacellidæ.**

Genus Testacella, Cuvier.

176. *Testacella haliotidea*, Drap.
Var. *scutulum*, Sowerby.

177. *Testacella Maugei*, Férussac.

This species is completely naturalized and widely spread now in gardens throughout England, and has been also found in Jersey by Mr. Bull.

Fam. 2. **Limacidæ.**

Genus 1. Limax, Linné.

178. *Limax maximus*, Linné.

179. *Limax marginatus*, Müller, =*L. arborum*, Bouch.-Chant.

This is generally considered, and I think with reason, to be the *L. marginatus* of Müller; but Jeffreys in Brit. Conch. vol. i. followed Draparnaud in applying that name to *L. carinatus*; but see vol. v. p. 155.

180. *Limax flavus*, Linn.

181. *Limax agrestis*, Linn.

182. *Limax lævis*, Müller, =*L. brunneus*, Bouch.-Chant.

Jeffreys, who had little studied other Mollusca than those which bear external shells, supposed that this was a variety of *L. agrestis*. It is very different in form from that species, very local, and inhabits, so far as I have observed, marshy meadows. Jeffreys at a later period described it (see Brit. Conch. vol. v. p. 156).

183. *Limax tenellus*, Müller.

The admission of this species into our lists I believe chiefly rests on Mr. Alder's authority. The specimen figured by Forbes and Hanley was found at Allansford, near Shotley Bridge, Co. Durham. All Mr. Alder's original drawings are in my possession, and among them is that of this slug.

There are three figures—one of the natural size, the second a lateral enlarged view, being that given in F. & H., the third taken from below; but a point of especial interest is that at one corner of the cardboard are still to be seen traces of a yellow stain, underneath which is written "stain of the mucus." "The mucus (this character is especially to be noted) is orange-coloured" (*F. & H.*).

North Mavine, Shetland, on stones in a watercourse of a mountain rill (*Jeffreys*).

Subgenus Amalia, Moq.-Tandon.

184. *Limax carinatus*, Risso, = *L. marginatus*, Drap. & Jeffreys (non Müller).

185. *Limax gagates*, Draparnaud.

This is generally considered a rare species; but I have found it more frequently than the last, and described it many years ago ('Zoologist,' 1853, p. 4048). I have had specimens from St. Martin's, Guernsey; Torquay; Tenby; several places in the county of Durham, including my own garden here; Cumbrae, N.B.; Killarney, Ireland.

Genus 2. Vitrina, Draparnaud.

186. *Vitrina pellucida* (Müller).

Genus 3. Conulus, Fitzinger.

187. *Conulus fulvus* (Müller).

A species apparently of more extensive distribution than any other land-shell—the whole of Europe, North Africa, the Azores, Western Asia, Siberia, Central Asia, whence it is recorded by von Martens. I cannot find the slightest difference when shells of the American *Helix chersina*, Say, are placed beside European *fulvus*, and that shell ranges from Alaska to Florida, Hudson's Bay Territory to California and Texas. Most authors make *H. chersina* a synonym of *C. fulvus*; but Dall (Proc. U. S. Nat. Mus. 1885, p. 271) writes:—"This species will probably be found identical with *Z. fulvus*; but as the name of *fulvus* is not uncontested and there seems to be some discrepancy in observations of the soft parts, I prefer to retain Say's name."

Genus 4. Hyalinia, Férussac.

188. *Hyalinia crystallina* (Müller).

189. *Hyalinia nitida* (Müller).

190. *Hyalinia excavata* (Bean).

191. *Hyalinia pura* (Alder).

192. *Hyalinia radiatula* (Alder), ? = *Helix hammonis*, Ström.

H. radiatula, like *Conulus fulvus*, has an enormous range, extending over Europe, Caucasia, Siberia, Amoorland, and North America, down to Florida and up to such remote places as Behring Island, and even Point Barrow, Alaska, whence Dall records it "from moss off the tundra." It is the *Hyalina pellucida*, Lehnert, and *Helix electrica*, Gould.

193. *Hyalinia glabra* (Studer).

Thirty years ago my dear old friend Alder gave me a series of seven specimens of this shell rightly named, which had been found by Mr. Gilbertson, of Preston, about 1837 *. I also have from his collection three European specimens of the same shell, which I have little doubt were sent to him for comparison by Férussac, with whom he was in frequent correspondence. Dr. Jeffreys in 1870 (Ann. & Mag. Nat. Hist. May) recorded the species as British, it having been found by Mr. Thomas Rogers at Marple Wood, Cheshire, and by himself at Grassmere and Barmouth. Three of Mr. Rogers's specimens (given me by Jeffreys) range in my cabinet next to those of Gilbertson. Subsequently I collected this shell in company with Jeffreys in his own grounds at Ware Priory; and it has since been found in many other localities.

194. *Hyalinia alliaria* (Miller).

195. *Hyalinia cellaria* (Müller).

196. *Hyalinia Draparnaudi* (Beck).

In the 'Journal of Conchology,' vol. iii. p. 177, this shell is stated to have been found by Mrs. Fitzgerald at Guernsey, Torquay, and Bristol.

197. *Hyalinia nitidula* (Drap.).
Var. 1. *nitens*, Mich.
Var. 2. *Helmii*, Gilbertson.

Westerlund and other continental authors, who have

* Alder, Mag. Zool. and Bot. 1838, ii. p. 108, and Gray's Turton's Manual, p. 169.

greatly multiplied so-called species in this genus, regard *H. nitens* as distinct from *H. nitidula*, and *Helmii* as a variety of it.

Fam. 3. **Helicidæ.**

Genus 1. Arion, Férussac.

198. *Arion ater* (Linn.).
  Var. *flavus* (Müller).

199. *Arion hortensis* (Férussac).

Genus 2. Geomalacus, Allman.

200. *Geomalacus maculosus*, Allman.

Genus 3. Helix, Linné.

Subgenus 1. Punctum, Morse.

201. *Helix pygmæa*, Drap.

Subgenus 2. Patula, Held.

202. *Helix rotundata*, Müller.

203. *Helix rupestris*, Studer.

Subgenus 3. Vallonia, Risso.

204. *Helix pulchella*, Müller.
  Var. *costata*, Müller.

Subgenus 4. Acanthinula, Beck.

205. *Helix aculeata*, Müller.
206. *Helix lamellata*, Jeffreys.

Subgenus 5. Gonostoma, Held.

207. *Helix obvoluta*, Müller.

Subgenus 6. Chilotrema, Leach.

208. *Helix lapicida*, Linn.

Subgenus 7. Fruticola, Held.

209. *Helix hispida*, Linn.
  Var. 1. *concinna*, Jeffreys.
  Var. 2. *depilata*, Pfr.

210. *Helix rufescens*, Pennant.

211. *Helix granulata*, Alder, = *H. sericea*, Drap. (non Müller).

212. *Helix revelata*, Férussac.

213. *Helix fusca*, Montagu.

214. *Helix cantiana*, Montagu.

215. *Helix carthusiana*, Müller.

Subgenus 8. Arianta, Leach.

216. *Helix arbustorum*, Linn.

Varieties of this species described, J. W. Taylor, 'Journal of Conchology,' vol. iii. p. 241.

Subgenus 9. Euparypha, Hartmann.

217. *Helix pisana*, Müll.

Subgenus 10. Xerophila, Held.

218. *Helix virgata*, Da Costa.

219. *Helix ericetorum*, Müll.

220. *Helix caperata*, Montagu, =? *H. intersecta*, Poiret.

221. *Helix acuta*, Müller, = *Bulimus acutus*, Jeffreys.

Subgenus 11. Tachea, Leach.

222. *Helix nemoralis*, Müller.
Var. *albolabiata*.

The shell agreeing in size, texture, &c. with the type, but the lip white.

Scarborough (*Bean & Leckenby*).

Var. *roseolabiata*.

Shell agreeing in size, texture, &c. with the type, but the lip rosy pink.

I have two specimens of this variety, one from Wells, Somerset, and the other from Falmouth. They agree in coloration and are yellow, girt with five deep salmon-coloured bands.

223. *Helix hortensis*, Müller.
Var. *fuscolabiata*, Kregl., = *hybrida*, Poir.

Subgenus 12. POMATIA, Leach.

224. *Helix aspersa*, Müll.

225. *Helix pomatia*, Linn.

Fam. 4. **Pupidæ.**

Genus 1. BULIMINUS, Ehrenberg.

226. *Buliminus montanus* (Drap.).
Var. *albinus.*

Cooper's Hill, near Cheltenham (*J. W. Taylor*).

227. *Buliminus obscurus* (Müll.).

Genus 2. PUPA, Draparnaud.

Subgenus 1. LAURIA, Gray.

228. *Pupa cylindracea* (Da Costa) = *Pupa umbilicata*, Drap.
Var. *Sempronii*, Charp.

"Shell smaller, aperture without denticle, lip not so wide; Penyghent, Yorkshire." (*J. W. Taylor.*)

229. *Pupa anglica* (Férussac) = *Pupa ringens*, Jeffreys.
Sutherlandshire (*Baillie of Brora*).

Subgenus 2. TORQUILLA, Faure-Big.

230. *Pupa secale*, Drap.
Var. *Boileausiana*, Charp.

Dorridge Bridge, near Ingleton, Yorkshire (*Nelson*).

Var. *edentula*, Taylor.

Rocks near Ingleton, Yorkshire (*J. W. Taylor*); Eastbourne, Sussex (*Loydell*).

Subgenus 3. PUPILLA, Leach.

231. *Pupa muscorum*, Müll., = *Pupa marginata*, Drap.
Var. *edentula*, M.-Tand.

Brough, N.E. Yorkshire (*J. W. Taylor*); Margate (*Cockerell*); Clevedon, Somerset (*A. M. N.*).

Var. *albina*, Menke.

Cleeve Priors, Worcestershire (*W. H. Boland*); Weston-on-the-Green, Oxfordshire (not Weston-super-Mare, as erroneously given by *Jeffreys*) (*A. M. N.*).

Subgenus 4. Sphyradium, Agassiz.

232. *Pupa edentula*, Drap.
Var. *columella*, von Martens.

Subgenus 5. Isthmia, Gray.

233. *Pupa minutissima*, Hartmann.

Subgenus 6. Alæa, Jeffreys.

234. *Pupa alpestris*, Alder.

235. *Pupa Lilljeborgi*, West.

Vertigo Moulinsiana, Jeffreys, Brit. Conch. vol. i. (1862) p. 255, vol. v. pl. xv. fig. 6; Reeve, Brit. Moll. 1863, p. 117, descr. et syn. nec fig. quæ ex Moq.-Tand. cop.; nec *P. Moulinsiana*, Dup. (*fide* Westerlund).
Vertigo modesta, Westerlund, Œfvers. af K. Vet.-Akad. Förh. 1865, p. 556 (nec *V. modesta*, Say).
Pupa Lilljeborgi, Westerlund, Exposé critique des Moll. de Terre et d'Eau douce de la Suède et Norvège, 1871, p. 90; Fauna der in der paläarc. Reg. lebenden Moll. iii. 1887, p. 136.
Vertigo Lilljeborgii, Jeffreys, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. (1878), p. 380.

Under stones by the side of a small lake at Ballinahinch, near Roundstone, Co. Galway, where Jeffreys made this acquisition to the British Mollusca in 1845.

I searched for the shell in this locality in 1874, but did not succeed in rediscovering it.

236. *Pupa Moulinsiana*, Dupuy.

Pupa Moulinsiana, Dupuy, Hist. Nat. des Moll. 1850, p. 415, pl. xx. fig. 11.
Pupa Charpentieri, Shuttleworth, Chemn. Conch.-Cab. 1852, p. 129, pl. xvi. figs. 41, 43.
Pupa Moulinsiana, Jeffreys, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. 1877, p. 432 (partim), and ser. 5, vol. ii. 1878, p. 380 (nec Brit. Conch. vol. i. p. 255, nec vol. v. pl. xv. fig. 6).
Pupa Moulinsiana, Reeve, Brit. Land and Freshw. Moll. (1863), p. 117, woodcut.
Pupa Moulinsiana, Westerlund, Fauna der in der paläarct. Region lebenden Mollusca, iii. 1887, p. 136.

Otterbourne, Hants; Hitchin, Herts; and Essex border of Herts near Rye House (*H. Groves*).

Dupuy's figure of this shell is good. Jeffreys says that it is found on grasses in wet places high up the stalk.

237. *Pupa pygmæa*, Drap.
Var. *quadridentata*, Studer.

Norwich (*W. K. Bridgman*, in Mus. Norm.), Dirtcar, near Wakefield (*J. W. Taylor*).

238. *Pupa substriata*, Jeffreys.

239. *Pupa antivertigo*, Drap.

Subgenus 7. VERTIGO, Müller.

240. *Pupa pusilla*, Müll.

[*Pupa tumida*, Westerlund.

Pupa tumida, Westerlund, Exposé critique des Moll. de Terr. et d'Eau douce de la Suède et Norvège, 1871, p. 99; Fauna der in der paläarct. Reg. lebenden Moll. iii. 1887, p. 141.

"I am indebted to Dr. Westerlund for *Pupa tumida*, of which I find a specimen in my collection named *V. pusilla*, var. I am not sure that it is more than a dwarf variety or form of *V. pusilla*. The two specimens sent by Dr. Westerlund differ from each other in the number of teeth, one specimen having five and the other seven teeth. He describes *V. tumida* as '6-dentata' and *V. pusilla* as '6–8-dentata.'" (*Jeffreys*, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. 1878, p. 381.)]

241. *Vertigo angustior*, Jeffreys.

Bundoran, Co. Donegal; Ballina, Co. Mayo; and Killauley Glebe, Co. Sligo (*Miss Amy Warren*).

Genus 3. BALEA, Prideaux.

242. *Balea perversa* (Linn.).

Genus 4. CLAUSILIA, Draparnaud.

Subgenus 1. CLAUSILIASTRA, Mollend.

243. *Clausilia laminata* (Mont.).

Subgenus 2. ALINDA, Adams.

244. *Clausilia biplicata* (Mont.).

Subgenus 3. Kuzmichia, Brusina.

245. *Clausilia bidentata*, Ström, = *C. rugosa*, Jeffr., = *T. nigricans*, Pult.

Westerlund makes *Clausilia rugosa*, Drap., a different species from *Turbo nigricans*, Pulteney; but the *Turbo bidentatus* of Ström is an earlier name than either, dating from 1765.

246. *Clausilia parvula*, Studer.

Clausilia parvula, A. Schmidt, Kritische Gruppen der Europäischen Clausilien, 1857, p. 33, figs. 69–74, 189, 190; Jeffreys, Brit. Conch. v. p. 161, pl. xcix. fig. 2.

Kinver, near Stourbridge; several specimens (*Grant Allen*).

The above reference will give good figures of the shell, the European distribution of which is thus represented in my collection:—Namur, Metz, Drachenfels, Geneva, Savoy, and var. *minor* from Carinthia.

It must be remembered that this is not the first time that so-called *Cl. parvula* has been recorded as British. Gray ('Manual,' p. 218) writes:—"Mr. Alder has kindly communicated to me 'a specimen of the shell he sent to Turton, which Dr. Turton calls *C. parvula* (t. v. p. 59), and also the specimens of the true *C. parvula* (according to Férussac), found in Germany, for comparison.' He further observes that all the British specimens he has seen he thinks are only varieties of *C. nigricans*, which I think the specimen fully bears out."

247. *Clausilia Rolphi* (Gray).

[Jeffreys, vol. v. p. 162, pl. xcix. fig. 2, records *Clausilia* (*Papillifera*) *solida*, Drap., as British on the strength of a single specimen found by Mr. Rich (a dealer in shells) with *C. laminata* at Stapleton, near Bristol. The wretched figure given appears to me to represent the allied *C. bidens*, Linn. (= *C. papillaris*, Müll.) rather than *C. solida*, Drap. *C. bidens* was long ago recorded by Pulteney as having occurred in Dorset, and I have a specimen which was one of several said to be British preserved in the Plymouth Museum, and given me thence in 1853.]

Fam. 5. **Stenogyridæ.**

Genus 1. Cionella, Jeffreys.

Cochlicopa of Férussac included species of *Glandina*, and is a synonym of that genus rather than of the present one.

248. *Cionella lubrica* (Müll.).

Subgenus Azeca, Leach.

249. *Cionella tridens* (Pulteney).

For notes on this species see Taylor, 'Journal of Conchology,' vol. ii. p. 220. A reversed monstrosity has been found by Mr. J. Emmet, of Boston Spa.

Genus 2. Cæcilianella, Férussac.

250. *Cæcilianella acicula* (Müller).

Fam. 6. Succineidæ.

Genus Succinea, Draparnaud.

251. *Succinea putris* (Linn.).

252. *Succinea elegans*, Risso.

Westerlund separates *S. elegans* and *S. Pfeifferi*, Rossm., and gives seven named varieties of the former and seventeen of the latter. I cannot myself, after an examination of twelve of these named varieties, find any points which seem to me to constitute specific characters between these most variable shells, and therefore I follow Jeffreys in using the earlier name.

253. *Succinea stagnalis*, Gassies.

Succinea putris, var. *vitrea*, Jeffreys, Brit. Conch. vol. i. (1872), p. 152.
Succinea virescens, Jeffreys, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. (1878), p. 378 (nec *S. virescens*, Morelet, *fide* Baudon).
Succinea stagnalis, Gassies, Malac. Terr. et d'Eau douce de la rég. int. litt. de l'Aquitaine, p. 14, fig. 2.
Succinea stagnalis, Baudon, Deuxième Supplément à la Mon. des Succinées Françaises (1879), p. 1, pl. xi. figs. 1–3.

Jeffreys gives the following localities:—Carmarthenshire, Grassmere, and St. Albans (*J. G. J.*), Cork (*Humphreys*), Mitcham, in Surrey (*Henry Groves*).

The *Succineæ* are most difficult to distinguish and the forms run into each other, so that I am myself disposed to hold that we have but two species, *S. putris* and *S. oblonga*. *Succinea stagnalis* affords a good illustration of confusion. Jeffreys first referred it to *S. putris* as var. *vitrea* (I suppose taking that name from Moquin-Tandon); then receiving from Baudon the shell described by him as *S. debilis*, said that his shell was the same, but that it was not *S. debilis* (Morelet, MS.) C. Pfeiffer, the types of which he had examined in the Cumingian collection, but that it was *S. virescens*, Morelet. Baudon (*l. c.*) replies that Jeffreys's shells are not Moquin-Tandon's *vitrea*, which is a var. of *putris*, that they are not *S. virescens*, Morelet, with a type of which he has compared them. He refers them to *S. stagnalis*, Gassies, and figures two of Jeffreys's shells—that from Grassmere, which he considers typical, and that from St. Albans, which he calls var. *Jeffreysi*. Judged by the drawings of these two shells, it seems to be a case of distinction without a difference. However, we have at least a certain name, and the British shells are *S. stagnalis* (Gassies), Baudon.

In the 'Annals' Jeffreys referred his shell to *S. debilis*, Baudon, from whom he had received specimens: it may be supposed that these specimens were Baudon's var. *viridula*, which would be colourless, like Jeffreys's own *vitrea* ; and it appears to me that to distinguish Baudon's figure of that variety in his original monograph (pl. ix. fig. 5) from his subsequent figures of *S. stagnalis* is hair-splitting indeed. But Jeffreys also stated that, having examined Pfeiffer's (*i. e.* Morelet's) type, he found that to be a different thing. How so, I would ask, in anything but colour?

It happens that in the collection of the late Dr. Tiberi, of Naples, now a part of my own, I find two *Succineæ* labelled "*Succi. debilis*, Morl. Alger.," and two others labelled "*Succinea pleuraulaca*, Letour. Alger." This collection is remarkably rich in types, and I have no doubt, although it is not so stated, that these shells were received from the authors whose names are attached to the species. These shells are identical, pale horn-coloured, but differing slightly in depth of tint, remarkable for their short spire, and are exactly represented by the figure in Baudon's original monograph as *Succinea debilis*, var. *stagnalis*, pl. ix. fig. 7. Now Morelet, in his second Supplement, has removed from his original *S. debilis* the varieties *stagnalis* and *tuberculata*, and elevated them to a species under the first of these names. Turning to Westerlund we find *S. pleuraulaca*, Letour., given as a variety of *S. putris*, and *S. debilis*, Pfeiffer, holding specific rank.

With reference to Jeffreys's ('Annals') criticism on a mistaken reference of Baudon to *S. humilis* as having been described by Morelet, see Baudon ('Troisième Supplément à la Mon. des Succinées Françaises' (1881), p. 12), where he writes:—"Le nom de *debilis* l'été donné par M. Morelet, et Pfeiffer décrivit l'espèce. M. Morelet me dit, à ce sujet: 'Je n'ai jamais décrit cette coquille. Il y a vingt ans environ que je donnai à Cuming, sous le nom de *debilis*, une Ambrette que j'ai recueillie en Algérie. C'est dans la collection de cet amateur que Pfeiffer la vit et la décrivit.' "

254. *Succinea oblonga*, Draparnaud.

B. DITREMATA.

Fam. 7. **Oncidiidæ.**

Genus ONCIDIELLA, Gray.

255. *Oncidiella celtica* (Cuvier).

The young of this species in its larval state is furnished with a shell which is afterwards cast off.

The systematic position of the Oncidiidæ has been much disputed. Bergh *, after reviewing the varied opinions of authors, sums up his views thus :—"*The Onchidia agree with the Pulmonata* in the structure of the *nervous system*, in the existence of a *lung* and of a *parenchymatous kidney*, in the presence of the peculiar *pedal gland*, and in various peculiarities of the *generative system*. From a tolerably extensive knowledge of the so-called Nudibranchs I cannot but regard the *Onchidia* as pretty widely separated from them. On the contrary, they branch off from the Pulmonata ; *they are Pulmonata which have adapted themselves to an amphibiotic or marine mode of life.*"

Suborder II. GEHYDROPHILA.

Fam. 8. **Auriculidæ.**

Genus 1. CARYCHIUM, O. F. Müller.

256. *Carychium minimum*, Müll.

Genus 2. ALEXIA, Leach.

257. *Alexia myosotis* (Drap.).

258. *Alexia denticulata* (Mont.) = *Melampus myosotis*, var. *ringens*, Jeffr.

Genus 3. LEUCONIA, Gray.

259. *Leuconia bidentata* (Mont.).
Var. *alba*, Turton.

* Bergh, 'Morphologisches Jahrbuch,' Bd. x. p. 172 ; translated, Ann. & Mag. Nat. Hist. ser. 5, xiv. 1884, p. 259.

Fam. 9. **Otinidæ.**

Genus Otina, Gray.

260. *Otina otis*, Turton.
   Var. *candida*, Jeffreys.

The variety from Sark (*Dr. Lukis, Mus. Norm.*).

Suborder III. HYGROPHILA.

Fam. 10. **Limnæidæ.**

Genus 1. Ancylus, Geoffroy.

261. *Ancylus fluviatilis*, Müll.
   Var. *capuloides* (Jan), Porro.
   Var. *gibbosus*, Bourg.

262. *Ancylus lacustris* (Linn.).

Genus 2. Limnæa, Lamarck.

263. *Limnœa stagnalis* (Linn.).

264. *Limnœa palustris* (Müll.).

265. *Limnœa truncatula* (Müll.).

266. *Limnœa glabra* (Müll.).

267. *Limnœa auricularia* (Linn.).

268. *Limnœa peregra* (Müll.).

Genus 3. Amphipeplea, Nilsson.

269. *Amphipeplea glutinosa* (Müll.).

This has been added to the Irish fauna by Mr. C. Ashford, who has found it in the Newry Canal, near Knocbridge, Co. Down, and the River Brusna, King's County (Journ. Conch. ii. p. 6).

270. *Amphipeplea involuta*, Thompson.

Genus 4. Planorbis, Guettard.

271. *Planorbis corneus* (Linn.).

272. *Planorbis contortus* (Linn.).

273. *Planorbis carinatus*, Müll.

274. *Planorbis umbilicatus*, Müll., = *P. complanatus*, Jeffr. (non Linn.).

P. complanatus, L., is generally now regarded as *P. nitidus*, and not the present species, which, however, has been called *complanata* by Stein, Dupuy, Moquin-Tandon, Locard, Bourguignat, &c.

275. *Planorbis vortex* (Linn.).

276. *Planorbis spirorbis* (Linn.).

[*Planorbis dilatatus*, Gould.

Planorbis dilatatus, Gould, Invert. Mass. (1841), p. 210, fig. 140; ibid. edit. Binney (1870), p. 498, fig. 748; Rogers, Journ. Conch. vol. i. (1874), p. 81.

An accidentally introduced species, which appears to have established itself in the neighbourhood of Manchester in the Bolton Canal at Pendleton and Galton (*Thos. Rogers*).]

277. *Planorbis glaber*, Jeffreys.

278. *Planorbis albus*, Müller.

279. *Planorbis nautileus* (Linn.).

280. *Planorbis complanatus* (Linn.) = *P. nitidus*, Gray = *H. fontanus*, Lightfoot.

Genus 5. Segmentina, Fleming.

281. *Segmentina nitida* (Müll.) = *Planorbis lineatus* (Walker), Jeffr.

Judged out of his own work, by comparing what is said of Müller's *Planorbis nitidus* in vol. i. p. 80, and vol. v. p. 172, Jeffreys shows that that species is the present and not the last to which he referred it.

Fam. 11. **Physidæ.**

Genus 1. Physa, Lamarck.

282. *Physa fontinalis* (Linn.).

Subgenus Aplexa, Fleming.

283. *Physa hypnorum* (Linn.).

[To be continued.]

XL.—Ebalia nux: *a Reply to Mr. R. I. Pocock.* By the Rev. Canon Norman.

Returning from a nine weeks' dredging-expedition in East Finmark, I find Mr. Pocock's paper on the above subject in the 'Annals' for July. I greatly dislike personal matters; but his remarks cannot be passed by, however much I regret that he should have necessitated my writing plainly.

In the 'Annals' for last December Mr. Pocock published an account of the Crustacea procured in the trawlings of the 'Flying Fox,' and the following notice of *Ebalia nux* is given:—

"*Ebalia nux*, sp. n.

"*Ebalia nux*, Norman, MS."

Then follows description, after which comes:—

"A number of specimens of this species were dredged by the 'Porcupine' in the Mediterranean. Some of these specimens were presented to the British Museum by the Rev. A. M. Norman and were labelled '*E. nux*, Norm.' This name is included in the list of the species composing the 'Museum Normanianum,' and is also in the list of the species of *Ebalia* given by Mr. Miers in his Report on the Brachyura of the 'Challenger.' But no description of the species has yet been published. I have consequently taken this opportunity of characterizing it and have selected as types an adult male and female specimen belonging to the series dredged in the Mediterranean. In some of the small specimens of this series the larger tubercles on the gastric region of the cephalothorax are wholly absent.

"A single damaged male specimen was obtained by Mr. Green at a depth of 315 fathoms. This specimen differs from all the Mediterranean forms that I have seen in having the legs almost wholly smooth."

Immediately after this Mr. G. C. Bourne submitted to me for determination certain Crustacea which he had procured in trawlings by H.M.S. 'Research' off the south-west of Ireland. These were named, and the synonymy of some of the species sent, with the addition of notes which he was at liberty to use or not as he thought best. At p. 315 of vol. i. of the 'Journal of the Marine Biological Association of the United Kingdom' is the following notice:—

"*Ebalia nux*, Norman, MS.

"1880. *Ebalia nux*, Norman, "Notes on the French Exploration of 'Le Travailleur' in the Bay of Biscay," Ann. & Mag. Nat. Hist. and Rep. Brit. Association, p. 387.

"1883. *Ebalia nux* (Norman), Marion, Annales du Musée d'Hist. Nat. de Marseille, vol. i. Mém. 2, p. 36.

"1883. *Ebalia nux* (Norman), A. Milne-Edwards, Recueil de figures de Crustacés nouveaux ou peu connus, pl. v.

"1889. *Ebalia nux*, Pocock, Ann. & Mag. Nat. Hist. ser. 6, vol. iv. p. 426.

" A single specimen was taken in 400 fathoms. The single specimen of the 'Flying Fox' was taken in 315 fathoms. Canon Norman sends me the following notes on this species:—'Mr. Pocock seems to have been unaware that *Ebalia nux* had been admirably figured by Prof. A. Milne-Edwards. The following is the distribution of the species as far as is known to me:—

"''Porcupine,' 1869, Stations 1, 3, 6, 11, all off the west and south-west of Ireland, in 90 to 1630 fath.; also Station 46, lat. 59° 23′ N., long. 7° 4′ W., that is to the north-west of the Butt of Lewis, on the margin of the Holtenia ground, in 374 fath.

"''Porcupine,' 1870, Station 8, lat. 48° 13′ N., long. 9° 11′ W., 257 fath.; Station 10, off Cape Finisterre, 91 fath., Vigo Bay; Station 13, off Cape Mondego, coast of Portugal, 220 fath.; Station 26, off south coast of Portugal, 364 fath.; and in the Mediterranean, off Cape de Gatt, 60 to 160 fath., and on the Adventure bank, 92 fath.

"''Travailleur' Expedition, 1880. In this expedition *Ebalia nux* was taken many times in the Bay of Biscay off the Spanish coast. My notes taken on board give me July 17th, 666 metres; July 23rd, 1107 to 1353 metres.

"''Travailleur,' 1881. In this year's expedition Prof. Milne-Edwards reports it as again taken in the Bay of Biscay and also in the northern part of the Mediterranean, 300 metres.

"''Flying Fox' and 'Research' trawlings off the south-west coast of Ireland. Profs. A. Milne-Edwards and Marion courteously recognize my MS. name *Ebalia nux*; but if that is rejected it will stand as *Ebalia nux*, A Milne-Edwards.'"

I really had been under the impression, and I fancy that your readers will be of the same opinion, that I had dealt very tenderly with Mr. Pocock. I merely gave a plain statement of facts, corrective of Mr. Pocock's omissions, without further comment. Mr. Pocock complains that I had "taken occasion to charge him by implication with lack of courtesy for not giving what I consider due acknowledgment to the name I applied to the above Crustacean." It happens that I took particular pains not to allege that lack of courtesy which his conscience now plainly tells him there was. Had he used a little care he could not have fallen into it. Naturalists living in the country, with nothing but their own or neighbouring small libraries to depend upon, may well in these days be excused if they are deficient in a knowledge of the literature of a subject on which they write; but the case is different with an Assistant at the British Museum, who has a magnificent library at his elbow. The literature of deep-sea dredging is not extensive, and surely ought to have been carefully consulted before writing. Either Mr. Pocock was not aware or was aware that Prof. Milne-Edwards had admirably figured *Ebalia nux* in illustrations which ought to have been the first work consulted on Crustacea when examining deep-sea forms of the Eastern North Atlantic. If he did not consult that work, he ought to have done so. If he did consult it, as he seems to imply in his last remarks that he had done, he had no excuse for writing "*Ebalia nux*, n. sp.," instead of either "*Ebalia nux*, Norman, MS.," or "*Ebalia nux*, A. Milne-Edwards." Again, Mr. Pocock states that he was indebted to Prof. Carus's 'Prodromus' for the knowledge that "*Ebalia nux*, Norman," was "species nondum descripta;" yet he possessed the same means of making the discovery which Prof. Carus had.

But what specimens did Mr. Pocock describe as *Ebalia nux*, n. sp. (*i. e.* Pocock)? The 'Flying Fox' specimen was apparently too imperfect for description, which was therefore drawn up from a series I had sent to the British Museum when my friend Mr. Miers wished to examine this species in connexion with certain 'Challenger' forms. Whether this was a courteous act let others judge.

The same carelessness in consultation of papers is evidenced in Mr. Pocock's notes on *Anamathia Carpenteri* and *Lispognathus Thomsoni*, of which he writes:—"I am not aware that they have ere this gained the right to be included in a list of the fauna of the British area." Yet these species were actually first figured in the 'Depths of the Sea' as from off the Butt of Lewis, that is as much within the British area as the waters trawled by the 'Flying Fox,' and were again recorded by me as among the Crustacea procured in the 'Knight Errant' expedition.

I must conclude with some general observations, regretting to occupy your pages on personal matters, but constrained to do so.

MS. Names.—I regard the publication of these as highly objectionable, and it is well understood that authors are not obliged to recognize them. I have had at times scores, I think I may say hundreds, of MS. names in my collection, but never have printed such names unless compelled by circumstances to do so.

Correspondents.—Mr. Pocock lays to my charge that a letter which he wrote to me asking whether I had described *Ebalia nux* remained unanswered. I have no recollection on the subject, though I have a recollection of Mr. Pocock asking me some question, which I am under the impression I answered by postcard. If I left his inquiry unanswered I am very sorry. I never omitted to answer a letter in my life from willing want of courtesy, but I deeply regret to say that I have been obliged to leave many unanswered from the impossibility of finding time to reply to them. Last autumn, when Mr. Pocock must have written, I was quite unable to answer the numerous letters which were written to me. This is impressed on my mind by the remembrance that my friend Prof. Jeffrey Bell wrote twice if not three times to ask me to allow him to see certain Echini which he desired to examine in connexion with his notes on the Echinoderms of the 'Flying Fox,' and that, though wishing to assist him as far as possible, I was unable to find time to send them until they were too late to be of service (*vide* 'Annals,' ser. 6, vol. iv. p. 441, note).

I am not a naturalist by profession. Science is the recreation, not the business of my life, and has always to be kept subservient to duty. Often, especially in the late autumn and winter months, I can find little or no time for the pleasurable pursuit of natural history. When possible I endeavour to answer letters at once; but sometimes such an accumulation takes place that hope of making up arrears vanishes. For years, though usually working in one form or another not less than twelve hours a day, the time which I have had for natural history has been more taken up in affording help to others in their studies than in pursuing my own work. For example, on returning home now from my holiday I find a large box full of letters and parcels from naturalists of Great Britain and many countries of Europe, and to answer all these letters and determine the specimens on which my opinion is wanted seems impossible. Collections meanwhile made by me ten and fifteen years ago as well as in more recent years remain almost untouched, and hence also MS. names and greatest neglect with respect to public collections referred to me for determination.

In conclusion, I must ask my scientific friends to be so indulgent as

First, not to write to me to ask questions or submit specimens for examination unless they cannot do without assistance.

Secondly, to be assured that if any letter addressed to me remains unanswered, it is not from discourtesy, but from sheer inability to find time to reply to it.

XLI.—*Descriptions of some new Species of African Butterflies in the Collection of Captain G. E. Shelley.* By Emily Mary Sharpe.

Fam. **Danaidæ.**

Genus Nebroda.

Nebroda lobengula, sp. n.

Nearest to *N. echeria*, Stoll (*Amauris echeria*, Kirby, Syn. Cat. Lepid. p. 8), but differing in the much greater extent of yellow on the hind wing. There is a row of unequal yellow spots on the hind marginal border extending to the submedian nervure. The base of the hind wing is deep brown.

The fore wing has a moderately large yellowish spot in the middle of the discoidal cell, with a second larger oval spot between the first and second median nervules.

Between the radial or discoidal nervules there are two medium-sized yellowish spots near the apical portion. At the apex of the fore wing there is a row of small white spots extending to the hind margin, with four smaller white spots outside the first row of spots, placed about the middle of the fore wing. Along the costal margin there are two white spots. The underside of the fore wing is a lighter brown, having all the spots plainly marked in white with the exception of the two larger spots, which are yellow.

The hind wing is similar to the fore wing, having the yellow basal area quite as dark as on the upperside, and the spots are white, while near to the precostal nervure there is one small white spot.

Exp. 3·1 inches.

Hab. Matabele Land.

Fam. **Lycænidæ.**

Genus Spalgis.

Spalgis latimarginata, sp. n.

Nearest to *S. epius*, Westwood, but is much larger, and the general colour is of a creamy white. The hind margin has a border of light brown extending to the costa and colouring the wing at the base; it is very wide near the apical portion of the fore wing.

The hind wing has the subcostal nervure paler, with no border along the hind margin, but having a small black spot at the end of each nervule.

The underside of the fore wing has a small black spot at the end of each nervule, and the fine lines of brown are more approximate than in *S. epius*, the lines being confined to a border along the hind margin. From the costa to the base of the wing are transverse lines of brown, less strongly marked and becoming more numerous at the base. A long transverse line of brown extends from about the middle of the fore wing to the middle of the inner margin, dividing the large white patch into two sections. The hind wing has the markings of the same fine character, but has more white between the lines than in *S. epius*.

Exp. ♂ 1·3 inch.

The female has the apex, costa, and hind margin of the fore wing broadly bordered with light greyish brown, widening a little more towards the base of the wing than in the male.

On the hind wing there is a somewhat broader border of brown extending from the costa to the anal angle, the costal margin being white.

The underside of the fore wing has a border of fine transverse lines from the costa to the hind margin, these lines being more numerous at the base. There is the same fine line down the middle of the wing as in the male.

The hind wing has the base and costal margin suffused with greyish brown, with a small black spot at the end of each nervule.

Exp. ♀ 1·2 inch.

Hab. Senegambia.

Fam. Hesperidæ.

Genus Antigonus.

Antigonus Jamesoni, sp. n.

Nearest to *A. indrani*, Moore, but differs in the general colour being a much lighter and altogether of a warmer yellow. The whole of the fore wing is reddish buff, relieved with white semitransparent spots. There are three white transverse spots at the end of the costa, with three extra spots placed outside the costal spots near the apical portion of the fore wing in a half-circle.

There is a large white spot edged with black in the discoidal cell, with a smaller one placed in the fork of the second and third median nervules. There are three large subconfluent white spots without lines of black, diminishing in size downwards, from the middle of the discoidal cell to the edge of the submedian nervure.

The hind wing has the central portion white, with the submarginal border of the same colour as in the fore wing. The fringe is white, with a row of equidistant black spots; this is followed by a broad subterminal band of buff, which in turn is succeeded by an uneven row of black spots, with a median spot of black between the costal and subcostal nervures. The colour at the base of the wing is dark brown.

The underside is very much paler in colour, with all the spots of the upperside on both wings distinctly marked.

Exp. 1·6 inch.

Hab. Umvuli River.

Genus Leucochitonea.

Leucochitonea umvulensis, sp. n.

Similar to *L. bicolor*, Trimen (*cf.* Trimen, 'Rhopalocera Africæ Australis,' p. 307, pl. vi. fig. 1, 1866), but differs in being much browner and duller in colour. The nervules are all plainly marked in black, with a very fine black marginal border.

There are six semitransparent spots on the fore wing, three small ones at the end of the costal nervules near the apex, one large one in the discoidal cell, with another between the first and second median nervules near the discoidal spot; a very small spot in the fork of the second and third median nervules. All the spots are pale yellow.

The hind wing is slightly deeper in colour, with a very fine black line along the hind margin. At the anal angle there is a tuft of yellow hairs.

The underside is paler in colour, with the light spots on the fore wing only slightly visible.

The hind wing has the veins plainly marked, especially the subcostal nervure, the costa being yellow. At the anal angle, in addition to the tuft of yellow hairs, there is a large black spot.

Exp. 1·5 inch.

Hab. Umvuli River.

Genus Proteides.

Proteides Shelleyi, sp. n.

Similar to *P. erinnys*, Trimen, but is at once distinguished by the two large yellow spots on the fore wing; one of these is in the middle of the discoidal cell and the other is situated close to the cell between the first and second median nervules. There are some other spots near the submedian nervure, one between the second and third median nervules, and another near the fifth and fourth subcostal nervules near the apex of the fore wing.

The fringe of the fore wing from the first median nervule to the posterior angle is yellow.

The hind wing differs in that the fringe is yellow, with small tufts of brown hairs at the end of each nervule. There is one yellow spot near the base, with a narrow bar of yellow spots from the second subcostal nervure to the middle of the submedian nervure.

The underside is similar to that of *P. erinnys*, but the fore wing differs in the large patch of yellow along the inner margin, extending to the first median nervure. At the base there is a patch of dark brown, and near the apical portion is another brown patch relieved by two transverse lines of purplish grey. The hind margin has three distinct brown spots between the subcostal and radial nervures, the before-mentioned brown patch extending to the first median nervure, where it then becomes much lighter in colour as far as the submedian nervure. Along the costa there are two streaks of grey alternating with brown.

The hind wing is darker, with the streaks and patches grey. The hind margin has six brown spots, commencing from the first subcostal nervule to the first median nervule. Above this there is a submarginal border of grey. The yellow band of the upperside is indicated by a lighter brown band, having the outlines of pale yellow, the spot being the same in colour. There is a streak of grey from the base of the wing to the costal margin.

Exp. 1·9 inch.

Hab. Fantee (*G. E. S.*).

XLII.—*Notes on the Racquet-tailed Rollers.* By H. E. Dresser.

Having been lately engaged in working out the synonymy of the Rollers, I had occasion to examine all available specimens of the Racquet-tailed Rollers, which are still extremely rare in collections, there being, so far as I can ascertain, but four specimens in Great Britain, viz. two in the British Museum, one in Captain Shelley's collection (now purchased by the British Museum authorities), and one in the collection of Canon Tristram, which he has kindly lent to me for examination. The three former of these have all been labelled by Mr. Sharpe as being referable to *Coracias spatulatus*, Trimen; but on receipt of the specimen from Canon Tristram I at once saw that it was specifically distinct from the other three. In order to work out the question I compared them carefully with their nearest allies, *Coracias abyssinicus* and *C. caudatus*, and may point out that all the Racquet-tailed Rollers differ from these in having the median wing-coverts cinnamon and in having all the tail-feathers conspicuously terminated with black and blue, whereas in *C. abyssinicus* and *C. caudatus* all the rectrices but the central and two lateral ones are pale blue throughout. The two adult birds in the British Museum, one from the Umvuli River, East Africa, and the other from Caconda, in West Africa, have the throat and breast blue, exactly as in *Coracias abyssinicus*; whereas the third, from Pantamenka, East Africa, labelled as young, has the throat and breast somewhat striped with pale blue, buff in general coloration on the sides, but otherwise pale turquoise-blue. The specimen from Canon Tristram, however, from Newala, East Africa, has the sides of the head, throat, and breast pale brownish buff, broadly striped with white, and without any trace of blue, much as in *Coracias nævius*, but much paler.

On referring to Trimen's original description of *Coracias spatulatus* (Proc. Zool. Soc. 1880, p. 31), I find that he states: "throat, breast, belly, thighs, and under wing- and tail-coverts pale bright verditer-blue, varied on the lower throat and breast by lilacine cinnamon-brown webs, leaving the shaft-stripes of the blue; cheeks and ear-coverts mixed lilac and verditer-blue; sides of neck coloured like the back; sides of breast dull sandy brownish, with bluish-white shaft-stripes." Thus Trimen's *C. spatulatus* is very different from Canon Tristram's specimen, and also from the two adult birds in the British Museum, but somewhat resembles the third (young) specimen in that collection, which appears to me to be in all probability the young of the true *C. spatulatus*. On referring to Professor Barboza du Bocage's description of *Coracias dispar*, from Caconda (Jorn. Sc. Lisb. xxviii. p. 227, 1880), I find that it agrees exactly with the two birds from Caconda and the Umvuli River, as he describes the underparts as blue ("subtus thalassinus"); and the species with the underparts blue, as in *C. abyssinicus*, will stand therefore as *Coracias dispar*, Bocage. The bird in Canon Tristram's collection is so very distinct from both *Coracias spatulatus* and *Coracias dispar* that I cannot do otherwise than give it a name, and propose to call it *Coracias Weigalli*, and give the description of it as follows:—

Pileo et nucha cum dorso antico sordide olivaceis; fronte, mento et superciliis albis; dorso postico, scapularibus et secundariis intimis dilute cinnamomeis; aliis et cauda sicut in *Coracio dispare* coloratis; capitis lateribus, gula et pectore toto pallide fusco-cervinis, conspicue albo striatis et indistincte vinaceo tinctis; abdomine imo, subcaudalibus et subalaribus pallide turcino-cæruleis; rectricibus extimis valde elongatis et spatulatis.

Long. tot. 13·0, culm. 1·25, alæ 6·3, caudæ 8·3, tarsi 0·78.

It is unfortunate that I have not had an opportunity of examining the type of *Coracias spatulatus*, which is, I believe, in the museum at Cape Town; and the material at hand is so very meagre that it is impossible at present to say much respecting the geographical range of these Racquet-tailed Rollers. Besides the specimens above referred to there are examples in the Lisbon Museum from West Africa which are doubtless all referable to *C. dispar*; there are also several in the Berlin Museum obtained by Boehm at Kakoma, and it will be interesting to ascertain to which form these specimens belong.

MISCELLANEOUS.

On the Occurrence of Eublepharis macularius *in Transcaspia.* By G. A. Boulenger.

Eublepharis macularius, Blyth, has long been known as an inhabitant of North-western India, not uncommon in the Punjab and Sind. In 1885 I was able to record it from much further west, Dr. Sauvage having submitted to me a specimen obtained by M. de Saulcy in the ruins of Nineveh. This lizard now turns up in Southern Transcaspia. M. C. Eylandt has sent me a tail, collected by him under peculiar circumstances near Ashkabad, and which belongs to *Eublepharis macularius.* M. Eylandt had noticed a bird of prey flying off with a lizard which it had captured; on approaching the spot whence the bird had risen, this gentleman found the detached tail of the lizard wriggling on the ground. As it differs considerably from the tails of any lizard previously observed in that district, the object was carefully preserved and submitted to me for identification.

Additional Notes on Peripatus Leuckarti. By J. J. Fletcher, M.A., B.Sc.

Some account is given of forty-two specimens of *Peripatus* from three new localities in this colony—Mount Kosciusko, the Blue Mountains, and Dunoon, on the Richmond River—all collected since the last occasion on which the attention of the Society was drawn to this species. Apart from the interest attaching to the occurrence of the specimens from Mount Kosciusko at high altitudes (5000–5700 feet), where for several months in the year the ground is covered with snow, the collection as a whole is remarkable for the interesting variations of colour and pattern which are presented, but chiefly for the unusual abundance (50 per cent.) of males, the characters of which were not found to be precisely in agreement with those of the only two male specimens hitherto recorded; that is to say, round whitish papillæ were found on some or all of the legs, with the exception of those of the first pair (not merely on the last pair, as in the specimens of Mr. Sedgwick and Mr. Dendy), and a similar state of things was found to obtain in five other males from other localities. On the papillæ open the ducts of the crural glands, as shown by sections; even when papillæ are not visible the apertures of the ducts in well-preserved specimens are generally noticeable. Attention is also called to the presence of a pair of pores on the ventral surface between the genital aperture and the anus, but nearer to the latter, which may possibly be the openings of the ducts of accessory glands. The majority of the specimens (thirty-five) were obtained at Mount Kosciusko by Mr. R. Helms, on behalf of the Australian Museum.—*Linn. Soc. of New South Wales,* Abstract of Proceedings, 30th July, 1890, p. vii.

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XLIII.—*Report on the Corals from the Tizard and Macclesfield Banks, China Sea.* By P. W. BASSETT-SMITH, Surgeon R.N.

[Plates XII.–XIV.]

IN April 1888, by order of Capt. Wharton, F.R.S., Hydrographer to the Navy, a short survey was made of these interesting coral-banks by H.M.S. 'Rambler,' in charge of Commander W. U. Moore, R.N. Sectional lines were run across the margins of the banks, both from within and without, into moderately deep water, and dredging-operations were carried on, which resulted in obtaining a large collection of corals &c., which were brought to England for further examination, and subsequently presented by the Lords Commissioners of the Admiralty to the British Museum (Natural History). The corals were for the most part dredged up under my own personal superintendence, and on the return of the vessel to England I obtained permission from the Admiralty to study and arrange the collection there through the kindness of Dr. Günther, F.R.S. In the original Report of the Survey several of the corals were incorrectly specified from want of books of reference. On my return home I was enabled to devote several months to their detailed study, but should not have ventured to publish my generic and specific determinations, if Dr. G. J. Hinde had not, at the sacrifice of much time, most kindly gone over the whole of the collection and revised my work. Owing to various circumstances the present Report is limited to an enumeration of the different species which have been determined; amongst them are many forms which in Dr. Hinde's opinion are apparently new, but a detailed description of these is delayed until they can be reexamined with the assistance of additional material, and until an opportunity can be found to figure them suitably. I have thought it desirable to subjoin some brief notes on the character of the reefs whence the corals were obtained.

The Tizard Bank (Pl. XII.) is situated in lat. 10° N., long. 114° E., near the centre of the China Sea between the Philippines and the Malay Peninsula. Like many others in the same region it is irregularly circular in outline; and it has an extreme length of 32 miles and a breadth of 10, and it is surrounded by deep water.

But with such an extended margin the only portions of the bank which project above the surface of the sea consist of three small islets, each from half a mile to one mile in length, and two very small sand-kays of about one mile each. For the greater part of the circumference of the bank, that is for 50 out of 67 miles, the rim is within 10 fathoms of the surface. On the north-east side there are two extensions of the bank, 5 and 4½ miles in length respectively; the first of these is nearly uncovered at low water, whilst the other is at a depth of 6 fathoms.

The area of the lagoon inclosed within this bank is very extensive; it has an average depth of 40 fathoms, with a few scattered elevations here and there, the eastern end being the most shallow portion. The bottom of the lagoon is covered by a fine foraminiferal sand, and the same material extends over the floor of the narrow channels which cut through the rim and connect the lagoon with the outer sea. At depths of 6 to 10 fathoms long channels paved with this sand can be seen bounded on either side by walls of living coral.

From the central portion of this sandy floor of the lagoon, at a depth of 45 fathoms, a living Astræan coral belonging to an apparently new species of *Favia* was dredged up, thus showing the existence of these reef-building forms at depths much greater than it has been supposed they could flourish in. I may here point out that the evidence obtainable by the lead alone regarding the presence of *living* corals is entirely misleading and almost worthless. For example, judging from the observations obtained by the lead, the greater part of the corals on the surface of the Macclesfield Bank appeared to be dead; but the dredge with swabs attached brought up from this bank an abundance of living forms.

Of the three islets on the Tizard Bank (see Pl. XII.), that named *Sand-Kay* is the smallest and the most recent; though it has increased in size within the last twenty years, it is still only a quarter of a mile in length. The surface is somewhat depressed in the centre; it is entirely composed of sand and small coral débris. Surrounding the island is a platform of coral-rock half a mile broad, covered generally with sand, but here and there with patches of growing coral which increase in number as the water becomes deeper, and they grow very luxuriantly amongst the breakers on the outer edge of the platform both next the sea and next the lagoon. Just below high-water mark there are parallel lines of hard solid rock formed by coral débris and sand cemented together, and a reef at a depth of 5 fathoms extends uninterruptedly to the westward for a distance of 4 miles.

The islet of *Nam-Yit* is rather larger than Sand-Kay; its highest part is not more than 12 feet above high water, and in bad weather the waves, according to the natives, break all over it. It is well covered with small trees, and the surface-soil is therefore of a brown and earthy character; beneath this is a conglomerate of sand and small coral débris. A well, 6 feet deep, passed through loose sandy rock.

The striking parallel lines of cement-rock are well marked on both sides of this island, more particularly on the south or weather side; they have an apparent dip of about 60° from the centre, one layer superimposed on the other. This islet is likewise surrounded by an extensive shore-platform with isolated rocks at its edge, and at its northern end there are sand-banks forming horn-shaped prolongations, which partially inclose a small lagoon; on the open side of this, facing the lagoon, there are many rocks just below the surface.

Itu-Aba, the largest islet, is three quarters of a mile in length and covered with large trees of considerable age; it is similarly surrounded by a shallow-water platform. Outside this, in 6 fathoms water, the number of living corals was found by the diver to be much fewer than elsewhere; but from the reef, in 21 fathoms water, several massive specimens were obtained, and a rich variety of species was found on the lagoon side of the reef.

A comparison of the sections (Pl. XIII.) taken across different portions of the Tizard Bank shows very great similarity in the form and slope of the bank throughout. Thus in all, with the exception of section C near Nam-Yit, there is a broad plateau sloping very gradually to a depth of 10–12 fathoms, on which coral-growth is most luxuriant; from the edge of this there is a more or less abrupt descent to a depth of about 30 fathoms, followed by a gradual slope to 50 fathoms; then there is an abrupt descent to 100–150 fathoms, and beyond this the average slope to deeper water is at an angle of about 30°, except in section F, near Itu-Aba, where it is somewhat less. In section C the slope of the plateau continues gradual to a depth of 30 fathoms, and in this respect is similar to the Macclesfield Bank.

The Macclesfield Bank (Pl. XIV.) is situated 300 miles to the north of the Tizard; it is 76 miles in length and 36 broad. This bank is entirely submerged; the shallowest portion of the rim is 9 fathoms beneath the surface, and inside the bank the depth is from 40 to 50 fathoms. Dredging on this bank was carried on from a small steam-cutter, but at depths of 20 to 45 fathoms there was considerable difficulty in moving the dredge with swabs attached. Living corals were found very abundantly to a depth of 30 fathoms, and some were obtained from a depth of 44 fathoms.

It will be seen from the subjoined tabular list that 129 species of Madrepore corals (Hydrocorallines and Alcyonarians are not here included) have been determined from the Tizard and Macclesfield Banks; of this number 99 species are from the Tizard and 26 from the Macclesfield Bank, whilst 4 only are common to both. Of the Madreporaria Aporosa there are 48 species, belonging to 23 genera; of the Madreporaria Fungida 23 species, included in 9 genera; and of the Madreporaria Perforata 58 species and 8 genera. The preponderance of the species of this latter division is principally due to the number of forms of the genus *Madrepora*, of which there are as many as 31 species.

An analysis of the bathymetrical distribution of these corals shows that at depths of 5 fathoms and under there are 45 species; between 5 and 10 fathoms 43 species; between 10 and 20 fathoms only 1 species; between 20 and 30 fathoms 30 species; between 30 and 40 fathoms 13 species; and between 40 and 50 fathoms 6 species. The rarity of species at depths between 10 and 20 fathoms may be accounted for by the fact that the shore-platform abruptly ceases at the upper limit of this zone, and there is a nearly vertical descent of 10 or more fathoms to a lower platform.

A very noticeable fact is the number of species which have been found living at depths of over 30 fathoms, a depth until lately supposed to be the extreme limit at which reef-building corals could exist. On these banks, however, we find 19 species occurring at depths between 31 and 45 fathoms; but of these there are 7 species belonging to genera which may properly be considered deep-water corals rather than reef-builders; these are *Desmophyllum*, *Flabellum*, *Cyathohelia*, *Lithophyllia*, *Tridacophyllia*, and *Balanophyllia*. The remaining 12 species of reef-corals living at these unusual depths belong to the following genera:—*Stylophora*, 1 sp.; *Favia*, 1 sp. at 45 fath.; *Pavonia*, 1 sp.; *Leptoseris*, 1 sp.; *Phyllastræa*, 1 sp.; *Psammocora*, 1 sp.; *Montipora*, 3 spp. (one of these at 44 fath.); *Rhodaræa*, 1 sp.; and *Alveopora*, 2 spp.

It is also worthy of mention that five new species of the genus *Madrepora*—a genus usually limited to depths of under 10 fathoms—were found living at depths of 20 to 27 fathoms both on the Tizard and Macclesfield Banks.

Of the 18 species found growing on the coral-head inside the lagoon 15 were not found elsewhere, and the diver reported that the bottom looked different. This is rather a remarkable fact, considering the size of the lagoon and the depth of water.

Tabular List of Genera and Species of Corals obtained from the Tizard and Macclesfield Banks.

[T. = Tizard Bank. M. = Macclesfield Bank.]

		Genera and Species.	Depth in Fathoms.						
			0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60.
		MADREPORARIA APOROSA.							
		Stylophora, *Schw.*							
1.	T.	—— digitata, *Pallas*, sp.	..	7					
2.	M., T.	—— prostrata, *Klunz.*	..	.	..	26–27			
3.	T.	—— pistillata, *Esper*, sp.	..	7					
4.	T.	—— ? Ehrenbergi, *E. & H.*	3						
5.	M.	—— Guentheri, sp. n.	..	..	..	..	32		
		Seriatopora, *Lam.*							
6.	M.	—— gracilis, *Dana*	..	..	..	$20\frac{1}{2}$			
7.	T.	—— imbricata, sp. n.	$\frac{1}{2}$						
8.	T.	—— compacta, sp. n.	..	$5\frac{3}{4}$					
9.	T.	—— tenuis, sp. n.	..	6					
10.	T.	—— armata, sp. n.	..	7					
		Pocillopora, *Lam.*							
11.	T.	—— elongata, *Dana*	2	$6\frac{3}{4}$					
12.	M., T.	—— verrucosa, *Ell. & Sol.*, sp.	1	10					
13.	T.	—— brevicornis, *Lam.*	$\frac{2}{3}$–1	$6\frac{1}{2}$					
14.	T.	——, sp.	2						

Tabular List of Genera &c. (continued).

		Genera and Species.	Depth in Fathoms.						
			0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60.
		Flabellum, *Lesson.*							
15.	T.	—— Stokesi, *E. & H.*	..	..	..	..	40		
		Desmophyllum, *Ehrenberg.*							
16.	M.	——, sp.	..	..	..	..	32		
		Cyathohelia, *E. & H.*							
17.	T.	—— axillaris, *Ell. & Sol.*	..	..	..	..	..	50	
		Lithophyllia, *E. & H.*							
18.	M.	—— lacrymalis, *E. & H.*	..	..	..	..	..	44	
19.	T.	——, sp.	..	..	..	26			
		Tridacophyllia, *Blainv.*							
20.	T.	—— cervicornis, *Moseley*	..	..	..	..	..	50	
		Galaxea, *Oken.*							
21.	T.	—— æqualis, sp. n.	..	6					
		Symphyllia, *E. & H.*							
22.	T.	—— radians	2						
23.	T.	—— labyrinthica, sp. n.	5						
		Mussa, *Oken.*							
24.	T.	—— multilobata, *Dana*	5						
25.	T.	—— sinuosa, *Lam.*	..	6					
		Meandrina, *Lam.*							
26.	T.	—— strigosa ?, *Dana*	2						
27.	T.	—— dædalea, *Ell. & Sol.*, sp.	2–4						
		Leptoria, *E. & H.*							
28.	T.	—— phrygia, *Ell. & Sol.*, sp.	..	6					
		Scaphophyllia, *E. & H.*							
29.	T.	—— cylindrica, *E. & H.*	..	6					
		Hydnophora, *Fischer.*							
30.	T.	—— microcona, *Lam.*, sp.	..	6					
31.	T.	—— rigida, *Dana*, sp.	..	6					
		Favia, *Oken.*							
32.	T.	—— denticulata (?), *Ell. & Sol.*, sp.	..	7					
33.	T.	—— Okeni, *E. & H.*	..	7					
34.	T.	—— Ehrenbergi, var. sulcata, *Kl.*	5						
35.	T.	—— pandanus, *Dana*, sp.	2						
36.	T.	—— rotulosa, *Ell. & Sol.*, sp.	2						
37.	T.	——, sp.	..	..	..	..	..	45	
		Goniastræa, *E. & H.*							
38.	T.	—— Bournoni, *E. & H.*	2						
		Prionastræa, *E. & H.*							
39.	T.	—— obtusata, *E. & H.*	2						
40.	T.	—— spinosa, *Kl.*	$\frac{1}{2}$						
41.	T.	—— robusta, *Dana*, sp.	2						
		Plesiastræa, *E. & H.*							
42.	T.	—— Urvillei, *E. & H.*	..	6					
		Cyphastræa, *E. & H.*							
43.	T.	—— Brueggemanni, *Quelch*	5						

Tabular List of Genera &c. (continued).

		Genera and Species.	Depth in Fathoms.						
			0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60.
		Leptastræa, *E. & H.*							
44.	T.	—— Ehrenbergana (?), *E. & H.*	..	7					
45.	T.	—— solida, *E. & H.*, sp.	..	6					
		Orbicella, *Dana.*							
46.	T.	—— annuligera, *E. & H.*	5	10					
47.	T.	——, sp.	..	7					
		Echinopora, *Lam.*							
48.	T.	—— rosularia, *Lam.*	..	6					
		MADREPORARIA FUNGIDA.							
		Siderastræa, *Blainv.*							
49.	T.	—— (?), sp. n.	..	6					
		Fungia, *Lam.*							
50.	T.	—— scutaria, *Lam.*	$\frac{1}{2}$						
		Pavonia, *Lam.*							
51.	M.	—— papyracea	..	..	..	..	40		
52.	T.	—— pretiosa, sp. n.	..	..	..	27			
53.	M.	—— ramosa, sp. n.	..	..	..	26			
54.	T.	—— clivosa, *Verr.*	..	8–10					
55.	M.	——, sp.	..	..	..	$26\frac{1}{2}$			
56.	M.	——, sp. n.	..	..	..	$20\frac{1}{2}$			
		Cycloseris, *E. & H.*							
57.	T.	—— cyclolites, *Lam.*, sp.	..	..	..	28			
58.	T.	—— tenuis, *Dana*, sp.	..	..	..	27–28			
59.	M.	—— sinensis, *E. & H.*	..	..	..	26			
60.	T.	—— Freycineti, *E. & H.*, sp.	..	..	..	27			
61.	T.	—— distorta, *Mich.*, sp.	..	..	..	28			
		Leptoseris, *E. & H.*							
62.	T.	—— striatus, *MS.* (?)	..	..	..	..	35		
63.	T.	——, sp.	..	..	..	28			
		Phyllastræa, *Dana.*							
64.	T.	—— Okeni (?), *E. & H.*, sp.	..	..	..	..	32		
65.	M.	—— tubifex, *Dana*	..	..	..	$26\frac{1}{2}$			
		Pachyseris, *E. & H.*							
66.	M.	—— levicollis, *Dana*, sp.	..	..	..	$26\frac{1}{2}$			
		Oxypora, *Sav. Kent.*							
67.	M.	—— contorta, *Quelch*	..	..	..	26			
		Psammocora, *Dana.*							
68.	M.	—— planipora (?), *E. & H.*	..	..	..	26–	32		
69.	M.	——, sp.	..	..	..	27			
70.	T.	—— Haimeana	..	6					
71.	T.	Gen. et sp. ind.	..	6					

Tabular List of Genera &c. (continued).

		Genera and Species.	Depth in Fathoms.						
			0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60.
		MADREPORARIA PERFORATA.							
		Balanophyllia, *Searles Wood.*							
72.	T.	—— parvula ?, *Moseley*	..	..	..	..	..	50	
73.	T.	—— scabrosa (?), *Dana*, sp.	..	..	..	..	40		
		Dendrophyllia, *Blainv.*							
74.	T.	—— gravis, *Brugg. MS.* ?	..	..	..	26			
		Montipora, *Quoy et Gaim.*							
75.	T.	—— papillosa, *Lam.*, sp.	..	..	..	25			
76.	M.	—— foliosa, *Pallas*, sp.	..	..	..	$20\frac{1}{2}$			
77.	M.	—— prolifica, *Brugg. MS.* ?	..	..	..	$26\frac{1}{2}$			
78.	M.	—— lima (?), *Lam.*, sp.	..	..	..	$26\frac{1}{2}$			
79.	T.	——, sp.	..	$8\frac{1}{4}$					
80.	T.	—— Danæ, *E. & H.*	$\frac{1}{2}$						
81.	M.	——, sp.	..	..	..	..	40		
82.	M.	—— porosa, sp. n.	..	..	..	..	35		
83.	M.	——, sp.	..	..	..	..	..	44	
		Turbinaria, *Oken.*							
84.	T.	—— stellulata, *Blainv.*, sp. var.	5–	10					
		Madrepora, *Linn.*							
85.	T.	—— robusta, *Dana*	5						
86.	T.	—— crebripora, *Dana*	$\frac{1}{2}$						
87.	T.	—— secunda, *Dana*	5						
88.	T.	—— scabrosa, *Quelch*	..	$6\frac{1}{2}$					
89.	T.	—— horrida, *Dana*	2						
90.	T.	—— Ehrenbergi, *E. & H.*	5						
91.	M., T.	—— dendrum, sp. n.	..	..	20	27			
92.	T.	—— compressa, sp. n.	5						
93.	M.	——, sp. n.	..	..	..	$26\frac{1}{2}$			
94.	T.	—— plantaginea, *Lam.*	..	6					
95.	T.	—— valida, *Dana*	..	6					
96.	T.	—— paxilligera, *Dana*	1						
97.	M., T.	—— pyramidalis, *Kl.*	2						
98.	T.	—— seriata, *Ehrenb.*, sp.	2						
99.	T.	—— tenuis, *Dana*	1						
100.	T.	—— nasuta, *Dana*	5						
101.	T.	—— effusa, *Dana*	5						
102.	T.	—— globiceps, *Dana*	..	7					
103.	T.	—— acervata, *Dana*	..	$8\frac{1}{2}$					
104.	T.	—— aculeus, *Dana*	..	$8\frac{1}{2}$					
105.	T.	—— corymbosa, *Lam.*	..	$5\frac{1}{2}$–$9\frac{1}{2}$					
106.	T.	—— prostrata, *Dana*	..	$6\frac{1}{2}$					
107.	T.	—— cytherea (?), *Dana*	..	6					
108.	T.	—— efflorescens, *Dana*	..	6					
109.	T.	—— spicifera (var. abbreviata), *Dana*	..	5					

Tabular List of Genera &c. (continued).

		Genera and Species.	Depth in Fathoms.						
			0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60.
110.	T.	—— hyacinthus, *Dana*	..	9½					
111.	T.	—— vastula (?), *Quelch*	..	7					
112.	T.	—— flabelliformis, *E. & H.*, var.	2						
113.	T.	—— labrosa, *Dana*	5						
114.	T.	—— fragilis, sp. n.	..	..	..	27			
115.	M.	—— Rambleri, sp. n.	..	..	..	26½			
116.	M.	—— Rambleri, var.	..	..	..	20½			
		Porites, *Lam.*							
117.	T.	—— mucronata, *Dana*	½						
118.	T.	—— conferta, *Dana*	2½						
119.	T.	—— lutea, *Quoy et Gaim.*	½						
120.	T.	—— tenuis, *Verr.*	½						
121.	T.	—— arenosa, *Esper*, sp.	2–	6					
122.	T.	—— lichen (?), *Dana*	2½						
123.	T.	—— solida, *Forsk.*, sp.	2						
124.	T.	—— crassa (?), *Quelch*	..	7					
		Rhodaræa, *E. & H.*							
125.	T.	—— gracilis, *E. & H.*	2						
126.	M.	—— (?) Lagrenii?, *E. & H.*	..	..	..	..	40		
		Alveopora, *Quoy et Gaim.*							
127.	M.	—— dædalea, *Forsk.*, sp.	..	..	..	27–	40		
128.	M.	—— retepora, *Ell. & Sol.*, sp.	..	..	..	..	35		
129.	T.	—— Tizardi, sp. n.	..	..	..	27			

References to Genera and Species.

MADREPORARIA.

Section Madreporaria Aporosa, Ed. & H.

Genus Stylophora, Schweigger.

Stylophora digitata, Pallas, sp.

Madrepora digitata, Pallas, Elench. Zooph. p. 326.

Two fragmentary specimens.
Tizard Bank. Depth from 3 feet to 7 fath.

Stylophora prostrata, Klunz.

1879. *Stylophora prostrata*, Die Korallth. des rothen Meeres, Th. ii. p. 62, pl. vii. fig. 8, pl. viii. fig. 7.

Two specimens were obtained.
Tizard and Macclesfield Banks. Depth 26–27 fath.

Stylophora pistillata, Esper, sp.

1797. *Madrepora pistillata*, Esper, Madre. pl. lx.

A single fragment doubtfully belonging to this species.
Tizard Bank, 7 fath.

Stylophora (?) *Ehrenbergi*, E. & H.

1859. *Stylophora Ehrenbergi*, E. & H., Ann. des Sci. Nat. 3e sér. t. xiii. p. 105.

A small fragment was obtained which apparently belongs to this species. It is doubtful, however, whether the form can properly be retained in the genus *Stylophora*, since there is apparently no cœnenchyma and in character the septa much resemble those of an Astræan coral.

Tizard Bank, 3 fath.

Stylophora Guentheri, sp. n.

Corallum incrusting, growing in thin successive layers over foreign objects; upper surface uneven, with nodose projections. Base with wrinkled epitheca formed of delicate concentric lines. The layers from 1 to 3·5 millim. in thickness. Calices circular, without regular arrangement, not projecting, but on a level with the general surface; no definite lip developed. The calices from ·8 to 1 millim. in diameter, from ·3 to 1 millim. apart, usually four in 5 millim., rarely five in this distance. The septa delicate, six small as well as the six large can be recognized, the free edges markedly dentate. Columella styliform, prominent, reaching nearly to the level of the calice. Interspaces between the calices thickly beset with minute blunt spines. In places fine lines can be seen in the interspaces, marking polygonal outlines of the corallite. Occasionally there is a small papilla-like prominence on one side of a calice apparently connected with one of the large septa; but this character does not appear to be general.

This species is characterized by its incrusting mode of growth, the small size and insert character of the calices, and the strongly dentate septa. Two specimens were obtained, one (alive) from a depth of 32 fath., the other (dead) from a depth of 22 fathoms.

Macclesfield Bank, China Seas, 22 and 32 fathoms.

Genus Seriatopora, Lam.

Seriatopora gracilis, Dana.

1848. *Seriatopora caliendrum*, var. *gracilis*, Dana, U. S. Explor. Expedition, Zoophytes, p. 522, pl. xlix. fig. 4.
1875. *Seriatopora gracilis*, Dana, Corals and Coral Islands, p. 334.

There are three fragmentary specimens which do not fully agree with Dana's description; but the differences do not appear sufficient to justify placing them in a new species. They form bushy masses of very slender branches from 2·5 to 3 millim. in thickness in the lower part, the terminal branchlets acutely pointed, slightly winged at their apices, from 2 to 5 millim. long and about 1 millim. thick at the base. Branches round to subangular, divergently bifurcating in lower portions of the colony and giving off antler-like spikes. Calices in five series, circular to oval, from ·4 to ·5 millim. in width, sometimes without prominent lips, at others the upper lip projecting; distance from each other in rows variable, from ·3 to ·6 millim.; there are from five to six calices in a length of 5 millim. Septa not recognizable, columella visible but not prominent. Spaces between the rows abundantly covered with acute spines.

From Dana's figured type these specimens differ in the less upright and more divergent mode of growth and the slightly winged apices of the branchlets. They differ materially from the form referred by Quelch to this species ('Challenger' Report, vol. xvi. p. 58), which has calices of about twice the size mentioned by Dana.

Macclesfield Bank, 20½ fath.

Seriatopora imbricata, sp. n.

Corallum forming fairly large bushy masses; branches dichotomizing at intervals, occasionally a distance of 15 millim. between the furcations, branches sometimes coalescing. The summit-branches furcating and giving off short, pointed, divergent apical spikes, not winged, about 2 millim. thick at their bases. Branches in lower portion about 4 millim. in thickness, distinctly subangular, the calices in five series on the angles. Calices transversely suboval, with their upper lips very prominent and strongly arching over the aperture, very spinous; in the lower branches the upper lip hardly at all developed. The calices about ·6 millim. in diameter, very closely arranged in the rows, so that there are seven in the space of 5 millim. The interspaces between the calices flattened, sometimes 1 millim. in width, closely covered with short stout spines, which are in places disposed in longitudinal wavy lines.

There is only a single specimen of this species; it is 120 millim. in height and 140 in width, but the lower portion of it was dead when dredged and the branches are hollowed out by boring-sponges and incrusted by Nullipores.

In its mode of growth and in the prominent lip of the calices this form belongs to the same group as *S. angulata*, Kl., *S. pacifica*, Brugg., and *S. spinosa*, M.-Edw. It approaches nearest to *S. angulata*, but the calices are much smaller and closer arranged in the rows than in this species, and the branches are less acuminate.

There are in this specimen several instances of those peculiar abnormalities of growth which Ehrenberg compared to galls in plants. They assume the form of flattened hollow disks, with thin walls formed of the coral; the margins of the disks are perforated. Imprisoned within each of these discoid cages is a small crab which cannot escape.

From the Tizard Bank, at a depth of ½ fath.

Seriatopora compacta, sp. n.

Corallum growing in small clumps consisting of rounded or somewhat compressed branches about 6 millim. thick, which dichotomize at intervals of from 5 to 7 millim. and frequently coalesce, so that the coral has a fenestrate appearance. The summit branchlets are short, from 3 to 5 millim., conical, about 2 millim. thick at their bases, summits obtuse, occasionally winged, crowded with young calices. Calices closely arranged on branches; the serial arrangement is not distinct, but there appear to be about nine rows on a branch; the calices are from 2 to 3 millim. apart in the rows and about an equal distance laterally; there are from five to six calices in a length of 5 millim. The calices are nearly circular, from ·6 to ·75 millim. in width, their margins scarcely at all prominent, but the upper lip is occasionally indicated by longer spines. The calices are deep and the large septa and the pits at the bottom can be distinguished. The narrow interspaces between the calices are covered with short spines.

This species is of the type of *S. crassa*, Quelch, and *S. transversa*, Quelch, but differs from these forms in having less robust and closer arranged branches, whilst the calices are larger and closer together.

Only two imperfect examples of this species have been obtained; the largest is 40 millim. in height by 60 in width.

Tizard Bank, 5¾ fath.

Seriatopora tenuis, sp. n.

Corallum forming small bushy masses of closely arranged branches, which in the lower portions are subpalmate, but above cylindrical; they are from 4 to 5 millim. in thickness, bifurcating at intervals of from 5 to 7 millim.; the apical branchlets depressed, conical, winged, so as to show the rows of calices very distinctly; they are 4 to 5 millim. in length by 2·5 millim. thick at their bases. Calices nearly circular, ·6 millim. in diameter, without projecting lip, from ·2 to ·4 millim. apart in rows, or five calices in 5 millim. There are seven or eight rows on the branches, the rows about ·4 millim. apart. Calices deep, showing a sharp thin edge of the axial septa, with occasionally a columellar tubercle slightly rising from the centre, the calicinal pits well shown. Intermediate space finely spinous.

This species approaches closely to *S. compacta*, but the branches are more slender; the calices are smaller, and they are in fewer rows. There is a single fairly complete specimen 40 millim. in height by 75 millim. in width.

Tizard Bank, 6 fath.

Seriatopora armata, sp. n.

Corallum growing in low depressed clumps of delicate thickly-set branches, from 3 to 4 millim. in thickness, somewhat compressed in their lower portions, bifurcating at intervals of about 5 millim., and frequently coalescing. Near the summit the branches furcate more frequently and give off numerous short spike-like branchlets, conical, acute, winged, and from 3 to 5 millim. long by 1·5 millim. thick at their bases. Calices in five rows on the branches, oval, about ·75 millim. long by ·6 wide, about 3 millim. apart in the rows; margins well marked by stout spines but not exsert. There are five calices in 5 millim. and the rows are about ·6 millim. apart. Calices showing the axial septa distinctly, in the centre a slight crestiform elevation (columella?). Areas between the calices with short spines which have sometimes a linear arrangement.

There is only a single perfect example of this species, which is 35 millim. in height and about 90 wide across the summit. In its mode of growth and in the character of the calices this form approaches *S. compacta* and *S. tenuis*; but its branches are more delicate, the rows of calices are fewer, and the surface more spinous; the numerous short apical branchlets is also a distinguishing feature.

Tizard Bank, 7 fath. On block of coral-rock in association with specimens of *Madrepora*, *Favia*, &c.

Genus Pocillopora, Lam.

The examples of this species are fairly numerous; with one exception, which was found in 26 fathoms, they have all been obtained in depths under 10 fathoms. The specific determination of these forms is extremely difficult; the definitions given by Lamarck, Edwards and Haime, and other older authors are so general that it is impossible to know what they include; and, on the other hand, the variations in the characters of the corallites appear to be so slight in the different forms that they may almost be considered as forming a continuous series separated only by slight modifications in their mode of growth. In the absence of authenticated specimens of known species the list given below can only be regarded as provisional.

Pocillopora elongata, Dana.

1848. *Pocillopora elongata*, Dana, Zoophytes, p. 531, pl. 50. fig. 4.

Three specimens from depths of 2–6¾ fath.
Tizard Bank.

Pocillopora verrucosa, Ell. & Sol., sp.

1786. *Madrepora verrucosa*, Ell. & Sol. Nat. Hist. Zooph. p. 172.
1836. *Pocillopora verrucosa*, Lam. Hist. des Anim. sans Vertbèbr. éd. 2, t. ii. p. 443.

There are several examples of this species, which appears to have flourished all over the reef. Depth 1–10 fathoms.
Tizard and Macclesfield Banks.

Pocillopora brevicornis, Lam.

1836. *Pocillopora brevicornis,* Lam. Hist. des Anim. sans Vertèbr. éd. 2, t. ii. p. 443.
1848. *Pocillopora brevicornis*, Dana, Zooph. p. 526, pl. xlix. fig. 8.

Several examples from depths ⅔–1 fath.; one specimen 6½ fath.
Tizard Bank.

Pocillopora, sp.

A single specimen, which in its mode of growth resembles *P. brevicornis*; but the branches are considerably thicker and the corallites somewhat larger.
Garvan Reef, Tizard Bank, 2 fath.

Genus Flabellum, Lesson.

Flabellum Stokesi, Ed. & Haime.

1848. *Flabellum Stokesi*, E. & H. Ann. des Sc. Nat. 3e sér. t. ix. p. 278, pl. viii. fig. 12.

One dead specimen, probably referable to this species.
Tizard Bank, 40 fath.

Genus Desmophyllum, Ehrenberg.

Desmophyllum, sp.

A single small example of this genus taken alive; it may be a young form of an undescribed species. The coral is attached by a short curved stem and a spreading base. The calice is elliptical in outline, 18 millim. long by 10 millim. wide, and about 19 millim. in height. There are about forty septa; ten of these are subequal and principal, reaching to the centre of the calice, where their inner, free, lateral margins slightly curve round; the septa are thin and furnished laterally with minute spines. Between each pair of the larger septa there are three smaller secondary septa which project but a short distance from the wall. The costæ of the larger septa project slightly as sharp-edged ribs on the exterior.
Macclesfield Bank, 32 fath.

Genus Cyathohelia, Ed. & H.

Cyathohelia axillaris, Ell. & Sol.

1786. *Madrepora axillaris*, Ell. & Sol. Nat. Hist. Zooph. p. 153, pl. xiii. fig. 5.

A single specimen, living, was obtained from the Tizard Bank, depth 50 fath.

Genus Lithophyllia, Ed. & H.

Lithophyllia lacrymalis, Ed. & H.

1848. *Caryophyllia lacrymalis*, E. & H. Ann. des Sci. Nat. 3e sér. t. x. p. 319, pl. viii. fig. 1.
1857. *Lithophyllia lacrymalis*, E. & H. Hist. Nat. des Corall. vol. ii. p. 292.

A single specimen, dead, attached to a nodule of *Lithothamnion*.
Macclesfield Bank, depth 44 fath.

Lithophyllia, sp.

A living specimen, but much broken. It has a wide surface of attachment; the coral is short, subcircular, and widely expanded; septa in four cycles, upper margins dentate or lobate and finely crenulate, costæ echinulate.

Tizard Bank, depth 26 fath.

Genus Tridacophyllia, Blainville.

Tridacophyllia cervicornis, Moseley.

1881. *Tridacophyllia cervicornis*, Moseley, Chall. Report, Zool. vol. ii. p. 183, pl. x. figs. 2, *a*, *b*, *c*, B*a*.

A single specimen, living, 11 millim. in height by 9 in width, growing attached by a spreading base and short peduncle.

From the Tizard Bank, depth 50 fathoms.

This is the first time that a locality and depth have been recorded for this species, these not being known for the type form described by Moseley.

Genus Galaxea, Oken.

Galaxea æqualis, sp. n.

Corallum forming extended masses with flattened or slightly convex surfaces. Calices very regular in height and distance from each other, circular, subcircular, or slightly compressed, so as to become subpolygonal, from 3·5 to 5 millim. in diameter at the summit. From twenty to twenty-four septa in three cycles, the septa varying in size according to the cycle, thick at the peripheral margin, becoming thin towards the free internal margins, strongly exsert. Low down the septal margins unite and form a perforate pseudo-columella. Lateral surfaces of the septa with numerous minute spines. The costæ formed by the peripheral margins of the septa, which can be distinguished individually. The calices are only from 1·5 to 2 millim. apart, and they project about 10 millim. above the platform of the cœnenchyma. The vesicles of the cœnenchyma small, from ·5 to ·75 millim. apart; at intervals compact platforms appear to be formed which grow over the former surfaces.

This species is allied to *G. Esperi*, Schweig., and *G. Ellisii*, E. & H., but is distinguished by the close arrangement of the corallites and their short extension above the cœnenchyma.

Only a single specimen was obtained, which is about 50 millim. in width at the summit and ·45 millim. in thickness; but the mass below the summit-platform of cœnenchyma is apparently dead and extensively eaten into by sponges.

East lagoon, Tizard Bank, 6 fath.

Genus Symphyllia, Edw. & Haime.

Symphyllia radians, E. & H.

1849. *Symphyllia radians*, E. & H. Ann. des Sci. Nat. 3e sér. t. xi. p. 255.

A single specimen from the Garvan Reef, Tizard Bank, depth 2 fath.

Symphyllia labyrinthica, sp. n.

Corallum large, massive, rudely inverted, conical, with plane or slightly convex surface. Lateral and under surface with longitudinal striæ, apparently not spinous, this surface usually covered by attached organisms quite close to the upper margin. Upper surface of sinuous labyrinthine calicinal series, the walls completely amalgamated, with no traces of grooves between. Width of calices 13 to 15 millim., depth 8 millim. There are usually two septa connecting the calicinal centres, sometimes traces of a third, sometimes only one is present. There are about fourteen large and small septa in the distance of 10 millim., the large septa with prominent spinous teeth, the smaller serrate or unequally jagged.

There is but a single specimen, which is 7·5 centim. in height and 25 centim. across the surface.

This species is nearest allied to *S. agaricia*, E. & H., and to *S. acuta*, Quelch, but from these it is readily distinguished by the narrowness and less depth of the calicinal valleys. It has been compared with *S. neglecta*, a MS. species in the British Museum, but its mode of growth and other features readily distinguish it from the type of this form.

Tizard Bank, 5 fath.

Genus Mussa, Oken.

Mussa multilobata, Dana (non Ed. & H.).

1848. *Mussa multilobata*, Dana, Zoophytes, p. 181, pl. viii. fig. 2.

A single specimen, 70 millim. in height and 170 millim. across the summit.

Tizard Bank (section C), 5 fath.

Mussa sinuosa, Lamarck.

1816. *Caryophyllia sinuosa*, Lam. Anim. sans Vert. éd. 1, t. ii. p. 229, éd. 2, t. ii. p. 357.

A single specimen, probably a young form; it is 20 millim. in height by 60 in width above.

Tizard Bank, 6 fath.

Genus Meandrina, Lamarck.

Meandrina strigosa?, Dana.

1848. *Meandrina strigosa*, Dana, Zoophytes, p. 257, pl. xiv. fig. 4.

A single specimen, cylindrical, truncate, gyri about 6 millim. in width and 3·5 millim. deep, about fifteen septa in 10 millim. Referred doubtfully to this species, which, according to Quelch, can be seen to vary considerably in its characters when a large series of forms is examined.

East of Nam-Yit, Tizard Bank, 2 fathoms.

Meandrina dædalea, Ell. & Sol., sp.

1786. *Madrepora dædalea*, Ell. & Sol. Nat. Hist. Zoophytes, p. 163, pl. xlvi. fig. 1.

Two specimens. Sand-Kay, Nam-Yit, Tizard Bank, 2–4 fathoms.

Genus Leptoria, Ed. & H.

Leptoria phrygia, Ell. & Sol., sp.

1786. *Madrepora phrygia*, Ell. & Sol. Nat. Hist. Zoophytes, p. 162, pl. xlviii. fig. 2.

One specimen from the Tizard Reef, depth 6 fath.

Genus Scapophyllia, Ed. & H.

Scapophyllia cylindrica, Ed. & H.

1849. *Scapophyllia cylindrica*, Edw. & Haime, Ann. des Sci. Nat. 3e sér. t. x. pl. viii. fig. 8, and t. xi. p. 278.

One specimen from lagoon, Tizard Bank, depth 6 fath.

The specimen is depressed, spreading, with irregular lobate slight elevations. The calicinal valleys are much curved, 4 millim. in width and about 2·5 millim. in depth; septa thin, with frilled edges. The so-called columella consists of irregular tooth-like projections from the free edges of the septa.

The description of this species states that it is cylindro-conical in form; but in what appears to be a genuine specimen of it in the British Museum there is a spreading basal platform, with here and there elevations, some of which are subcylindrical and rise to a considerable height. In the present specimen the subcylindrical portions are not developed.

Genus HYDNOPHORA, Fischer de Waldheim.

Hydnophora microcona, Lam., sp.

1816. *Monticularia microconos*, Lam. Hist. des Anim. sans Vert. t. ii. p. 251, 2nd ed. (1836) p. 393.
1786. *Madrepora exesa*, Ell. & Sol. (non Pallas), Zoophytes, p. 161, pl. xlix. fig. 3.

A single specimen of this species from the east lagoon, Tizard Bank, China Seas, at a depth of 6 fath.

Hydnophora rigida, Dana, sp.

1846. *Merulina rigida*, Dana, Expl. Exp. Zoophytes, p. 276, pl. xvii. fig. 1.

A single specimen from the east lagoon, Tizard Bank, at a depth of 6 fath.

Genus FAVIA, Oken.

Favia denticulata?, Ell. & Sol., sp.

1786. *Madrepora denticulata*, Ell. & Sol. Nat. Hist. Zoophytes, p. 166, pl. xlix. fig. 1.

A small specimen incrusting the base of a Madrepore. Tizard Bank, 7 fath.

Favia Okeni, Ed. & H.

1857. *Favia Okeni*, Ed. & H. Hist. Nat. des Corall. t. ii. p. 430.

A small specimen on the same block of rock with the preceding species.

Tizard Bank, 7 fath.

Favia Ehrenbergi, Klunz., var. *sulcata*, Klunz.

1879. *Favia Ehrenbergi*, Klunz. Die Korallth. des rothen Meeres, Th. iii. p. 29, Taf. iii. fig. 8 (var. *sulcata*).

Tizard Bank, 5 fath.

Favia pandanus, Dana, sp.

1848. *Astræa pandanus*, Dana, Expl. Exp. Zooph. p. 222, pl. xi. fig. 2.

Tizard Bank, 2 fath.

Favia rotulosa, Ell. & Sol., sp.

1786. *Madrepora rotulosa*, Ell. & Sol. Nat. Hist. Zooph. p. 166, pl. lv.

Garvan Reef, Tizard Bank, 2 fath.

Favia, sp.

A portion of a specimen 80 by 50 millim. was dredged up in a bag full of foraminiferous sand from the centre of the lagoon, Tizard Bank, at a depth of 45 fathoms. There were sixteen bright green living polyps on it, each with twelve yellow tentacles. Calices circular or irregularly oval, about 8 millim. wide, furrow between them well marked, septa with prominent denticles.

Tizard Bank, 45 fath.

Genus Goniastræa, Ed. & H.

Goniastræa Bournoni, E. & H.

1850. *Goniastræa Bournoni*, E. & H. Ann. des Sci. Nat. 3e sér. t. xii. p. 162.

A single specimen, taken alive, from Itu-Aba, depth 2 fath. Tizard Reef.

Genus Prionastræa, Ed. & H.

Prionastræa obtusata, Ed. & H.

1850. *Prionastræa obtusata*, E. & H. Ann. des Sci. Nat. 3e sér. t. xii. p. 130.

One specimen only, taken alive.
Garvan Reef, Tizard Bank, 2 fath.

Prionastræa spinosa, Klunzinger.

1879. *Prionastræa spinosa*, Klunz. Die Korallenth. des roth. Meeres, Th. iii. p. 39, Taf. iv. fig. 7.

One specimen only. Nam-Yit, Tizard Bank, ½ fath.

Prionastræa robusta, Dana, sp.

1848. *Astræa robusta*, Dana, Expl. Exp. Zooph. p. 248, pl. xiii. fig. 10.

Tizard Reef, 2 fath.

Genus Plesiastræa, Ed. & H.

Plesiastræa Urvillei, Ed. & H.

1850. *Plesiastræa Urvillei*, Ed. & H. Ann. des Sci. Nat. 3e sér. t. x. pl. ix. fig. 2, and t. xii. p. 117.

Tizard Bank, 6 fath.

Genus Cyphastræa, Ed. & H.

Cyphastræa Brueggemanni, Quelch.

Cyphastræa Brueggemanni, Quelch, Chall. Report, Reef-Corals, p. 106.

Tizard Bank, 5 fath.

Genus Leptastræa, Ed. & H.

Leptastræa Ehrenbergana ?, Ed. & H.

1850. *Leptastræa Ehrenbergana*, E. & H. Ann. des Sci. Nat. 3e sér. t. xii. p. 120.

A small incrusting lobed specimen, which approaches close to the above species; but it does not exhibit the deformed corallites, which are stated to be usually present. From *L. transversa*, Kl., it differs in the character of the columella.

Tizard Bank, 7 fath.

Leptastræa solida, Ed. & H., sp.

1850. *Baryastræa solida*, Ed. & H. Ann. des. Sci. Nat. 3e sér. t. xii. p. 144.

Tizard Bank, 6 fath.

Genus Orbicella, Dana.

Orbicella annuligera, Ed. & H., sp.

1880. *Astræa annuligera*, E. & H. Ann. des Sci. Nat. 3e sér. t. xii. p. 103.

Tizard Bank, 5–10 fath.

Orbicella, sp.

A small incrusting specimen on mass of coral with Madrepore and other species of corals.

Tizard Bank, 7 fath.

Genus Echinopora, Lam.

Echinopora rosularia, Lam.

1816. *Echinopora rosularia*, Lam. Hist. des Anim. sans Vertèbr. éd. 2, t. ii. p. 397.

Lagoon, Tizard Bank, 6 fath.

[To be continued.]

XLIV.—*Descriptions of new Species of* Pedaria, *with Observations on allied* Scarabæidæ. By Charles O. Waterhouse.

Pedaria tuberculigera, sp. n.

Elongato-oblonga, nigro-fusca, parum nitida, clypeo leviter emarginato; thorace confertim sat fortiter punctato, antice tumiditate ovali sat elevata parcius subtiliter punctulata nitida instructo; elytris thorace paullo latioribus, convexis, ad apicem arcuatim angustatis, sat fortiter punctato-striatis, interstitiis creberrime fortiter punctatis.

Long. 9 millim.

Hab. Senegambia (*Bocandé*).

Dark smoky brown, with a slight purple-bronze shade. The head is evenly and closely punctured, the punctures small but very distinct, usually separated from each other by a diameter of a puncture; the clypeus has a very few punctures; the anterior margin is distinctly but not very deeply emarginate, the angles of the emargination rounded; and between this emargination and the posterior angle of the head there is a distinct angulation. The thorax is transverse, parallel-sided, with a slight sinuosity before the anterior angles, convex, closely punctured; the punctures at the sides are moderately large, separated from each other by about one quarter the diameter of a puncture; but towards the disk the punctures become a little smaller and the intervals proportionately greater; halfway towards the side about twenty-five punctures would form a line from the front to the posterior margin. The elytra at the base are not broader than the thorax, but are gradually widened to the middle and then again narrowed to the apex; the striæ are strong; the interstices are closely, strongly, and irregularly punctured (except perhaps the sixth), the intervals between the punctures very narrow and inclined to form small tubercles.

Pedaria Taylori, sp. n.

Elongato-oblonga, nigro-fusca, parum nitida; clypeo leviter emarginato; thorace confertim fortiter punctato, antice medio leviter tuberoso, lateribus ante medium et ad basin leviter sinuatis; elytris thorace paullo latioribus, sat fortiter punctato-striatis, interstitiis fortiter seriatim punctatis.

Long. 8 millim.

Hab. Mombas, Rabai Hills (*Rev. W. E. Taylor*); Lake Nyassa (*Thelwall*).

Very similar to *P. tuberculigera*, but a little less convex. The head has the punctuation stronger and the punctures are less numerous; about seventeen may be counted in a line from the vertex to the commencement of the clypeus, whereas in *P. tuberculigera* about twenty-four might be counted; the line dividing the clypeus from the forehead is very indistinct, and the punctures on the clypeus are nearly as strong and close as on the forehead; the outer angles of the anterior emargination are very slightly dentiform. The thorax is very similar, but is a trifle narrower at the base, and the sides have a more distinct indentation immediately before the posterior angles; the punctuation is stronger and more uniform, with very narrow intervals; at halfway towards the side about seventeen punctures may be counted in a line from the front to the posterior margin; the swelling at the front margin is very distinct, but not quite as much raised as in *P. tuberculigera*. The elytra are distinctly more rounded at the apex; the striæ are equally strong, but have the punctures a little more separated (about one and a half diameters of a puncture); the punctures on the interstices are strong, arranged in lines, slightly irregular on the second, third, and fifth interstices, regular on the fourth and sixth.

The specimen from Lake Nyassa has the punctures on the thorax a trifle larger, and the swelling in front is much less marked. This is probably the female.

A specimen from S.E. Africa, Arusha (*F. J. Jackson, Esq.*), differs from *P. Taylori* in having the tubercle on the front of the thorax smaller and more shining, but not less elevated. The elytra have the interstices more regularly punctured in double lines, the second and fifth interstices having one or two additional punctures between the lines near the base.

Another specimen received with the above from Arusha, and agreeing with it in having the interstices of the elytra punctured in lines, differs very much in the form and punctuation of the thorax and in the almost entire absence of the anterior swelling. It seems unlikely that this should be the female of the specimen with the tubercle with which it was received, as the specimen from Nyassa above referred to as the probable female of *P. Taylori* has the punctuation of the thorax very similar to that of the male. I propose to name this specimen provisionally *P. Jacksoni*. The following is a full description:—

Pedaria Jacksoni, sp. n.

Elongato-oblonga, convexa, nigro-fusca, subpurpurascens, sat nitida; thorace creberrime fortiter punctato, antice medio leviter gibboso subtilius punctulato; elytris fortiter striatis, interstitiis planis, nitidis, fortiter biseriatim punctatis, interstitio suturali solum crebre punctato.

Long. $7\frac{1}{2}$ millim.

Hab. Arusha (*F. J. Jackson, Esq.*).

The head is closely and rather strongly punctured, the punctures very near together, but not confluent; at the division between the forehead and clypeus the punctures are very feeble, but are stronger again on the clypeus itself; the angles of the anterior emargination are slightly dentiform. The thorax has the sides gently arcuate, so that there is not such a suddenly oblique inflexion at the anterior angles as in the above-described species; the sinuosity at the middle is very slight. The punctuation is strong, but the punctures are not quite so large as in the foregoing species, crowded at the sides, distinctly separated from each other on the disk, fine on the anterior swelling, which is very slight; halfway towards the side about nineteen punctures may be counted in a line from the front to the posterior margin, the punctures being separated from each other at this part by about one half the diameter of a puncture. The elytra have the striæ strongly marked; the interstices shining, each with a regular line of strong punctures on each side; the sutural interstice, however, has three rather irregular lines of punctures; in the second interstice there are a very few stray punctures.

This species is nearest to one which I have determined to be *P. picea*, from Natal, but differs in having the punctures on the thorax less close and in having a finely punctured area in front.

Pedaria nigra, Castelnau.

This species is figured by Castelnau (Hist. Nat. ii. pl. v. fig. 7) under the name *P. aphodioides*, evidently by an oversight in lettering the plate. The locality placed opposite the name in the 'Munich Catalogue' is "Cap bon. spei," which is an error; Senegal is given by Castelnau in his description of *P. nigra*, and the same locality is given in Dejean's Catalogue opposite *P. aphodioides*. In the 'Munich Catalogue' moreover *P. cylindrica*, Fåhr., is placed as a synonym of *P. nigra*, the locality Port Natal being correctly given. I consider this species quite distinct from *P. nigra*, from which it differs in having an elongate shining tubercle at the base of the thorax, as described by Fåhraeus.

Pedaria criberrima, sp. n.

Elongato-oblonga, nigro-fusca, parum nitida; thorace confertim fortiter punctato, disco medio leviter transversim impresso, lateribus medio leviter sinuatis, ad basin oblique introrsum directis; elytris fortiter punctato-striatis, interstitiis fortiter punctatis, punctis in interstitiis quarto et sexto biseriatim positis. Long. 7 millim.

Hab. Senegambia, Old Calabar.

The head has the punctuation as in *P. Taylori*; the clypeus has the angles of the emargination slightly dentiform. The thorax is rather parallel-sided, but obliquely narrowed at the extreme base; the punctuation is strong and crowded, the punctures near the front being a little smaller than at the base; at halfway towards the side about twenty punctures might be counted in a line from the front to the posterior margin; in the middle of the front margin there is a slight swelling (with a light transverse impression behind it), but no distinct tubercle; the punctures on the swelling are smaller and more separated. The elytra have the apex obtuse. Owing to the coarse punctuation, the striæ (although strong) are not so conspicuous as in *P. Taylori*; in the second, third, and fifth interstices there are three lines of punctures, but owing to the large size of the punctures they are quite irregular, as there is not space for three punctures side by side. In the fourth and sixth interstices there are two lines of punctures, regular at the middle but crowded at the base and apex.

The specimen from Old Calabar has the front part of the thorax less parallel, slightly narrowed in front.

Pedaria alternans, sp. n.

Elongato-oblonga, nigro-fusca, subnitida; thorace crebre minus fortiter punctato, leviter convexo, antice non tuberoso; elytris subtilius punctato-striatis, interstitiis quarto et sexto biseriatim punctatis, reliquis irregulariter punctatis; carina subhumerali brevi, altera laterali crenulatis instructis.

Long. 8 millim.

Hab. S. Africa (*Dr. Smith*).

Although the punctuation in this species is very distinct, it is nevertheless considerably finer than in any species with which I am acquainted. The head has the angles of the anterior emargination distinctly dentiform, and the side between this angle and the posterior angle is slightly bisinuate. The thorax is slightly constricted at the base and has a very slight sinuosity at the middle of the side. The punctuation (when compared with other species) is rather fine, nearly the same all over; halfway towards the side about twenty-five punctures might be counted in a line from the front to the posterior margin, the intervals between the punctures being a trifle less than the diameter of a puncture; the punctures, however, often touch each other in a longitudinal direction. There is no swelling or tubercle in front. The elytra have the striæ rather fine; the sutural interstice is more closely and rather more strongly punctured than the others. The fourth and sixth interstices have each two regular lines of punctures, the sixth having other punctures at the base. Below the shoulder there is a slightly elevated costa, marked with five or six distinct shining tubercles; and on the ninth interstice there is a longer series of similar tubercles.

Pedaria puncticollis, sp. n.

Elongato-oblonga, nigro-fusca, parum nitida; thorace convexo, haud tuberculato, creberrime fortiter punctato; elytris striatis, interstitiis primo et secundo irregulariter punctatis, reliquis biseriatim punctatis; carina brevi subhumerali, altera laterali tuberculis parvis instructis.

Long. $6\frac{1}{2}$ millim.

Hab. S. Africa, Nyassa?

The head is evenly and rather strongly punctured, with much less distinct punctuation on the clypeus; the clypeus has the angles of the emargination distinctly but slightly dentiform; halfway between this angle and the posterior angle there is a very slight sinuosity. The thorax is evenly convex, without any swelling in front, a little constricted at the base, arcuately narrowed at the anterior angles, evenly and strongly punctured; at halfway towards the side about seventeen punctures may be counted in a line from the front to the posterior margin; the punctures are deep, separated from each other by about one half the diameter of a puncture. The elytra have the striæ rather fine, with the punctures in them not very close together; the first interstice is rather closely punctured, the second is irregularly punctured for the basal half and then (like the other interstices) has two lines; these punctures are rather small, and leave a rather wide smooth space in the middle of the interstice; below the shoulder there is a line of about five small shining tubercles, and on the ninth interstice a longer line of more distant tubercles; these tubercles are visible when viewing the insect from above.

Aphengium.

I have just had an opportunity of examining the type of *Aphengium seminudum*, Bates (Biol. Centr.-Amer., Coleopt. ii. 2, p. 42), and it appears to have been placed in this genus by an oversight. In characterizing the genus Harold says, "Tarsorum posticorum articulus primus sequenti longitudine multo longior; pygidium rectum. Segmenta abdominalia connexa" (Col. Hefte, iii. p. 54). *A. seminudum* has the abdominal segments free; the pygidium is completely turned under, so that its apex is directed forwards, and Mr. Bates observes, "The short and broad, compressed and subtriangular tarsal joints are a remarkable distinguishing feature. The anterior cavity of the prosternum is exceedingly deep." These characters appear to me to conform more with *Bdelyrus*, Harold (Col. Hefte, v. p. 97), of which Harold says: "Clypeo antice angustato et breviter bidentato. Prosternum antice profundissime foveolatum. Segmenta abdominalia suturis distinctis. Pygidium contractum et abdomini appositum. Tarsi postici dilatati, compressi, articulis latitudine sensim decrescentibus." The clypeus has a projection in the middle, and in fresh specimens this is slightly bidentate; this seems to agree with Harold's character.

Uroxys Rodriguezi, de Borre.

This species is described by M. Preudhomme de Borre in the Ann. d. l. Soc. ent. de Belgique, 1886, p. 107, and he mentions that it is the "*Uroxys dilaticollis*, Deyrolle," a manuscript name. In the British Museum collection there is a specimen bearing this manuscript name, and it agrees well with the description of *U. Rodriguezi*. It appears to me, however, that it is a *Chœridium* having a short, punctured mesosternum and short anterior coxæ.

XLV.—*Notes on Slugs, chiefly in the Collection at the British Museum.* By T. D. A. Cockerell.

[Continued from p. 288.]

III. The Genus *Limacella*, Blainville.

While working on the slugs at the British Museum I came across the type specimens of *Limacella lactiformis*, Blainville. The two examples are in a bottle with the label "*Limacella lactescens*," and another label, apparently written by Dr. Heynemann, "Original zu Fig. 1. Taf. 7. Fér. Hist. Nat." They are true *Philomycus*, presenting no generic difference from the well-known species of that genus. Heynemann (1884) has referred them to *Arion*, but he could not have examined them sufficiently, and was no doubt misled by the figure in Man. de Mal. (1827), pl. xli. That they are really Blainville's types need not be doubted, as they agree with his figures in outline, and his original description, notwithstanding that he misunderstood the characters of the slug, is sufficient to show that he had not an *Arion* before him. He refers to the absence of a shell and the genital orifice at the base of the right tentacle. The outline of the figure, and especially the anterior portion of the mantle, suggests at once a *Philomycus*. The supposed *Arion*-like mantle indicated in the figures is really due to an outline of some of the internal organs, visible on account of the transparency of the slug. The figures in Journ. de Phys., November 1817, show how the mistake began, fig. 4 having even a sort of spiral coil in the middle of the anterior part of the mantle. The figure of *L. elfortiana* in Man. Mal. is the same outline, but apparently patched up from an *Arion ater*, with altogether fictitious rugæ on the back. Férussac's figure is after one of those in Journ. de Phys., and is fairly recognizable.

Altogether I think it must be held that Blainville described and figured his genus *Limacella* sufficiently for recognition, and as it antedates *Philomycus* by three years, the name must be used. *Limacella*, Brard, 1815, need not be considered, as it is identical with *Limax*, Linné, 1767. The synonymy of *Limacella*, Bl., will accordingly stand :—

LIMACELLA, Blainville.

1817. *Limacella*, Blainville, "Mém. sur quelq. Moll. Pulm." Journ. de Phys. Dec. 1817, p. 443 (text), and Nov. 1817, figs. 4, 5.
1820. *Philomycus*, Rafinesque, Ann. of Nat. p. 10.
1820. *Eumelus*, Rafinesque, Ann. of Nat. p. 10.
1824. *Meghimatium*, v. Hass. Bull. Univ. Sci. iii. p. 82.
1842. *Incilaria*, Bens. Ann. & Mag. Nat. Hist. ix. p. 486.
1842. *Tebennophorus*, Binney, Bost. Journ. Nat. Hist. iv. p. 171.
1864. *Pallifera*, Morse, Journ. Portl. Soc. i. 8, fig. 5, pl. iii. fig. 6.

It does not seem necessary to recognize more than one genus here, though v. Ihering (Nachr. d. m. Ges. 1889) recognizes three—*Philomycus*, *Pallifera*, and *Meghimatium*. *Pallifera* may be conveniently retained as a subgenus.

The species of *Limacella* are as follows :—

Limacella lactiformis, Blainv.

1817. *Limacella lactiformis*, Blainv. Journ. de Phys. Dec. p. 444.
1821. *Limacellus lactescens*, Férussac, Hist. Nat. Moll. pl. vii. fig. 1.
1825. *Limacella elfortiana*, Blainv. Man. de Mal. et de Conch. p. 464.

This appears to be distinct from any species since recognized. The British Museum types may be briefly described as follows :—42 millim. long; respiratory orifice 7 millim. from anterior border of mantle. Sole, lat. 7 millim. Entirely greyish white; mantle pellucid, semitransparent, finely granulose. Sole slightly ochreous, unicolorous. A distinct groove round the edge of the foot. Liver pale chocolate.

Gray in 1855 (Cat. Pulm. p. 158) has referred this species to *Philomycus*.

Limacella carolinensis (Bosc).

Limax carolinensis, Fér. Hist. 77, pl. vi. fig. 3.

There are two specimens of this species in the British Museum from Virginia (*Dr. J. Wyman*), agreeing excellently with Férussac's figure. This slug is cylindrical, curved, and *narrow* (in alcohol); *sole narrow*; ground-colour and colour of sole pale yellow, back thickly marbled with brown-grey, and with *two longitudinal series* of dark egg-shaped spots. Jaw bright-coloured, not ribbed. (Description from Brit. Mus. specimens.)

Dr. Gray (Brit. Mus. Cat.) also describes *L. carolinensis.*

Limacella nebulosa.

? *Eumelus nebulosus,* Raf. Ann. of Nat. 1820.
Tebennophorus carolinensis, Binney, Terr. Moll. U. S. vol. ii. p. 20.

This and the last have hitherto been included together under the one name *carolinensis,* and it is not without misgivings that I venture to separate them here *. Yet, from the specimens which I have examined, there would certainly seem to be a specific distinction between the northern and southern forms referred to *carolinensis* in the Eastern United States and Canada. The British Museum contains specimens of *nebulosa* as follows:—

(1) From Mr. W. G. Binney, labelled *T. carolinensis.*—Ochreous, marbled with black above, the marblings rather inclined to be in three longitudinal series. Sole unicolorous.

(2) W. Canada (*Dr. Maclagan*).—Pale yellow, marbled above with brownish grey, the markings being a broadish dorsal and narrower lateral brownish-grey bands, with irregular spots over the rest, except sides near foot. Sole unicolorous.

(3) Amhurstburgh, Canada West (*Dr. O. W. Maclagan*).—Like the last, but mottling grey and more diffuse; two narrow dorsal and narrowish lateral bands, rather obscurely indicated in grey. Grey mottling thicker. Ground-colour pale yellowish.

Comparing *carolinensis* with *nebulosa,* we note:—

(*a*) The Virginia *carolinensis.*—Sole narrow, yellowish, pale, without transverse striæ; body smoothish.

(*b*) *nebulosa,* no. 1 above.—Sole broad, brown, with strong transverse striæ; body rugose.

* Mr. W. G. Binney writes (*in litt.* Sept. 9, 1890):—"I am rather sceptical about there being two species . . . . as you say . . . .—there *is* a big species of *Tebennophorus* confounded with *carolinensis,* but having a ribbed jaw."

Or, taking measurements :—

(*a*) The Virginia *carolinensis.*—Long. 35 millim., sole, lat. 3 millim.

(*b*) *nebulosa*, no. 1 above.—Long. 35 millim., sole, lat. $7\frac{1}{3}$ millim.

(*c*) *nebulosa*, no. 2 above.—Long. 36 millim., sole, lat. 8 millim.

Rafinesque described five supposed species belonging to *Philomycus* and *Eumelus* in 1820 as *quadrilus*, *oxurus*, *flexuolaris*, *fuscus*, and *lividus*. They will probably prove to be varieties of *nebulosa* or *carolinensis*, but they have not yet been identified.

Limacella aurata (Tate).

A little-known species from Nicaragua.

Limacella crosseana (Strebel).

Mexico. Seems near to *L. carolinensis*.

Limacella costaricensis (Mörch).

Costa Rica.

Limacella Sallei (Cr. & Fisch.).

Mexico, State of Vera Cruz.

Limacella dorsalis (Binney).

Philomycus dorsalis, Binney, Bost. Journ. Nat. Hist. 1842, iv. 174.
Pallifera dorsalis, Morse, Journ. Portl. Soc. 1864.

N.E. United States. Jaw ribbed.

Limacella Wetherbyi (W. G. Binney).

Pallifera Wetherbyi, W. G. Binney, Ann. Lyc. of Nat. Hist. of New York, 1874, xi. 31, pl. ii. figs. 1, 2.

Kentucky. Jaw ribbed.

Limacella Hemphilli (W. G. Binney).

Tebennophorus Hemphilli, W. G. Binney, Man. Amer. Land-Shells, 1885, p. 247; Third Suppl. Terr. Moll. U. S. 1890, pl. vi. fig. H.

Georgia and North Carolina. Jaw ribbed.

Limacella australis (Bergh).

Oahu, Sandwich Islands. Jaw ribbed.

Limacella confusa, sp. nov.

Limacella bilineata (Kef. et auctt. plur. (non Bens.) sp., as *Philomycus*, &c.).

Very close to *L. nebulosa*, at least externally. Long. 34 millim., sole, lat. 6 millim., respiratory orifice 6 millim. from anterior border. Head and sole pale yellow, unicolorous; sole finely transversely wrinkled all over. Mantle rather rugose, ground-colour pale yellowish, clouded with brown-grey dorsally, with also numerous dorsal dark spots, tending to form oblique lines running centrally backwards. Sides with broad black bands and dark marbling below them. Jaw not ribbed.

The above description is from a specimen in the British Museum labelled "Challenger coll., May 1875, Yokohama, Japan." It is the so-called *bilineatus*; it is like v. Martens's figure of that species copied by Tryon. W. Keferstein (Mal. Blätt. 1866) figures *L. striata* and *L. confusa* (as *P. bilineatus*), the latter from Yokohama, with the anatomy. The anatomical characters of *confusa* offer differences from those of the American *nebulosa*, so that, apart from their geographical ranges being distinct, they need not be confused.

Limacella formosensis, subsp. nov.

Length 33 millim., sole 4 millim. broad; respiratory orifice 5 millim. from anterior border of mantle. Elongate-cylindrical, slightly tapering, dark coffee-colour; sole unicolorous, transversely thickly but finely granulose-wrinkled; back with an ill-developed, median, narrow black band, and better-developed, narrow, black lateral bands in the situation of the upper edge of the bands of *L. confusa*; area between the bands (subdorsal) slightly dark-marbled. Sides below lateral bands dark-marbled, with a slight tendency towards the formation of a lower second lateral band. Face with two longitudinal grooves. Back granulose.

Described from two alcoholic specimens in the British Museum, collected in Formosa and presented by Matthew Dickson.

I was at first inclined to regard this as a geographical race of *confusa* (=*bilineata*, auctt., non Bens.) (which has been recorded from Formosa *), and as I have not examined the jaw, I cannot yet be certain whether it belongs with that species or true *bilineata*. However, *bilineata* is found in the Chusan Islands; so it becomes highly probable that the Formosa form has a ribbed jaw and is allied thereto.

L. formosensis differs externally from *confusa* in its colour and markings, but resembles it in its tuberculose sole. *L. formosensis* compared with the Chusan *bilineata* does not seem specifically different so far as external characters go.

Limacella campestris (Godw.-Aust.).

Limacella bilineata, subsp.
Philomycus (*Incillaria*) *campestris*, Godw.-Aust. Journ. As. Soc. Beng. xlv. pt. 2, p. 315, pl. viii. fig. 3 (1876).

Ochraceous yellow, with an obscure dorsal and lateral pale brown bands, narrow and more or less interrupted. Sole finely laterally transversely wrinkled. Length 23 millim., respiratory orifice 4 millim. from anterior border of mantle; sole 4 millim. broad.

Shape of slug cylindrical, tapering posteriorly. Jaw pale, ribbed.

Differs from *confusa* in its non-tuberculose sole and different markings and its ribbed jaw.

Described from five specimens in the British Museum from Dukhun (*Col. Sykes*).

Although Godwin-Austen gives but a short description and rather indifferent figure of his type of *campestris* from Kholabari, and says nothing about the jaw, I think there can be no reason for considering our Dukhun form distinct from *campestris*, since, so far as we know, there is not any important difference between them. Should the type of *campestris* be found later on not to have a ribbed jaw, it will be time to propose a new subspecific name for the slugs described above. The discovery of a group of *Limacella* with ribbed jaw in Asia is very interesting and tends to endorse the opinion that this is not a generic character.

* See Heynemann, 'Die nackten Landpulmonaten des Erdbodens,' 1885, p. 66.

Limacella bilineata (Bens.).

Incilaria bilineata, W. H. Benson, Ann. & Mag. Nat. Hist. 1842, ix. p. 486.

Length 26 millim., sole 4 millim. broad. Respiratory orifice 4 millim. from anterior border of mantle. Colour reddish brown. Back with obscure grey marbling, sides with a broadish black band. Sole finely transversely striate-grooved. Mantle rugose. Jaw dark, strongly curved, with about sixteen ribs.

L. bilineata differs from *L. confusa* in its non-tuberculose sole, the lines on the top of the neck diverging between the eye-peduncles, the ground-colour, partly in the markings, and in the jaw.

But for its ribbed jaw it might be thought specifically identical with *confusa*.

Described from a specimen in the British Museum marked "Chusun [apparently so written, but presumably meant for Chusan], on garden-fences; ash, with dark lines lengthwise."

Benson's type was a similar specimen from Chusan.

Limacella monticola (Godw.-Aust.).

Philomycus monticolus, Godw.-Aust. Journ. As. Soc. Beng. xlv. p. 315 (1876).

From Godwin-Austen's short description this would appear to be a quite distinct species.

Limacella chinensis, sp. nov.

Length 17 millim., respiratory orifice $2\frac{1}{2}$ millim. from anterior border of mantle; sole 2 millim. broad. Colour pale grey, sole ochreous anteriorly. Three pale brown bands on mantle—one dorsal, faint; lateral ones rather stronger; all narrow. Some slight marbling round respiratory orifice. Sole with lateral, transverse, grooved striæ.

A small cylindrical species, tapering posteriorly. Smoother and more delicate than *L. confusa*.

Described from a specimen in the British Museum, collected 1300 miles up the Yang-tse River, China (Consul Swinhoe's collection).

Apparently a distinct little species, but more material is very desirable. Judging from the published account of *picta*, it resembles that species.

Limacella striata (Hass. 1824).

Hab. Java.

See Bull. Soc. Nat. iii. p. 82, 1824, and also Férussac, Hist. Moll. ii. p. 96[5], pl. 8 E. fig. 1 (as *strigatum*), and W. Keferstein, Mal. Blätt. xiii. p. 64, pl. 1. figs. 1–4 (1866).

Limacella picta (Stol.).

Meghimatium pictum, Stol. Journ. As. Soc. Beng. xlii. pt. 2, p. 30.

Hab. Island of Penang.

Limacella reticulata (Hass., Fér.).

A doubtful species.

Limacella cylindracea (Fér.).

Meghimatium cylindraceum, Fér. Hist. Moll. pl. 8 F. figs. 8, 9.

A very doubtful species. In the figure the mark where the respiratory orifice should be looks more like an injury.

IV. Descriptive Notes on Various Species.

Under this head I will note a few species belonging to genera which will not be specially reviewed in the present series of papers.

"*Arion*" *aterrimus*, Gray.

Arion aterrimus, Gray, Cat. Pulm. 1885, p. 55.

Length 36 millim.; mantle, length 22 milllim.; respiratory orifice 8 millim. from anterior border of mantle; sole 11 millim. broad. Entirely black, mantle granulose, tuberculate anteriorly, oval, produced and bluntly angled behind; body smoothish, with linear grooves from mantle to foot, about 2 millim., more or less, apart. Body not keeled. Tail flattened, mucus-pore inconspicuous or none. Sole apparently undifferentiated into parts. Edge of foot sulcate.

This description is from an alcoholic example in the British Museum marked "*Limax* (*Arion*) *allerian* [sic], S. Africa." There can hardly be a doubt that it is Gray's *A. aterrimus*, although the description in Cat. Pulm. is so very short.

It is interesting to be able to redescribe this slug, as it has been a lost species, not recognized by subsequent authors. It is surely not an *Arion*, and it may represent a new genus, unless it belongs to Mörch's *Oöpelta*, with which it seems to agree externally so far as generic characters go. But until the jaw and lingual dentition of *A. aterrimus* are known it will be impossible to be certain of its proper position.

Ariunculus Moreleti (Hesse).

Length 13 millim., breadth 2½ millim. Head dark brown. Mantle dark brown, faintly mottled with black lateral bands, bordered above by pale bands, and continuous with those on body; respiratory orifice a little anterior to middle. Body pale grey at sides, with dark lateral bands and dark subdorsal bands, four in all, leaving pale dorsal and subdorsal narrow bands between them. Sole broad and grey.

Described from a specimen kindly sent to me by Mr. J. H. Ponsonby, collected at Tangier some years ago. It differs a little from the original description, but is evidently the same species.

Pollonera has recently placed this species in *Geomalacus*, subg. *Letourneuxia*.

Testacella albida.

1885. *Testacella haliotidea*, v. *scutulum* (pars), Taylor and Roebuck, Journ. of Conch. iv. April, p. 320. (*Hab.* Gibraltar.)
1885. *Testacella haliotidea*, v. *scutulum*, subv. *albida*, Cockerell, Sci. Goss. October, p. 225. (*Hab.* Gibraltar.)
1887. *Testacella*, sp., Ponsonby, Journ. of Conch. v. July, p. 195. (*Hab.* Gibraltar.)
1888. *Testacella*, probably *haliotidea*, Taylor, Journ. of Conch. v. July, p. 346. (*Hab.* Gibraltar.)
1888. *Testacella*, sp., Pollonera, Boll. Mus. Zool. An. Comp. Torino, p. 6, figs. 10, 11. (*Hab.* Olot, Spain.)

The dried type of *T. albida*, collected by the Rev. J. W. Horsley at Gibraltar, is as follows:—

Length 15½ millim.; sole 3 millim. broad; dorsal longitudinal grooves about 2⅜ millim. apart, oblique grooves well marked. Sole separated from body by a groove and with transverse grooves at intervals, well marked at sides. Nucleus of the shell gone (broken or eroded). Shell pale horn, growth-ridges strong. Length of shell 4 millim.

The other white *Testacella* recorded from Spain (by Pollonera) is placed here, although the Gibraltar shell is narrower anteriorly than Pollonera's figure. It is not very likely that these white specimens are more than a varietal form of *haliotidea* or some allied species; but as they do not agree exactly with anything known to me I place them provisionally as a species, *T. albida*. Moquin-Tandon's *T. haliotidea*, var. *albinos*, does not appear to be identical with the Spanish *albida*.

The type specimen of *albida* is now in the British Museum.

Vaginula olivacea (Stearns).

Veronicella olivacea, Stearns, Proc. Bost. Soc. Nat. Hist. 1871.

Length 45 millim., breadth 18 millim., sole $5\frac{1}{2}$ millim. broad.

Finely granulate above, blunt-squarish behind. Above dull ochrey, indistinctly and minutely marbled with grey; a pale dorsal line is slightly indicated on posterior half. Superior tentacles (eye-peduncles) bluish grey; inferior tentacles pale ochrey, concolorous with head and underside of body. Jaw brown; I counted about eighteen ribs without removing it from the animal.

Described from a specimen sent to me by Mr. W. G. Binney, collected in Nicaragua. The Californian locality quoted for this species is surely rather doubtful; probably the specimen found was accidentally introduced. Is it not possible that *olivacea* and *occidentalis* (Guild.) are different forms of the same species?

Hyalimax (*Jarava*) *andamanicus*, Godw.-Aust.

A specimen in the British Museum, which appears to be typical, is labelled "Andaman Is., Dr. J. Anderson." It has the mantle strongly convex; the colour is yellowish white, without markings; foot slightly orange-tinged.

Hyalimax andamanicus, var. *punctulatus*, var. nov.

Yellowish white; foot slightly orange-tinged. Minute grey specks on mantle and grey streaks on hind part of body.

Hab. Andaman Islands (*Dr. J. Anderson*; Brit. Mus., in bottle with type).

The mantle of this specimen is flattish, so that the outline of the slug is greatly depressed compared with the typical one. The jaw does not seem quite like that figured by Godwin-Austen for the type; but I was not able to sufficiently examine it. It seemed to me that it had some sort of central projection. It is possible that *punctulatus* may be a distinct species; but there is not yet sufficient evidence for classing it as such.

Chlamydephorus Gibbonsi, W. G. Binn.

Length 47 millim., orifice $7\frac{1}{2}$ millim. from posterior extremity. Sole not differentiated into parts, smoothish, 5 millim. broad. Tentacles (eye-peduncles) pale bluish grey. Colour pale yellowish, becoming dark grey on back, with more or less of a pale dorsal line of ground-colour. Reticulations polygonal, with the interstices minutely subdivided. Sole slightly transversely grooved. Mantle none.

Described from a specimen in the British Museum from Cape Colony (*F. P. M. Weale*).

Apera, the name proposed by Heynemann for this genus, will probably have to be used. *Chlamydophorus* (Harl.) was proposed for a genus of Mammalia as early as 1825.

[To be continued.]

3 Fairfax Road, Bedford Park, Chiswick, W.,
September 16, 1890.

XLVI.—*A List of the Species of* Achatina *from South Africa, with the Description of a new Species.* By Edgar A. Smith.

In the endeavour to identify the new form hereafter described it was necessary to find out what species were already known from the region where it was discovered. In doing this it appeared that it would be useful to get together a list of all the forms known to occur in the southern portion of the African continent. This I have done, arbitrarily limiting the area on the north at the 20th parallel.

Already as many as eighteen species have been described, and doubtless this number eventually will be increased considerably when this region, and especially the mountainous parts, has been more completely explored.

A number of the *Achatinæ* from various parts of Africa seem to differ only very slightly from allied forms, and it may fairly be anticipated that the separation of species will become more and more difficult through the discovery of intermediate forms in parts hitherto unexplored.

1. *Achatina semidecussata*, Menke.

Achatina semidecussata, Menke, Philippi, Abbild. vol. ii. p. 213, pl. i. fig. 1; Pfeiffer, Conch.-Cab. ed. 2, p. 336, pl. xxvii. figs. 2, 3.

Hab. Natal (*Menke and Brit. Mus.*).

2. *Achatina vestita*, Pfeiffer.

Achatina vestita, Pfeiffer, Novit. Conch. vol. i. p. 35, pl. ix. figs. 8, 9.

Hab. Port Natal (*Pfr.*); near Delagoa Bay (*Brit. Mus.*).

3. *Achatina granulata*, Pfeiffer.

Achatina granulata, Pfeiffer, Mon. Hel. vol. iii. p. 484.

Hab. Natal (*Pfr. and Brit. Mus.*); Cape (*Semper*).

A. semigranosa, Pfeiffer (Mon. Hel. vol. vi. p. 216), I regard merely as the young of *A. granulata*.

4. *Achatina varicosa*, Pfeiffer.

Achatina varicosa, Pfeiffer, Mal. Blätt. 1861, p. 73, pl. ii. figs. 7, 8; Novit. Conch. vol. iii. p. 490, pl. cvi. figs. 1, 2.

Hab. Enon, north of Port Elizabeth (*Pfr.*).

5. *Achatina bisculpta*, Smith.

Achatina bisculpta, Smith, Quart. Journ. Conch. vol. i. p. 349.

Hab. South Africa.

This species, also *A. albopicta*, *A. zebroides*, *A. dimidiata*, *A. simplex*, and *A. transvaalensis*, published in 1878, are omitted from the 'Zoological Record' of that and subsequent years.

6. *Achatina damarensis*, Pfeiffer.*

Achatina dammarensis, Pfeiffer, Malak. Blätt. 1870, vol. xvii. p. 31; Novit. Conch. vol. iv. p. 2, pl. cix. figs. 3, 4.

Hab. Damara Land (*Pfr.*).

7. *Achatina Crawfordi*, Morelet.

Achatina Crawfordi, Morelet, Journ. de Conch. 1889, p. 8, pl. i. fig. 3.

Hab. Near Port Elizabeth, Cape Colony (*Morelet*).

* All the species, with the exception of this and the two following, are in the British Museum.

8. *Achatina Smithii*, Craven.

Achatina Smithii, Craven, Proc. Zool. Soc. 1880, p. 617, pl. lvii. fig. 1.

Hab. Leydenburg, Transvaal (*Craven*).

I had the honour of having a second species of this genus associated with my name last year by Mr. G. B. Sowerby (Proc. Zool. Soc. 1889, p. 579, pl. lvi. fig. 3). It is a small form, but belongs to the true *Achatinæ*. The name being preoccupied I propose to substitute that of *A. Sowerbyi*. *Achatina Sowerbyana*, Pfeiffer, is a species of *Glandina*.

9. *Achatina transvaalensis*, Smith.

Achatina transvaalensis, Smith, Quart. Journ. Conch. vol. i. p. 351.

Hab. Eastern slope of the Drakensberg, at Leydenburg Gold-fields, Transvaal (*Smith*); not rare at Leydenburg (*Craven*).

10. *Achatina natalensis*, Pfeiffer.

Achatina natalensis, Pfeiffer, Proc. Zool. Soc. 1854, p. 294; Monog. Hel. vol. iv. p. 602.

Hab. Port Natal (*Pfr. and Brit. Mus.*); near Delagoa Bay (*Brit. Mus.*).

11. *Achatina simplex*, Smith.

Achatina simplex, Smith, Quart. Journ. Conch. vol. i. p. 350.

Hab. Port Natal.

12. *Achatina Burnupi*, sp. n.

Hab. The Drakensberg, north of Natal, at 5000 to 6000 feet.

13. *Achatina dimidiata*, Smith.

Achatina dimidiata, Smith, Quart. Journ. Conch. vol. i. p. 348.

Hab. Eastern slope of the Drakensberg, at Leydenburg Gold-fields, Transvaal (*Smith*); not rare at Leydenberg (*Craven*).

14. *Achatina zebra* (Chemnitz).

Achatina zebra (Chemnitz), Reeve, Conch. Icon. vol. v. pl. vii. fig. 23; Pfeiffer, Conch.-Cab. ed. 2, pl. ii. fig. 3.

Hab. George District, Cape Colony, and Natal (*Krauss*); Caffraria (*Reeve*).

A. obesa, Pfeiffer, said to be from "West Africa," is probably only a stunted form of this species.

15. *Achatina aurora*, Pfeiffer.

Achatina aurora, Pfeiffer, Proc. Zool. Soc. 1854, p. 294; Monog. Hel. vol. iv. p. 602.

Hab. Port Natal (*Pfr.*).

16. *Achatina planti*, Pfeiffer.

Achatina planti, Pfeiffer, Novitat. Conch. vol. ii. p. 160, pl. xliii. figs. 1, 2.

Hab. Cape Natal (*Pfr.*).

17. *Achatina ustulata*, Lamarck.

Achatina ustulata, Lamarck, Reeve, Conch. Icon. pl. xii. fig. 40; Férussac, Hist. Nat. Moll. pl. cxxv. figs. 1, 2.

Hab. George District, Cape Colony (*Krauss*).

18. *Achatina Kraussi*, Reeve.

Achatina Kraussi, Reeve, Conch. Icon. pl. vi. fig. 21; Pfeiffer, Conch.-Cab. ed. 2, p. 329, pl. xxiii. fig. 2; Krauss, Südafr. Moll. p. 81.

Hab. On the right bank of the Koega River, near Algoa Bay (*Krauss*).

This species, according to Krauss, is not found in Natal, as stated by Reeve.

19. *Achatina immaculata*, Lamarck.

Achatina immaculata, Lamarck, Férussac, Hist. Nat. Moll. pl. cxxvii.; Pfeiffer, Mon. Hel. vol. iv. p. 600.

Hab. Cape Delagoa (*Pfr.*); Port Natal and Zulu country (*Brit. Mus.*).

Description of the New Species.

Achatina Burnupi.

Testa elongato-ovata, subtenuis, epidermide nitida, flavo-olivacea induta, hic illic strigis saturatioribus ornata, prope suturam flava, et circa medium anfr. ultimi zona obscura cincta; anfractus 8, leviter convexi, superiores granulati, ultimus elongatus, lævis, lineis incrementi paulo obliquis striatus, antice vix descendens; apertura inverse auriformis, intus pallide cærulescens, opalescens, longit. totius $\frac{1}{2}$ æquans; columella rectiuscula, antice oblique truncata, callo tenui albido induta.

Longit. 71 millim., diam. 39; apertura 35 longa, 18 lata.

This is a rather slender species, in general proportions somewhat resembling Reeve's representation of *Bulimus Thompsoni* (Conch. Icon. pl. xxiv. fig. 158). It is moderately thin and clothed with a yellowish-olive glossy epidermis, exhibiting at short intervals oblique streaks of a darker tint and close to the suture becoming decidedly yellow, so that the upper edge of the last whorl appears to be bordered with that colour. The three uppermost volutions, which have lost the epidermis, are pale brown. All the whorls excepting the last are sculptured with spiral and oblique striæ, forming a rather fine granulation. The body-whorl is rather long and ornamented only with lines of growth which are well marked and slightly puckered at the suture. A faint band is noticeable just above the middle, and several other transverse lines parallel with it are also observable on close inspection.

This species resembles *A. simplex*, Smith, in the absence of colour-markings and in the size of the apical whorls, but differs entirely in its more elongate form. This is particularly apparent in the body-whorl and aperture.

The above description is based on a single specimen recently presented to the British Museum by Colonel J. H. Bowker. It was collected on the Drakensberg, north of Natal, at an elevation of 5000 to 6000 feet, by Mr. Henry E. Burnup, after whom I have named the species.

XLVII.—*Summary of Researches into the Anatomy and Histology of Nemertines, with Contributions to their Classification.* By Dr. Otto Bürger *.

Nemertines used to be commonly classed with the Platyhelminthes, and thus brought into the closest relationship with the Turbellaria; only a small number of authors, among whom von Siebold † must be mentioned, placed them at an early period among the Annelids. M'Intosh, however, was one of those who held this view, to which he gives expression in prefixing to the whole of his monograph the title 'The British Annelids.—Part I. Nemerteans.' Yet it is only within the last ten years that the views with regard to the proper position of the group have undergone a more extensive

* Translated from the 'Zeitschrift für wissenschaftliche Zoologie, Bd. L. Hefte 1 and 2, June 1890, pp. 248–260; whole paper, *ibid.* pp. 1–277, with ten plates and twelve woodcuts in the text.

† V. Siebold, 'Lehrbuch der vergleichenden Anatomie,' 1848.

change, owing to the recognition of a metameric arrangement in certain organs in the middle and posterior portion of the body in some more highly organized Nemertines.

To Hubrecht must be ascribed the honour of having demonstrated the existence of septa in the region of the intestinal cæca, instead of the uniform development of the gelatinous matrix, the parenchyma, in which all the organs are imbedded. This indefatigable investigator of Nemertine anatomy was likewise unremitting in his insistence on the constant relations shown in the arrangement of intestinal cæca, septa, blood-vascular loops, and, lastly, even of the proboscis-sheath.

The immediate object of all this was finally to sever the connexion between the Nemertines and the Turbellarians, and to enrol them among the Annulata. According to the old-established classification the Nemertines were completely merged in the Turbellarians, of which they were merely recognized as suborders.

Hubrecht, however, did not stop at this, but sought to establish relations between Nemertines and Vertebrates. In this direction I cannot follow him. Far-reaching speculations are permissible and justifiable only after an exhaustive study of the embryology of the form in question; and in this respect my work is completely wanting.

Yet it has seemed to me that it may be interesting to compare the various systems of organs, as we have learnt to know them in the forms we have examined, with those of the Nemertine genera not treated of in these pages, casting at the same time a passing glance in the direction of the Turbellarians and the Annelids.

Nemertines one and all possess a ciliated ectoderm. This either carries the whole of the gland-cells of the integument, and in this case rests on an almost structureless layer of connective-tissue, a so-called basement-membrane, or a portion of the gland-cells sink into the connective tissue, and we get a cutis, which is often rich in muscle-fibres. The first of these conditions is met with in all forms having a stylet in the proboscis, the Enopla, as also in *Carinella*, and, according to Hubrecht, in *Carinina*, *Carinoma*, and probably, too, in *Cephalothrix*. We find that a double layer of gland-cells, on the other hand, is characteristic of *Eupolia*, *Cerebratulus*, and *Langia*; but, from the works of M'Intosh and Hubrecht, we may conclude that it is present in *Valencinia*, *Lineus*, and *Borlasia* also.

The development of a cutis is manifestly followed by highly important changes, as exemplified in the appearance of an outer longitudinal muscular layer, of the subepithelial muscle-layers, and the formation of a muscular tissue at the cephalic extremity, where, in the case of *Carinella*, we found a parenchyma, which persists in the Enopla also. Moreover, we find these forms provided with cephalic glands, not present in *Carinella*, and probably likewise absent in its allies. A cephalic gland is characteristic also of the Enopla; and with regard to this group we may make the same observation as in the case of that to which *Eupolia*, *Cerebratulus*, &c. belong, viz. that the cephalic gland remains small in forms which, judged by the development of their nervous system, sense-organs, and cephalic grooves, must be regarded as the higher, such as *Drepanophorus* and *Amphiporus*, as also *Cerebratulus* and *Langia*; but that in *Tetrastemma*, *Prosadenoporus*, and *Geonemertes*, on the contrary, as in the more primitive *Eupolia*, it has undergone a colossal development.

The musculature of the body-wall is precisely similar in structure in the case of the first group, in which I unhesitatingly include *Carinella*, *Carinina*, and *Carinoma*—I would prefer not to come to any decision as to the position of *Cephalothrix*, although I am inclined to assign it to the first group—and in that of the third, which embraces the Enopla, and consists of a circular, a diagonal, and a longitudinal layer. In the second group, which includes the remaining forms unprovided with a stylet in the proboscis (*Valencinia*, *Eupolia*, *Lineus*, *Borlasia*, *Cerebratulus*, and *Langia*), we find that the musculature of the body-wall consists of a longitudinal, diagonal, circular, and longitudinal layer. The entirely different position of the diagonal muscular layer in Group II. as compared with Groups I. and III. is most remarkable.

We have recognized the inner circular muscle-layer of Group I. as not belonging to the musculature of the body-wall, and have homologized it with the dorso-ventral system which appears in the metamerized forms of Groups II. and III., and which we have derived from the circular layer in question.

None of the groups is without a system of radial muscles, the tracts of which split up the layers of the body-wall, dividing them into compartments.

In its ciliated epithelium, the manifold gland-cells thereof, and the development of the deeper system of gland-cells lying beneath the basement-membrane, the integument of the Nemertines exhibits an unmistakable resemblance to that of the Turbellarians.

The musculature of the body-wall of the Rhabdocœla *

* V. Graff, 'Monographie der Turbellarien.—I. Rhabdocœlida,' 1882.

displays a marked conformity with that of Groups I. and II. in that it likewise consists of circular and longitudinal layers of fibres, in addition to which, in the case of many Rhabdocœla, we also have a diagonal layer, lying between the two former. Much more complicated is the musculature of the body-wall in the Polyclads, in which, according to Lang *, as many as six layers may be present, arranged in the following order:—circular, longitudinal, diagonal, circular, diagonal, longitudinal. In this case also it is at once evident that only the internal layer of diagonal fibres has to disappear in order that we may get the arrangement of the muscle-layers found in Group II., and in *Cerebratulus* in particular.

I have alluded to the fact that the integument, and especially the ectoderm, is composed of fibrillar and gland-cells, exactly like the hypodermis of the Annelids, among which I should like to see the Gephyreans included. It remains to be added that the ectoderm of Nemertines is clothed by a cuticle, which may be provided with cilia in places. As a general rule a cutis is not present in the Annelids; yet in the case of *Sipunculus nudus*, for example, this has recently been described by Andreæ †, who states that it contains pigment-masses and gland-cells. The phenomena presented by the hypodermis of the Annelids and the ectoderm of the Nemertines at the time of sexual maturity are very remarkable; in both cases the naked gland-cells swell up to a large size, almost entirely filling up the epidermis around the genital apertures (clitellum of the Earthworms, porophore of the Capitellidæ) ‡. The musculature of the body-wall of the Annelids is allied to that of Groups I. and III., since it consists of a circular and a longitudinal layer. If we neglect the fact that the diagonal layer, which is stated by Andreæ to lie in *Sipunculus* between these two muscle-layers, does not entirely agree in structure with that of the Nemertines, the musculature of the body-wall of a *Carinella* or a *Drepanophorus* would be essentially the same as that of the Gephyrean.

In all Nemertines the parenchyma is developed to its utmost extent, and the organs are consequently imbedded in a gelatinous tissue. In the case of Groups II. and III. this tissue is arranged in septa in the region of the mid-gut, and

* Lang, "Die Polycladen des Golfs von Neapel" (Fauna und Flora des Golfs von Neapel), Monographie, xi. 1884.

† J. Andreæ, "Beiträge zur Anatomie und Histologie des *Sipunculus nudus*," Zeitschrift für wiss. Zoologie, Bd. xxxvi.

‡ Eisig, "Monographie der Capitelliden des Golfs von Neapel," Fauna und Flora des Golfs von Neapel, xvi. 1887.

at the same time a cleft appears on each side between intestine and parenchyma (*Cerebratulus marginatus* and *Drepanophorus serraticollis*). This cleft is interrupted at the points at which the extremities of the intestinal cæca come in contact with the septa, and also where those plates which include the genital sacs and the dorso-ventral muscle-bands touch the axial portion of the intestine. This cleft was pronounced by Salensky *, who determined its existence in *Monopora vivipara* and *Eupolia aurita*, to be a cœlom. Salensky finds that it is bounded by a somatic and splanchnic membrane.

The Turbellaria are devoid of cavities of this kind lying between the tissue of the body and the intestine. On the other hand, muscular septa are present, and in this respect the elongated *Gunda segmentata* † is especially worthy of notice, since in it the lateral unbranched intestinal cæca are regularly separated from one another in this way. In the other direction, however, the pronounced metameric arrangement of the septa in Nemertines leads us to the Annelids, and to the Hirudineæ in particular, in which, while a body-cavity is non-existent, muscular septa are developed.

The alimentary canal of the Nemertines exhibits two divisions, which are both histologically and morphologically well marked off from one another: these are, the fore-gut, which is devoid of cæca in all forms, but is lined by a richly glandular epithelium, and the mid-gut, which in the two last groups is provided with metamerically arranged paired evaginations, but is without glands. The intestinal cæca decrease gradually in size towards the posterior extremity of the animal, and finally we get a little short piece of intestine, straight and without glands, which we are able to distinguish as rectum, but which nevertheless in the character of its epithelial lining does not differ from the mid-gut. It is therefore doubtful whether, without referring to embryology, we are entitled to speak about a proctodæum in the case of the Nemertines. The mouth is always ventral in Groups I. and II., behind or beneath the ganglia, and opens into an expanded, bell-shaped, pharyngeal cavity—in the case of Group III. in front of the ganglia—which in its turn opens into a narrow œsophagus. The mouth does not always open independently to the exterior, but more often unites with the aperture of the proboscis-sheath. In *Monogonopora* and also in *Prosadenoporus* the œsophagus opens into the proboscis-

* Salensky, "Zur Entwickelungsgeschichte v. *Borlasia vivipara*," Biol. Centralbl. ii. Jahrg.

† A. Lang, "Der Bau von *Gunda segmentata*," Mitth. a. d. Zool. Station zu Neapel, Bd. iii. 1881.

sheath—in the latter case at some distance from its exterior aperture. The same thing very probably occurs in *Geonemertes palaensis*, only in this case the opening of the alimentary canal is carried right to the anterior extremity, so that, as a matter of fact, the apertures of mouth and proboscis coincide. In *Malacobdella*, however, the proboscis-sheath opens into a peculiar cavity, which is provided with villi, and must be regarded as a veritable pharynx. Von Kennel * would have us believe that the cavity of the proboscis-sheath opens into the mouth in *Geonemertes palaensis* also; but it appears to me, according to the figure which the author gives, that the condition is precisely the same as in *Monogonopora* and *Prosadenoporus*, that is to say that the œsophagus opens into the most anterior portion of the cavity of the proboscis-sheath. The anus, which is never absent, is always terminal.

Von Graff †, too, asserts that the proboscis-sheath in *Geonemertes chalicophora* opens into the mouth. But on referring to Taf. xxvi. fig. 7, of the work in question, we see quite clearly that the œsophagus opens into the proboscis-sheath at a considerable distance from the external aperture of the latter; it *curves distinctly upwards*, and the opening of the proboscis—of the mouth according to von Graff—is almost exactly terminal in this form, whereas it should be ventral if it were the mouth-opening. In all respects the structure presents the appearance of a prolongation of the proboscis-sheath.

In the intestine of the Nemertine we have the type of that of the Annelid. If, however, we attempt a comparison with the intestinal tract of a Turbellarian, even though we select *Gunda segmentata* for the purpose—a form distinguished by the possession of a straight unbranched intestine, which is provided with a regular series of cæcal evaginations and opens into a mouth placed at the extreme anterior end of the body —we nevertheless unavoidably fail; for the intestine of our Turbellarian, however far it may have diverged in development from the radially-branched organ of the Polyclad, in the direction of that of the Nemertine, is devoid of an anus.

According to Hubrecht ‡ and Max Müller § the proboscis

* Von Kennel, "Beiträge zur Kenntnis der Nemertinen," Arbeiten aus dem Zool. Inst. zu Würzburg, Bd. iv. 1877.

† Von Graff, "*Geonemertes chalicophora*, eine neue Land-nemertine," Morphol. Jahrb. Bd. v. 1879.

‡ Hubrecht, 'Report of the Scientific Results of the Voyage of H.M.S. 'Challenger,' 1873–1876,' Zool. vol. xix. Nemertea, 1887.

§ Max Müller, 'Observationes Anatomicæ de Vermibus quibusdam maritimis,' Berolini, 1852.

in the first two groups is provided with nematocysts (we were able to determine the presence of rhabdites only), in the third, with the exception of the parasitic *Malacobdella*, it is armed with stylets. The proboscis varies in structure in Groups I. and II., and even in the arrangement of the layers of its wall we find important variations between a *Eupolia* and a *Cerebratulus*. The proboscis of *Carinella* is composed of a circular and a strong longitudinal muscle-layer, while that of *Eupolia* shows the opposite arrangement of a longitudinal and a circular layer. In *Cerebratulus*, again, we find that the proboscis repeats the structure of the musculature of the body-wall, and we get a longitudinal, a circular, and a longitudinal muscle-layer. In *Carinella* the nerves of the proboscis adjoin the circular muscle-layer, but in the case of *Eupolia* the longitudinal layer, and in this the nerve-tissue exhibits a condition which, so far as my own experience goes, is only repeated in the proboscis of the Enopla, viz. that the nerve-mass is not adjacent to a circular muscle-layer, as it otherwise is in all our species, be they those of *Carinella*, *Eupolia*, *Cerebratulus*, *Drepanophorus*, &c., wherever we find that the nerve-mass has a constant position, whether in the form of a nerve or of a nerve-sheath. In the proboscis of *Cerebratulus* the nervous plexus, derived from the expansion of the two nerve-cords, adjoins the circular muscle-layer on the inner side. The proboscis of the Enopla exhibits a precisely similar structure, consisting of circular, longitudinal, and circular layers. The nerve-cords are imbedded in the longitudinal muscle-layer, dividing it into two sheets. The aperture of the proboscis-sheath, however, is not, as has often been assumed to be the case, terminal in position; on the contrary, it is in all forms subterminal and ventral. This is clearly expressed even in *Carinella*, where the tip of the head projects beyond the aperture of the proboscis-sheath. Another organ, however, the cephalic gland, does open terminally to the exterior.

A comparison has been suggested between the proboscis of Nemertines and the so-called proboscis of the Turbellaria Proboscidea, a terminally placed retractile and extensile sense-organ. Yves Delages * and Salensky † are among the more recent advocates of this theory. In opposition to this we may repeat once more that the aperture by which the Nemertine proboscis is extruded is by no means terminal,

* Yves Delages, "Études histologiques sur les Planaires Rhabdocœles Acœles," Arch. de Zool. expériment. et génér. sér. 2, t. iv. 1886.

† Salensky, "Bau u. Metamorphose d. Pilidiums," Zeitschr. für wiss. Zoologie, Bd. xliii. 1886.

but that the spot where the proboscis of *Convoluta Schulzii*, for example, is placed, is occupied by the cephalic gland in Nemertines.

In addition to this, the relation in which the mouth and the opening of the proboscis-sheath stand to one another, particularly as exemplified in *Malacobdella*, appears to me to be instructive, and to point to the fact that we must regard the proboscis as a species of pharyngeal apparatus—as a pharynx, which is now no longer enclosed in the pharyngeal pouch as a division of the œsophagus, but possesses a cavity of its own. The structure of the pharynx, too, is precisely similar to that of the Nemertine proboscis, consisting as it does of circular and longitudinal muscle-layers, besides radial muscles. (In the case of *Prosthiostomum sipunculus* we have the following arrangement :— longitudinal and circular layers, radial muscles, longitudinal and circular layers.) The pharynx, too, possesses gland-cells, or, at any rate, the prolongations of such cells open through its walls. The pharynx is also supplied with nerves, in the form of a nerve-sheath. The pharyngeal apparatus of the Annelids, which is styled a proboscis, is furnished with papillæ and with jaws, and is a structure which, especially in the case of the Eunicidæ, where it lies in a chamber separated from the gullet, forcibly reminds us of the Nemertine proboscis, though owing to its position, ventral to the intestine, a direct comparison between the two is impossible.

We find that the cavity of the proboscis-sheath in Nemertines increases in extent from the first group to the last. It has been regarded as equivalent to a body-cavity, and as such its development from the blastocœle proves it to be a remnant of the primitive segmentation-cavity. Hubrecht* accordingly terms this space an archicœle. The cavity of the proboscis-sheath contains free nucleated bodies, resembling blood-corpuscles; it possesses an endothelium-like lining, as is the case with the blood-vessels, in connexion with which it is supposed to have arisen.

The cavity of the proboscis-sheath may be still further increased by sac-like metamerically arranged evaginations.

The Turbellaria naturally afford us no points of comparison with reference to the cavity of the proboscis-sheath.

But what about the Annelids? I venture to put forward the following hypothesis:—While in Annelids all the organs lie in a body-cavity, in Nemertines such a cavity has only been developed to a limited extent, embracing the proboscis

* Hubrecht, "Contribution to the Embryology of the Nemertea," Q. J. M. S. vol. xxvi.

and a section of the dorsal blood-vessel. This constitutes the "rhynchocœlom," the wall of which similarly repeats the structure of the body-wall, that is, of the muscular portion thereof. The free corpuscles in the rhynchocœlom are to be compared with those of the perivisceral fluid.

We find therefore that the body of the more highly organized Nemertines possesses two cavities, which we may regard as constituting a body-cavity—the rhynchocœlom, or cavity of the proboscis-sheath, and the cleft between the intestine and the parenchyma. It must not be supposed that both these spaces are of equal value. The cellular lining of the cleft, which is in the highest degree similar to that of the genital sacs, renders it extremely probable that this cavity is a schizocœl. The rhynchocœlom, on the contrary, is a persistent segmentation-cavity (blastocœle). I must leave it to embryology to say whether one or other of these cavities is homologous with the body-cavity of the Annelids.

The blood-vascular system attains its highest development in Groups I. and II. as far as regards the elaboration of the vessels; in these groups we find, in addition to two or three longitudinal trunks, which are united together in the head and in the caudal extremity, an œsophageal blood-vascular plexus, and behind this another surrounding the cavity of the proboscis-sheath. Besides this we generally get in the second group sinus-like blood-spaces for the cephalic pits. In the three longitudinal vessels of the third group, which are united to one another by a series of metamerically arranged transverse loops, we have the nearest approach to the blood-vascular system of the higher Annelids. A blood-vascular system is wanting in the Turbellaria.

A water-vascular system is probably present in all Nemertines, with the exception of the terrestrial forms and the genus *Prosadenoporus*, in which I was not able to determine it. That of Group I. is stated to open directly into the blood-vessel. Be that as it may, it sends out cæcal tubes which enter and pierce the wall of the vessel. Most Nemertines possess only a single pair of nephridial pores; but in many forms, including *Valencinia*, *Eupolia*, *Amphiporus lactifloreus*, &c., it is stated by Oudemans * that there are a large number.

The similarity between the excretory system of the Nemertines and that of the Turbellarians is unmistakable, especially if it should be more generally found, as Silliman † claims for

* Oudemans, "The Circulatory and Nephridial Apparatus of the Nemertea," Q. J. M. S. vol. xix. n. s. 1885.

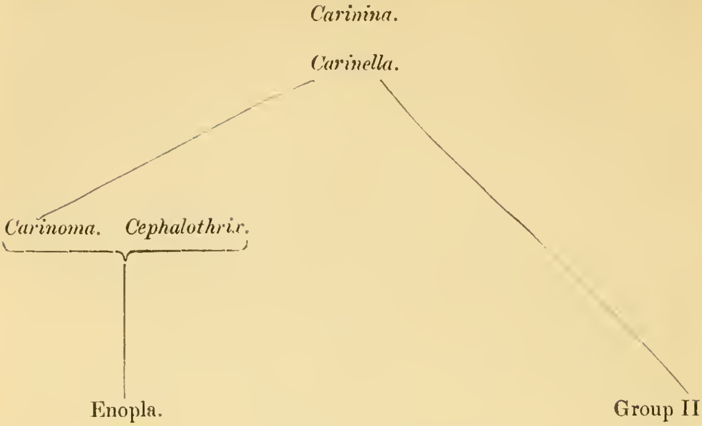
† Silliman, "Beobachtung über Susswasserturbellarien Nordamerikas," Zeitschr. für wiss. Zoologie, Bd. xli. 1885.

Tetrastemma aquarum dulcium, that the excretory vessels of Nemertines are provided with flame-cells.

Yet we are by no means debarred from a comparison with the Annelids, even as regards the nephridial system, if we bethink ourselves of *Lanice conchilega*, that remarkable Terebellid in which four nephridia are united together on each side by a longitudinal vessel. In this connexion it is of the utmost importance to ascertain whether the forms possessing a number of excretory channels exhibit a metameric arrangement of the nephridiopores. In all probability the peculiar line of development followed by the excretory apparatus of the Annelids has been influenced by the large size of the body-cavity found in these forms.

As regards the nervous system, if we start from the lowest forms of the first group and continue our investigations through the other two, we meet with unmistakable evidence of a progressive development; and this not only in the primitive or more complicated composition of the nervous system itself, but also in its varying position, which passes from the epithelial, as described by Hubrecht for the nervous system of *Carinina*, through the intermuscular stage, until finally we find the nervous system lying entirely within the muscle-layers (infra-muscular). According to Hubrecht the most widely different stages in the progressive passage of the nervous system from the exterior towards the interior of the body is found in representatives of Group I. What is in all probability to a certain extent a resting-stage is reached when we find the nervous system situated outside the circular muscle-layer, but lying immediately upon it. I gather from the works of M'Intosh, Hubrecht, and Oudemans, that this occurs in all forms belonging to Group II. But a transition from this position to the infra-muscular one found in the Enopla is not known in this group. In order to trace this transition we have, indeed, to go back to Group I., and, according to the description and figure given by Hubrecht *, we find it in *Carinoma* and *Cephalothrix*. It is therefore from these forms, judging by the position of the lateral nerve-cords, that the Enopla are to be derived; but the genera of the second group can only have sprung from a form in which the lateral cords are still outside the circular muscle-layer. We may therefore represent the affinities thus :—

* Hubrecht, *op. cit.* tab. xi.



The central nervous system is divided into a brain and lateral cords. In addition to the swollen anterior portion of the lateral cords, which forms the ventral ganglia, the brain always shows traces of a pair of dorsal ganglia, which, in the highest forms, far exceed the ventral ganglia in size, while the degree to which they are developed appears to depend to a certain extent on the development of the lateral organs. This is proved by the most primitive forms, in which both lateral organs and dorsal ganglia are of simple structure and small size. In the higher forms, however, in which the lateral pits are reduced in size, as we have found to be the case in *Prosadenoporus*, the dorsal ganglia by no means undergo a corresponding reduction. The ganglia of the brain are united by a dorsal commissure, which passes above the rhynchodæum in *Carinella* and above the rhynchocœlom in *Cerebratulus* and *Drepanophorus*. A ventral commissure passes below the rhynchocœlom and in the Enopla lies upon the fore-gut. The position of the brain is consequently by no means absolutely constant even in this respect. Many Nemertines have been shown to possess an anal commissure connecting the two nerve-cords. The central nervous system possesses a variously constituted sheath of ganglion-cells, which differ exceedingly in form, according to the particular region of the brain, and are eminently characteristic of the various regions. The brain and lateral nerve-cords of certain representatives of Group II. (*Cerebratulus* and *Langia*) possess neurochord-cells and branched neurochords, which traverse the central substance of the lateral cords. Representatives of Group III. (*Drepanophorus* and *Prosadenoporus*) possess only *one pair* of neurochord-cells, which belong to the brain, and only a single pair of unbranched neurochords, which run through the brain and the lateral cords.

The entire mass of the central nervous system is enveloped in a neurilemma. The fibrillar central substance of the lateral cords in all cases, and throughout Group II. that of the brain as well, is also enclosed in an inner neurilemma and sharply marked off from the coat of ganglion-cells.

The peripheral nervous system is represented by nerves and nerve-sheaths. Nerves supply the cephalic extremity, the eyes, and the lateral pits. A pair of nerves, which arise from the ventral ganglion, runs back to the œsophagus; a precisely analogous pair, springing from the ventral commissure, supplies the proboscis in Groups I. and II. In Group III. the proboscis is innervated by means of numerous stems, arising from the brain. In some species of the first group, and in all those of the third, the lateral organs are united by nerves to the dorsal ganglia. In all the groups the lateral cords give off nerves, which are arranged metamerically in Groups II. and III. In *Carinina* the nerve-sheath assumes an epithelial position, in accordance with the situation of the lateral cords; in the other genera of this group the sheath is subepithelial. In Group II. the nerve-sheath is generally situated outside the circular muscle-layer, but it may occur within it, as in *Langia* and *Cerebratulus*. In Group III. nerve-sheaths are not found. The nerve-sheaths are characterized by the presence of a median dorsal nerve, which runs through them in the longitudinal axis of the body. This nerve also persists in Group III., only in this case it maintains an intermuscular position, above the circular muscle-layer. A second and smaller nerve of this kind, lying within the circular muscle-layer, is characteristic of the first two groups only.

In close connexion with the nervous system come the sense-organs—the subepithelial eyes (the pigment-cups of which are directed outwards), the lateral organs, the accessory lateral grooves lined with columnar epithelium (*Drepanophorus*), and the terminal cephalic grooves (*Cerebratulus*).

The lateral organs are placed in the same position as the brain, and in a portion of the genera belonging to the first group and in all those of the second and third they fuse with the dorsal ganglion, behind which they always lie. In the Enopla they occupy an independent position, being connected with the upper ganglion by nerves only, and generally lying to the side of it, though they may occupy a position in front of it, towards the cephalic extremity. As special formations of the body-wall we have the lateral indentations known as cephalic pits in the majority of the representatives of Group II.; these supply the place of a canal in bringing the lateral organs into communication with the outer world. We have yet to mention the existence of a pair of lateral organs in the neighbourhood of the nephridio-pores of *Carinella*.

While the Nemertines, owing to their plexus-like epithelial and subepithelial nervous layers, give grounds even for a reference to the Cœlenterates (a vista opened up by Hubrecht), nevertheless the central nervous system shows so high a degree of development, in the stoutness of its central substance, of its ganglionic coat (so widely and so sharply differentiated from it), and of the twofold membranous and fibrillar elements of its sheath, that it equals the Annelids in this respect. The appearance of a second sheath surrounding the central substance is of especial importance. An inner neurilemma of this kind, which interposes itself between the coat of ganglion-cells and the fibrillar substance, has been identified and described by Hermann * in *Hirudo* also. The tissue, however, which has been styled by many authors an inner neurilemma, does not correspond to the inner neurilemma of Nemertines. For the term has been applied to the finely fibrillar elements of the sheath of the ganglion-cells (Nansen †), or to a membranous sheath which surrounds the nervous elements, ganglion-cells, and central substance of the ventral cord of certain Annelids, and which, as an inner neurilemma, has been contrasted with an outer one, which envelops an intermediate mass lying between the two membranes (Leydig ‡, Andreæ §).

In other respects the connexions which can be made out between the brain of Nemertines and that of Annelids are many in number. I may instance in particular the fact which has lately been more and more insisted upon, viz. that the ganglionic coat consists almost exclusively of unipolar ganglion-cells, and lastly, but by no means least, the occurrence in Nemertines also of neurochord-cells and neurochords.

Whether we are justified in placing the brain of Nemertines absolutely on a level with that of Annelids appears to me to be a question which must be postponed for the present on embryological grounds. Salensky arrives at the following

* Hermann, 'Das Centralnervensystem von *Hirudo medicinalis*.' München, 1875.

† Nansen, "Anatomie u. Histologie des Nervensystems der Myzostomen," Jenaische Zeitschr. 1887.

‡ F. Leydig, 'Tafeln zur vergl. Anatomie,' Tübingen, 1864, i. fig. 9.

§ J. Andreæ, "Beiträge zur Anatomie und Histologie des *Sipunculus nudus*," Zeitschr. für wiss. Zoologie, Bd. xxxvi.

conclusions :—The cerebral ganglia of Nemertines and Annelids are homologous; the ventral commissure of the Nemertine brain corresponds to that which connects the two halves of the Annelid brain; the dorsal commissure of Nemertines is a structure *sui generis* and has no homologue in the case of the Annelids; the œsophageal commissure of the Annelids corresponds to the lateral nerves of Nemertines.

The author draws the last inference from the fact that the Nemertine brain, which arises as an ectodermal thickening on each side of the proboscis-invagination, is prolonged posteriorly into the lateral cords. Nevertheless it is not proved that this brain is exactly the homologue of that of the Annelids, which always includes a portion of the larval apical plate; whereas in the *Pilidium*, on the contrary, the apical plate is thrown off. In any case I am inclined to compare the lateral cords of Nemertines with the ventral cord of the Annelids (the arrangement of the nerves which pass off from the cords makes the comparison justifiable), without further discussing the question whether the Nemertine brain is to be regarded merely as an expansion of the lateral cords, or as a special formation in the same sense as the brain of the Annelid.

The grounds on which we might institute a comparison with the central nervous system of Turbellarians appear to me to be of so general a nature that they must recede into the background when contrasted with the resemblances between the Nemertine and the Annelid nervous systems.

The eyes of Nemertines, on the other hand, may be shortly characterized as Turbellarian eyes.

An agreement in the mode of origin of the lateral organs of Nemertines and the ciliated pits of certain Rhabdocœla (Microstomæ) has already been pointed out by Dewoletzky *, who was also successful in proving the occurrence of similar structures in the case of the Annelids. To this end the author instances Lovén's larva which is provided with ciliated pits, the larva of *Sipunculus*, and also *Ctenodrilus*, in which v. Kennel † found cephalic pits, corresponding as it were to the lateral organs of Nemertines. The similarity between the lateral organs of Nemertines and the ciliated organs of the Capitellidæ has been demonstrated by Eisig also.

I will not attempt to find the homologues of the second pair of lateral organs of the species of *Carinella* in the

* Dewoletzky, "Das Seitenorgan der Nemertinen," Arbeiten aus dem zool. Inst. zu Wien, Bd. vii. 1886.

† V. Kennel, "Ueber *Ctenodrilus pardalis*," Arbeiten aus dem zool. Institut zu Würzburg, Bd. v. 1882.

Annelids—though in them only, and not in the Turbellaria, would it be possible to discover them. I will merely draw attention to the fact that with the appearance of this second pair we find that a lateral line appears in the Nemertines as the bearer of sense-organs, precisely as we find it in the Annelids.

The genital products are either formed directly in the parenchyma, in which case a membrane forms round them, constituting a sac, or else they arise in the walls of sacs which alternate with the intestinal cæca. Before maturity is reached a duct is formed, one from each sac. In the non-metamerized forms the first of these methods appears to prevail (*Carinella*), in the metamerized forms the latter (*Cerebratulus*, *Drepanophorus*). Moreover in these forms, as in *Prosadenoporus*, *Geonemertes*, and many others, several genital sacs are situated between a single pair of intestinal cæca, and we consequently find several genital pores in one metamere. Nemertines are not all of separate sexes: the terrestrial and allied forms, *e. g.* the Prosadenoporids, are hermaphrodite. Hermaphrodite forms are also found among the Tetrastemmids, which are closely allied to the Prosadenoporids. *Prosorhochmus* and *Monopora* are stated to be viviparous.

The extraordinarily complicated genital organs of the Turbellaria exclude any comparison with those of Nemertines.

But even as regards the genital organs of the Polychæte Annelids, it is only in their simplicity that those of the Nemertines agree.

Shortly stated, the conclusion we deduce from the considerations which we have discussed in the above pages amounts to this:—That in many respects the organization of Nemertines exhibits an affinity with that of the Turbellaria, but that on the whole this is put into the shade by the general Annelid-like structure of the animals which we have been considering.

If we merely observe the living flat Nemertine crawling in its mucus, and compare it with a Polychæte or an Oligochæte, the metamerism of which is exhibited externally by means of rings and the arrangement of bundles of setæ, we find but little difficulty in persuading ourselves to follow our predecessors in the field of natural history and in agreeing with the place they assigned to these worms in their classifications—so long, that is, as we are compelled to work with the same appliances as they had. To-day, however, when methods and microscopy have overcome untold difficulties which they had to contend against, we may judge an individual by its external appearance in the last resort only; we determine its systematic position far rather from its internal organization, as displayed to us by means of anatomy and histology, and above all from its embryology.

The latter lead us to the conclusion that Nemertines have probably been derived from Turbellarian-like forms, but that after following a line of development over which the Annelids had already passed, they diverged from it again in a direction of their own.

Göttingen, Sept. 1889.

XLVIII.—*On the Fate of the Quadrate in Mammals.* By R. Broom, M.B., C.M., B.Sc.

One of the most troublesome points in the study of the descent of the Mammalia is the explanation of the changes which have taken place in the structure of the lower jaw and in its mode of articulation with the skull. In Amphibians and Reptiles the lower jaw is invariably made up of a number of pieces and articulates with the skull by means of the quadrate. In Mammals the jaw is apparently a single bone articulating with the squamosal. What we have therefore to explain is, What has become of the quadrate and how has the jaw become simplified? In the present paper I shall only deal with the fate of the quadrate.

Hitherto the majority of comparative anatomists, chiefly from the study of the early condition of the visceral arches, have agreed in finding the homologue of the quadrate in one or other of the auditory ossicles. Gegenbaur, Kölliker, Wiedersheim, and Reichert find its representative in the incus, while Huxley looks upon the malleus as its equivalent. Parker, who has done more than any one else to elucidate the development of the skull, after for many years holding the same view as Huxley, ultimately came to regard the incus as the Mammalian quadrate.

That the quadrate of the Amphibian or Reptilian ancestors of the Mammals should gradually move back from the articulation of the jaw and degenerate into one of the auditory ossicles is improbable; and there is little doubt but that the view has been founded on a misinterpretation of the morphological value of the malleus and incus. The researches of Peters *, Dollo †, Baur ‡, and Gadow § place it beyond doubt that the Mammalian auditory ossicles are together homologous with the Reptilian columella auris and extra-columella, and that the malleus and incus can never have taken any part in the articulation of the jaw.

An entirely different view of the fate of the quadrate has recently been revived by Albrecht ‖, and has been supported by Dollo, Cope ¶, and Baur. According to this view the quadrate is represented by the zygomatic portion of the squamosal. It is highly probable that the Mammalian squamosal represents more than one element; but the palæontological evidence which would find in it the quadrate is unsatisfactory, the zygomatic portion being most probably homologous with the quadrato-jugal.

Gadow and Seeley ** advocate the view of Cuvier and Owen, that the quadrate is represented by the tympanic bone. This, however, involves a gradual shifting back of the quadrate from the articulation, which, though conceivable, is not borne out by positive evidence either from palæontology, embryology, or comparative anatomy.

The Mammalia and Reptilia seem to have had a common origin in a group of highly developed Amphibians, of which no remains have as yet come to light, but of which *Pareiasaurus* is the nearest ally as yet known. In these ancestral forms there was in all probability but a feebly developed flattened quadrate, probably ossified and articulating with the quadrato-jugal, squamosal, and pterygoid. In *Pareiasaurus* Seeley †† says the quadrate bone "would appear to have been

* W. Peters, "Ueber die Gehörknockelchen und ihre Verhältniss zu den ersten Zungenbogen bei *Sphenodon punctatus*," Monatsber. d. k. preuss. Akad. d. Wiss., Berlin, 1874.

† L. Dollo, "On the Malleus of the Lacertilia, &c.," Quart. Journ. Micr. Sc. 1883.

‡ G. Baur, "On the Quadrate in the Mammalia," Quart. Journ. Micr. Sc. 1887.

§ H. Gadow, "On the Modifications of the First and Second Visceral Arches, &c.," Phil. Trans. vol. clxxix, 1888.

‖ P. Albrecht, 'Sur la valeur morphologique de l'articulation mandibulaire, &c.,' Bruxelles, 1883.

¶ E. D. Cope, "The Relations between the Theromorphous Reptiles and the Monotreme Mammalia," Proc. Amer. Assoc. Adv. Sci. vol. xxxiii. 1884.

** H. G. Seeley, "On the Anomodont Reptilia and their Allies," Phil. Trans. vol. clxxx., 1889.

†† H. G. Seeley, "On *Pareiasaurus bombidens* (Owen), and the Significance of its Affinities to Amphibians, Reptiles, and Mammals," Phil. Trans. vol. clxxix., 1888.

a very short flattened bone with a ball-like articular surface on the palatal aspect of the head."

In the Reptilian branch of descendants the quadrate gradually became more powerfully developed to give a firmer articulation to a snapping jaw. Still, in the primitive reptiles we find the quadrate but feebly developed. In *Dicynodon* we find it as a comparatively small bone so feebly articulated with the descending process of the squamosal and the pterygoid that it is lost from many of the British Museum specimens. Even in *Ichthyosaurus*, which is well advanced along the Reptilian line, we still find a small quadrate.

In the Mammalian line of descent, with the development of flexible muscular lips and cheeks a looser articulation of the jaw became advantageous. The short flattened quadrate with the rounded articular surface was doubtless gradually transformed into a flattened bony plate, giving great freedom of movement to the condyle of the jaw. In process of time nature found an equally firm and more elastic medium of articulation in an unossified quadrate, which remains in the Mammals of to-day as the *Interarticular Cartilage.*

The condition of affairs in the skull of a monstrosity I recently described* would seem to favour this view as against the other theories advanced. In this specimen there is no trace of a lower jaw, and the only part of the first visceral arch to be detected is an irregular piece of bone about half the size of the malleus, representing the fused palatines and pterygoids. The zygomatic portion of the squamosal, though altered in shape somewhat, is unusually well developed, while the tympanics are present as a powerful arch of bone stretching from one side of the skull to the other. It is difficult to believe that either squamosal or tympanic can represent part of an arch whose development is in its other parts so completely arrested.

Should the present theory be confirmed by further research, the Interarticular Cartilage might appropriately be called the "Quadrate Cartilage."

* "On the Condition of the Auditory Ossicles of a Synotic Cyclopian Lamb," Trans. Nat. Hist. Soc. Glasg. 1888–89.

XLIX.—*On the Distinctive Cranial Characters of the Iguanoid Lizards allied to* Iguana. By G. A. Boulenger.

Shortly after the publication of the second volume of the British Museum 'Catalogue of Lizards' Prof. Cope proposed an arrangement of the genera of Iguanina, *i. e.* of the genera closely allied to *Iguana*, "without abdominal ribs or free dermal margins of the digits, with the nostrils on the line of the canthus rostralis and not below it, and which possess the compressed form and other characteristics indicating an arboreal rather than a terrestrial habit of life" *. This arrangement is certainly no advance on that which I had previously followed, the only important innovation being the union of the genera *Metopoceros* and *Cyclura* under the latter name. His reasons for doing so are given in the following words:—"If the presence of the second row of femoral pores is not constant in *C. cornuta*, then the genus *Metopoceros* cannot be distinguished from *Cyclura*. Mr. Boulenger relies on the rather greater number of denticles in the lateral teeth in *C. cornuta*, but my specimens show a tendency to the tridentate form of *C. nubila*. The character is, I think, even if constant, insufficient for generic distinction." Although agreeing now with Prof. Cope as to the value of the latter character, to which I attached too much importance, I yet wish to uphold the distinction of the genera *Cyclura* and *Metopoceros* on the ground of the cranial structure. Although closely allied to *Cyclura*, *Metopoceros* is, in some respects, equally related to *Iguana*, whilst the skull of *Cyclura* stands nearer to that of *Ctenosaura* than to that of *Metopoceros*.

On this occasion I propose to indicate the distinctive cranial and dental characters of the genera more nearly related to *Iguana*.

1. *Amblyrhynchus*, Bell.—All the teeth trilobate. Præmaxillary not extending as far as the posterior border of the nasal fossæ; the length of the latter nearly equals their distance from the orbits. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch short, not longer than the orbit; postfrontal as long as deep. Transpalatine in contact with palatine. Basisphenoid short and much constricted behind the basipterygoid processes.

* Proc. Amer. Phil. Soc. xxiii. 1886, p. 261.

2. *Conolophus*, Fitz.*—All the teeth trilobate. Præmaxillary not extending as far as the posterior border of the nasal fossæ; the length of the latter nearly equals their distance from the orbits. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch longer than the orbit; postfrontal longer than deep. Transpalatine in contact with palatine. Basisphenoid short and much constricted behind the basipterygoid processes, as in the preceding.

3. *Brachylophus*, Wagl.—All the teeth tricuspid. Præmaxillary not extending as far as the posterior border of the nasal fossæ; the length of the latter equals their distance from the orbit. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch short, not longer than the orbit; postfrontal as long as deep. Transpalatine not in contact with palatine. Basisphenoid as in *Cyclura*, rather elongate and much constricted behind the basipterygoid processes.

4. *Iguana*, Laur.—Lateral teeth with numerous denticles. Præmaxillary not extending as far as the posterior border of the nasal fossæ; the length of the latter nearly equals their distance from the orbits. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch slender, short, not longer than the orbit; postfrontal as long as deep. Transpalatine in contact with palatine. Basisphenoid short and but slightly constricted behind the basipterygoid processes.

5. *Metopoceros*, Wagl.—Lateral teeth with four to seven cusps. Præmaxillary not extending as far as the posterior border of the nasal fossæ; the length of the latter much greater than their distance from the orbits. Præfrontal entering the nasal fossa. Postfronto-squamosal arch wide, a little longer than the orbit; postfrontal longer than deep. Transpalatine not in contact with palatine. Basisphenoid intermediate between *Iguana* and *Cyclura*.

6. *Cyclura*, Harl.—Lateral teeth with three to six cusps. Præmaxillary extending as far as the posterior border of the nasal fossæ; the length of the latter not more than their distance from the orbits. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch long and wide, intermediate between *Metopoceros* and *Ctenosaura*; postfrontal longer than deep. Transpalatine not in contact with palatine. Basi-

* The cranial characters are taken from the figure given by Steindachner, Festschr. zool.-bot. Ges. Wien, 1876, pl. v.

sphenoid rather elongate and much constricted behind the basipterygoid processes, intermediate between *Metopoceros* and *Ctenosaura*.

7. *Ctenosaura*, Wiegm.—Lateral teeth with three or four cusps. Præmaxillary extending as far as the posterior border of the nasal fossæ; the length of the latter less than their distance from the orbits. Præfrontal not entering the nasal fossa. Postfronto-squamosal arch slender, at least as long as the orbit; postfrontal longer than deep. Transpalatine not in contact with palatine. Basisphenoid elongate and much constricted behind the basipterygoid processes.

The skull of *Cyclura* is figured by Brühl, 'Zootomie,' pl. cxliv., as that of *Iguana tuberculata*. An excellent figure of the skull of *Metopoceros* is given by Cuvier, Oss. Foss. v. pt. 2, pl. xvi. figs. 23–26. In the figure published by Günther, Trans. Zool. Soc. xi. pl. xliv., the parietal foramen is represented, through an error of the artist in the drawing of the sutures, as in the frontal bone, whilst, as in other Iguanas, it is situated between frontal and parietal. The three possible positions of the parietal foramen are to be found in the family Iguanidæ, viz. between frontal and parietal (nearly all the genera), in the frontal (*Basiliscus*, *Corythophanes*), or in the parietal (*Chamæleolis*, *Anolis*). *Xiphocercus* and *Norops*, though so closely allied to *Anolis*, have the foramen between frontal and parietal.

L.—*The Genera* Trigaster *and* Benhamia. By W. Blaxland Benham, D.Sc., Assistant to the Jodrell Professor of Zoology, University College, London.

In 1886 I described an earthworm from the island of St. Thomas, West Indies, its most remarkable peculiarity (at that stage of our knowledge of earthworms) being the possession of three separate gizzards; to this worm I gave the name *Trigaster Lankesteri* *. Its other characters ally it to *Acanthodrilus*, e. g. the two pairs of cylindrical and convoluted prostates and the condition of the nephridia.

In 1889 Dr. Michaelsen, of Hamburg, described a worm, under the name of *Benhamia rosea*†, which in some respects

* Quart. Journ. Micr. Sci. xxvii.

† Jahrb. d. Hamburg. wiss. Anstalten, vi.

agrees with *Trigaster Lankesteri*, but differs in several of the characteristic features of the latter, one being the possession of two gizzards and another the extent of the clitellum. Dr. Michaelsen, however, suggested the suppression of the name *Trigaster* in favour of *Benhamia*, on the ground that the former generic name no longer holds good for his new species on account of its significance.

In my recent article, "An Attempt to Classify Earthworms" (Quart. Journ. Micr. Sci. xxxii.), I have included his species under the older name *Trigaster*; this I did believing that, although the name had no longer a literal significance for the new species, I was justified in retaining the prior name. Dr. Michaelsen has published descriptions of other species of the same genus, and after communication with him and with Dr. Rosa, of Turin, and a careful perusal of his papers, I am led to regard the species of *Benhamia* as distinct from *Trigaster*. The two genera are not synonymous, as would appear from his article, but are distinct though very closely allied forms; and perhaps they should both be regarded as subgenera of *Acanthodrilus*. At present, however, I would consider them as distinct.

The following characters are common to the three genera, together with *Deinodrilus* (Beddard) :—

(1) Nephridia in form of a network.
(2) Two pairs of coiled cylindrical prostates in somites xvii. and xix.
(3) Two pairs of spermathecæ.

Deinodrilus differs from the rest in possessing twelve setæ per somite and in its short clitellum (xiv. to xvi.).

Acanthodrilus has a single gizzard and behind it paired calciferous glands.

The anterior nephridia form a compact mass or pepto-neph communicating (? always) with the pharynx.

The spermathecæ lie in somites vii. and viii.

The two sperm-ducts of each side are separate till near the sperm-pore.

Trigaster :—

1. The *clitellum* is extremely long, occupying somites xiii. to xl.
2. There are *three* separate gizzards, in somites vii., viii., and ix.
3. There are no calciferous glands.

4. The two pairs of spermathecæ lie in viii. and ix., are globular, have no appendix or swellings or diverticula near the external apertures, which are placed posteriorly, *i. e.* between viii./ix. and ix./x.
5. No penial setæ.
6. No dorsal pores.

Benhamia :—

1. The clitellum occupies at most eight somites, varying, however, in extent and limits (xiii. to xix. or xiv. to xxi.).
2. There are only *two* gizzards.
3. Calciferous glands are present.
4. The spermathecæ are rather ovoid than globular and have appendices or diverticula to their narrowed ducts, which open externally on the anterior boundaries of their somites, viz. vii./viii. and viii./ix.
5. Penial setæ in special sacs are present in relation to the prostate.
6. Dorsal pores are present, at any rate in some of the species.

Both genera, however, agree in having all the eight setæ in each somite close together on the ventral surface, in having a pit or fossa, at the bottom of which the prostates and spermiducal pores open externally, and in these two characters they differ from *Acanthodrilus*.

The genus *Trigaster* includes at present only one species, *T. Lankesteri*, Benham, 1886, from St. Thomas, West Indies.

The genus *Benhamia* includes the following species, all being from West Africa, with the exception of the last, the locality of which is unknown, and is merely a matter of speculation :—

1. *B. rosea*, Michaelsen, 1889.
2. *B. Stuhlmanni*, Michaelsen, 1890.
3. *B. affinis*, Michaelsen, 1890.
4. *B. Schlegelii*, Horst, 1884.
5. *B. Büttikoferi*, Horst, 1884.
6. *B. Beddardi*, Horst, 1888.
7. *B. scioana*, Rosa, 1888.
8. *B. Godeffroyi*, Michaelsen, 1890.

The species 4, 5, 6, 7 were originally described under the genus *Acanthodrilus* (see my article in Quart. Journ. Micr. Sci. xxxii.), but have been transferred on account of their possessing two gizzards and a genital fossa.

October 17, 1890.

LI.—*On a new Species of* Gyracanthus. By R. H. Traquair, M.D., F.R.S.

In their recently published 'Catalogue of British Fossil Vertebrata' Messrs. Smith Woodward and Sherborne state concerning the spine from Burdiehouse figured by Hibbert (Trans. Roy. Soc. Edinb. xiii. pl. xi. fig. 1), and referred by Agassiz to his *Gyracanthus formosus*, that it "is of doubtful species." This spine is in the collection of the Museum of Science and Art, and I had long been of opinion that neither it nor any other specimen of *Gyracanthus* from the Calciferous Sandstone series could be referred to the same species as that from the Coal-measures *figured* by Agassiz as such (Poiss. Foss. t. iii. tab. v. figs. 2–6), and which, on the other hand, must also include his *G. formosus.* Lately a considerable number of *Gyracanthus* spines have occurred in the "Dunnet" shale at Straiton, which clearly belong to the same species as those from Burdiehouse, and enable one to have a still better idea of its characters and configuration.

Those spines resemble *G. formosus* (incl. *tuberculatus*) in the nature of their ornament, and though most of the Burdiehouse specimens are eroded and worn, that figured by Hibbert has the tuberculation of the ridges in places exceedingly well marked. But from *G. formosus* the species differs in having the basal or inserted portion very small, and again in the usual want of that lateral curvature which is so constant a feature in all examples of that species which have attained any size. The antero-posterior curvature is usually present, but only in one specimen out of many have I observed any pronounced lateral flexure. Like *G. formosus* they are frequently worn at the tips, and all are bilaterally unsymmetrical.

As there is no doubt that we have here a species which has not hitherto been named or defined, I propose for it the name of *Gyracanthus rectus.*

Not uncommon in the Calciferous Sandstone series of the east of Scotland. Besides Burdiehouse and Straiton, the following localities may be noted:—Burntisland, Pittenweem, St. Andrews.

BIBLIOGRAPHICAL NOTICE.

A Monograph of the Horny Sponges. By Robert von Lendenfeld. London: published for the Royal Society by Trübner and Co., 1889. 4to. Pp. 936, pls. 50.

Dr. von Lendenfeld, after qualifying himself as an authority on sponges by studying them under the supervision of Prof. F. E. Schulze, went to Australia and New Zealand, and spent some years in making a collection of these organisms. In the seas bordering these countries sponges with horny skeletons largely predominate, and this fact induced the author to devote special attention to these particular forms, with the primary idea of preparing a catalogue of those inhabiting the Australian seas; but finding that these embraced a large proportion of the entire group known to science, the project was extended so as to include the description of them as a whole, and with this view the collections were brought to England and worked out by the author in the British Natural-History Museum; and the large collection of these forms belonging to the Museum, many of them new, were at the same time studied and described in the present work, which has been published under the auspices of the Royal Society.

In the introductory part is a bibliographic list of publications relating to sponges generally, both fossil and recent, which contains 1641 entries. This list is in the main similar to that previously published by the author in 1886 in the 'Proceedings of the Zoological Society,' and thus revised it may be considered as a fairly complete list up to January 1888 of the literature which treats of this class.

The main body of the work is divided into two portions—an analytical, devoted to the systematic description of all the known horny sponges, which professes to give the plain empirical facts relating to the anatomy, physiology, and classification of each genus, without any reference to phylogeny or other hypothesis; and a synthetical part, which treats of the anatomy of sponges generally, and discusses their phylogeny, systematic position, and classification. The author regards the *genus* as the most important unit, and endeavours to include in the characters of each a complete *résumé* of the comparative morphology and physiology of all the species embraced within it. The particular characters are thus summarized:—(1) Historical Introduction, (2) Shape and Size, (3) Colour, (4) Surface, (5) Rigidity, (6) Canal System, (7) Skeleton, (8) Histology and Physiology, (9) Affinities of the Genus, (10) Statistics of the Species, (11) Key to the Species and Varieties, and (12) Distribution.

The author frankly acknowledges that sponges which possess the common characteristic of a horny skeleton cannot be considered as forming a natural order, since certain groups are more nearly related to other sponges which have not horny skeletons than to each other. Four main groups of horny sponges are distinguished; three of these are considered to be related to as many distinct families of siliceous sponges of the order Cornacuspongiæ, Vosmaer, and these are placed in the *artificial* order Monoceratina, characterized by a soft ground-substance or mesoderm, with a supporting skeleton of spongin fibres, without proper spicules, but in some instances with flesh-spicules (microsclera), and with pyriform or sac-shaped ciliated chambers; in other words, they are siliceous Cornacuspongiæ, but without skeletal or proper spicules in the supporting skeleton, though in some instances still retaining minute flesh-spicules of the same types as in the more typical siliceous sponges. The fourth main group of horny sponges is a relatively small one; and it is considered as a *natural* order, allied to the siliceous Hexactinellida, and from this it is named Hexaceratina.

The first family of the artificial order Monoceratina, the Aulenidæ, includes but two genera, *Aulena* and *Hyattella*, and in the former of these the skeletal fibres are not only charged with sand-grains, so common in the fibres of horny sponges, but they possess true echinating siliceous spicules similar to those of the siliceous Desmacidonidæ; and the author acknowledges that the genus is placed with horny sponges not because it properly belongs to this group, but because it furnishes an interesting and important link between the typical horny sponges and typical siliceous Desmacidonidæ.

The second family of the Monoceratina, the Spongida, is the largest of the three groups, and, as defined by the author, contains seventeen genera. The sponges of this family are not clathriform; they have small spherical or pear-shaped ciliated chambers, ·02 to ·05 millim. wide; the ground-substance or mesoderm is granular in varying degrees, and the horny fibres of the reticulating skeleton may be solid or pithed, and, of course, destitute of proper spicules. These sponges are regarded as very closely related to the siliceous Chalinids, and in fact merely their modified descendants, which have lost the ancestral spicules whilst retaining their external form and appearance for a protective purpose. It is significant to find that the mere relation of the *size* of the ciliated chambers is adopted by the author as a distinguishing feature, and in certain genera also the *dimensions* of the fibres and the skeletal meshwork are regarded as good generic characters.

Within this family are embraced the sponges of commerce, belonging to the genera *Euspongia*, Bronn, and *Hippospongia*, Schulze. These genera are very closely allied and connected by numerous transitional forms which run into each other at every point, so that it is an almost impossible task to establish satisfactory species or varieties; but in spite of this the author finds it necessary to make nine new forms in *Euspongia*, bringing the number in this genus to thirty-one, and six new in *Hippospongia*, which now numbers twenty-seven species and varieties.

A full account is given of the peculiar filamentous bodies so abundant in the genus *Hircinia*, which have been the subject of very varied opinions amongst spongologists, some considering them to be parasitic organisms, others that they have been produced by the sponge itself. Lendenfeld formerly held that they were foreign organisms, Oscillarians, which multiplied in the sponge and became invested by a coating of spongin; but this view is given up as untenable, and, with Schulze, he now confesses himself unable to satisfactorily explain their origin; but it seems certain that, though not produced by the sponge, these filaments are in some way necessary to its existence, and may thus be compared with the zooxanthellæ or yellow cells frequently found in low forms of marine life. Curiously enough these filaments are, in the author's opinion, invariably associated with this genus of sponges and with no other, and they are as abundant in the Australian as in the Mediterranean species.

The sponges included in the Spongelidæ, or third main group of the Monoceratina, have a reticulate or dendritic skeleton of solid horny fibres without proper spicules, but containing foreign bodies and occasionally entirely replaced by large sand-grains; sometimes rod- or S-shaped flesh-spicules are present. The ground-substance or mesoderm is transparent, and the ciliated chambers are large and sac-shaped and do not possess special efferent canals. This group is more nearly allied to the siliceous Heterorhaphidæ of Ridley and Dendy, and includes only five genera, two of which, *Sigmatella* and *Haastia*, are new; the latter is somewhat remarkable in having a layer of minute oval siliceous bodies sheathing the fibre. The generic term *Spongelia*, Nardo, is preferred by the author to that of *Dysidea*, Johnston, on the ground of priority, and our English authors who retain Johnston's name are blamed for their ignorance of Nardo's works; but Dr. Lendenfeld does not seem to be aware that Nardo's term was unaccompanied by any description whatever, and is therefore invalid. As stated by Oscar Schmidt, the names given by Nardo must remain as shadows merely, since this author did not live to carry out his intention of describing the forms themselves; and though it pleased Oscar Schmidt to adopt some of them subsequently, *Spongelia* included, this would by no means be sufficient to displace the properly constituted term *Dysidea* proposed by Johnston before O. Schmidt published anything respecting the bodiless term *Spongelia*. Dr. Lendenfeld has another reason for preferring *Spongelia*, equally as valid as its assumed priority, viz. "because Schulze, who for the first time defined the genus in a really scientific manner, used that name."

In the remaining principal division of Lendenfeld's system, that of the order Hexaceratina, the sponges may have skeletons of pithed horny fibres, or of horny spicules, or they may be without skeletons at all. They are furnished with large sac shaped ciliated chambers, with simple canals. These sponges are regarded as forming a natural group, most closely allied to the siliceous Hexactinellida; but, judging from the distinguishing features of the three families which constitute the group, it is difficult to perceive in what way they are related to each other or to the Hexactinellida. Thus in the leading family, the Darwinellidæ, there are fibres and horny spicules, the next family of the Aplysidæ has fibres only in the skeleton, whilst in the third family of the Halisarcidæ there are neither fibres nor spicules.

Perhaps the most peculiar horny sponges are those included in

Darwinella, F. Müller, which possess a skeleton mainly of horny spicules detached from each other and irregularly scattered in the mesoderm of the sponge. Only two species are as yet known: in the first described, *D. aurea*, the spicules have from three to eight rays; some of them resemble the four-rayed or Calthrops spicules of siliceous Tetractinellid sponges, whilst others approach in form the six-rayed spicules of Hexactinellids. In the other species, *D. australiensis*, Carter, the large majority of the spicules have only three rays in one plane, and thus singularly resemble in form the three-rayed spicules so common in Calcisponges. The author concludes that these varied forms of horny spicules in *Darwinella* are directly derived from the siliceous spicules of the Hexactinellida in which the silica has been replaced by spongin; but there seems very little warrant for supposing that spicules so far removed from the Hexactinellid type as the Calthrops and three-rayed forms can ever have been derived from normal six-rayed Hexactinellid spicules; if they have been derived from siliceous sponges at all, they are more nearly related in form to Tetractinellid spicules.

Yet further, Dr. Lendenfeld states that the substitution of spongin for silica in these horny spicules has been brought about to meet the "exigencies of changed circumstances resulting from a migration from the siliciferous depths of the ocean to shallower water, where the amount of silica contained in solution in the water is not so great"! It may be asked if there is any reason for believing that the water of the ocean at great depths contains more silica than in shallower areas? Judging from the abundance of recent siliceous sponges in shallow and moderate depths, and from their enormous development under similar conditions in past ages, there is no ground whatever for supposing that the spicules of siliceous sponges would be at all likely to undergo substitution of spongin for silica through a comparative scarcity of this mineral in shallow water.

The author justifies the inclusion in Horny Sponges of such genera as *Halisarca* and *Bajulus*, in which there is no horny skeleton whatever, on the ground that they are rudimentary horny sponges; on the other hand, Schulze considers these forms as rudimentary Hexactinellids!

A total number of 248 distinct species and varieties are described in this work, of which no fewer than 258, or 74 per cent, are found in the Australian seas, whilst 179 species are limited to this region. Horny sponges are distinctively inhabitants of shallow water, the greater number occurring at depths between 20 and 50 metres, and the greatest depth at which they have been met with is 750 metres. They also flourish most in warm seas.

In the synthetical part of the volume the general results deduced from the empirical descriptions are discussed in a series of chapters in which the structure, classification, and systematic positions of sponges generally are treated. We can here only touch upon a few salient points, and one of these is the statement that the canal-system is the most important organ in sponges, and that it should principally be taken into account in classifying them. But is it not the fact that an essentially similar canal-system is present in many sponges which are fundamentally different in the nature of their skeleton and in other respects, so that it would be quite impossible to classify them on this principle?

The discovery by Prof. C. Stewart of the rudimentary sense-organs or palpocils in sponges is referred to; but Dr. Lendenfeld claims that he was the first to *describe* these organs in sponges, and that he has discovered various modifications of a nervous system in horny as well as in calcisponges. An unimportant objection is made to the term "palpocil" for these organs; but the new one proposed seems hardly necessary. The stratification or layers noticeable in the horny fibres of sponges is attributed to the variable character of the spongin produced by the spongoblasts or fibre-cells at different intervals owing to changes in outer circumstances, and the production of pith in the fibres of the Hexaceratina is considered to be due to the action of cells which eat out the fibres and change the spongin into pith; but this theory has been called in question by Poléjaeff, who considers the pith to be an original constituent of the fibres.

Regarding the physiology of sponges, the somewhat humiliating confession is made that we do not yet know the kind of food which is taken by them, nor how it is absorbed, nor the particular way in which the functions of secretion and respiration are carried on; and, further, but little is as yet definitely known of the embryology of horny sponges. As to the phylogeny of horny sponges, the author concludes that they have originated from four distinct phyla, which have been developed independently of each other from as many different groups of siliceous sponges. The system of the horny sponges set forth in this work is stated to be entirely new and fundamentally different from any previously propounded. The two concluding chapters deal with the phylogeny and systematic position of sponges generally, and the inevitable ancestral tree is produced —we are told for the first time—showing the relationship of the different families of the class. The author considers that the phylogenetic affinities of sponges are now established on a satisfactory footing, and the merit of this is modestly ascribed to four recent writers of the 'Challenger' Reports on these organisms and to the author himself.

Apart from hypothetical subjects, no doubt can be entertained of the value of this Monograph, as giving us for the first time full, detailed, and accurate descriptions of the minute anatomy and other structural characters of the group of horny sponges, so that in future there should be no serious difficulty in determining any member of it. Serious exception may be taken, however, to the arbitrary way in which, in many instances, the generic and specific names given by previous authors to many of these sponges have been disregarded and set aside by Dr. Lendenfeld in favour of new terms proposed by himself. It is indeed asserted that the sense in which the terms "variety," "species," and "genus" are used is the result of the author's own original researches and independent of any authority, and further that it is impossible to give a definition of his own peculiar meaning of them; but such a plea will not excuse the autocratic way in which new names are proposed by which previous ones are either rejected or ingeniously relegated to such a subordinate position that they are likely to be altogether lost sight of.

The work is illustrated by a few woodcuts in the text and fifty plates; some of these are from photographs of dry or spirit specimens, others, representing the minute structures &c., have been drawn by the author. These latter in many instances are somewhat crude in appearance; but their lack of artistic merit may perhaps be compensated by greater accuracy of detail. Dr. von Lendenfeld may be congratulated on his good fortune in obtaining the assistance of the Royal Society to bring out such an important and, judging from the price set upon it, expensive publication.

MISCELLANEOUS.

On the Discovery of a Jurassic Fish-Fauna in the Hawkesbury Beds of New South Wales. By A. Smith Woodward *.

A large collection of fossil fishes from the Hawkesbury-Wianamatta series of Talbralgar, New South Wales, has been forwarded to the author for examination by Messrs. C. S. Wilkinson and R. Etheridge, Jun., of the Geological Survey of New South Wales. The final results will appear in a forthcoming memoir to be published by that Survey; but the investigation has already proceeded so far as to justify the announcement of the discovery of a typically Jurassic fish-fauna in Australia. Fine examples of the Palæoniscid genus *Coccolepis* occur, and this has previously been met with only in the Lower Lias of Dorsetshire, the Purbeck Beds of Wiltshire, and the Lithographic Stone of Bavaria. A new fish allied to *Semionotus*, but with thinner, much imbricating scales, is also conspicuous; and another new form, allied to the Dapedioids, is remarkable from the presence of typical rhombic ganoid scales in the front half of the trunk and deeply overlapping cycloid scales over the whole of the caudal region. A *Leptolepis*-like fish, with a persistent notochord, seems to represent a third unknown generic type. Of *Leptolepis* itself there are many hundreds of individuals in a fine state of preservation. The fishes occur in a hard, ferruginous, fissile matrix associated with well-preserved remains of plants.

The Fossil Fishes of the Hawkesbury Series at Gosford, New South Wales. By A. Smith Woodward †.

Some years ago an early Mesozoic fish-fauna was discovered in a bed of dark grey shale in the Hawkesbury Formation at Gosford, New South Wales, and the collection was forwarded to the author for determination. The present memoir comprises the results of

* Abstract of paper read before Section C, British Association, Leeds, 1890.

† Abstract of no. 4 of the 'Palæontological Memoirs of the Geological Survey of New South Wales,' Sydney, 1890.

the investigation, and is illustrated by ten quarto plates. An indeterminable Selachian fish and an imperfectly-preserved Dipnoan are not of much interest; but the latter seems to indicate a new genus and species, *Gosfordia truncata*, characterized by its very small head, laterally compressed body, and minute striated scales. The Palæoniscid genus *Myriolepis* is more completely defined than was possible in the original description; and the fish is compared with the so-called *Thrissonotus Colei* from the Lower Lias of Lyme Regis. A new species, *Myriolepis latus*, with larger scales than the type, is also added. A new genus and species of Palæoniscidæ, *Apateolepis australis*, is remarkable for the extreme tenuity of the squamation, which is usually destroyed, except on the upper caudal lobe. The family of Catopteridæ is instituted for the reception of *Catopterus* and *Dictyopyge*, and placed near the Palæoniscidæ on account of the fact that the endoskeletal supports of the median fins are fewer in number than the apposed rays. *Catopterus* is not known in the Hawkesbury Beds, but of *Dictyopyge* there are three new species, *D. symmetrica*, *D. illustrans*, and *D. robusta*. Close to the Catopteridæ is placed the family of Belonorhynchidæ, in which the same non-correspondence of the median fin-supports and dermal rays is conspicuous. Two new species of *Belonorhynchus*—*B. gigas* and *B. gracilis*—are described at length, and add much to previous knowledge of the genus. Of the typically Triassic fish, *Semionotus*, there are imperfect indications of two species, named *S. australis* and *S. tenuis*. A new genus, intermediate between *Semionotus* and *Dapedius*, is termed *Pristisomus*, having the three species *P. gracilis*, *latus*, and *crassus*, and much new information is added concerning the exoskeleton of the allied genus *Cleithrolepis*, of which an outline-restoration is given. The Pholidophoridæ are represented by a small species of *Pholidophorus*, appropriately named *P. gregarius*; while a small, short, and stout fish with three series of deep flank-scales is described as *Peltopleurus* (?) *dubius*. Genera of the *Leptolepis* type are entirely wanting; and, as a whole, the fauna under consideration seems to be most nearly paralleled by that of the Keuper of Europe.

Is Asterias tenuispinis, *Lamk., a "British" Species?*

There is in the British Museum collection an example of *Asterias tenuispinis*, Lamk., which is, with a query, stated to have come from Lyme Regis; it was presented to the Trustees in 1856 by the late Lord Enniskillen. The only writer who, to my knowledge, has reported the English coast as one of the habitats of this species is Dr. Gray (Synop. Starf. 1866, p. 1), but as he did not always (*cf.* Ann. & Mag. Nat. Hist. 1841, vi. p. 179) distinguish between this species and *A. glacialis*, which is undoubtedly British, his evidence is not unimpeachable. Can any naturalist acquainted with the British fauna tell me that he has found this species on our shores? From its known area of distribution one might well have done so.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 36. DECEMBER 1890.

LII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 20. *On some undescribed Shore-Fishes from the Bay of Bengal.* By A. ALCOCK, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

CONTENTS.

§ 1. Introduction and Sketch of the Habitat.
§ 2. Descriptions of New Species.

§ 1. *Introduction and Sketch of the Habitat.*

BETWEEN the 11th November, 1889, and the 25th March, 1890, the 'Investigator' trawled, on occasion, in shallow water off the south-east coast of Ceylon (32 fathoms), off the east coast of the Andaman chain and in the Gulf of Martaban (20 to 41 fathoms), and systematically along the east coast of the Indian peninsula between lats. 17° 50′ and 19° 50′ N. in depths ranging from 7 to 102 fathoms.

In the class of Fishes numerous forms previously unnoticed in the Indian fauna and also forms apparently hitherto undescribed were taken; and the present paper is devoted to those among the latter which were collected inside the 50-fathom line. Of these there are thirteen species to notice, namely, one from Ceylon, two from the Andaman side, and eleven (including one common to two conventional localities) from the east coast of India.

A short sketch of some of the more obvious physical and faunistic features of the 'Investigator's' trawling-stations may first be given.

i. *The South-east Coast of Ceylon* is rocky and reefy, and on the occasions in this and previous years on which the 'Investigator' has used the trawl here the bottom has been found to consist of coarse sand and broken shells and a shingle of irregular fragments of coral, with worn and eroded surfaces more or less incrusted with Foraminifera, Sponges, Hydrozoa, Bryozoa, &c. These in their turn shelter, among other things, crowds of small Crustaceans—Leucosine crabs being predominant—which, in their colour, in their form and sculpture, and in their curious cataleptiform attitudes, furnish most wonderful examples of protective resemblance to their animate and inanimate surroundings. The ground-fishes taken here too (*Rhomboidichthys polylepis*, *Rh. angustifrons*, *Rh. azureus*, *Samaris cristatus*), in the complicated and undescribable mottling and variegation of their upper surfaces, show most remarkable harmonies with their environment.

ii. *The Andaman Chain.*—Off the rocks and reefs we again meet with a clean bottom of incrusted rock and coral shingle, with a profusion of Hydrozoa, Polyzoa, Comatulids, &c., harbouring small Crustaceans. But the ground is too rough for the use of the trawl; and the tangles, which alone are available, have not brought up many fishes.

iii. *The Gulf of Martaban.*—Here the bottom is formed of the copious silt of the Irrawádi, Sittang, and Salween Rivers, and the marine fauna has the well-known facies of all Indian deltas.

iv. *The Ganjam Coast.*—The 120 miles of this part of the east coast of the peninsula, along which the systematic trawling of the 'Investigator' was carried on during the season, are characterized by low-lying sand-dunes, broken by the numerous creeks and swamps into which the small river-channels from the Eastern Gháts open. The sea is shallow (the 100-fathom line being from 18 to 23 miles distant from shore), and the bottom consists of mud or of fine sand, though occasionally a rocky patch with a profuse Cœlenterate fauna is met with.

Setting aside the last, where the details of the fauna strongly recall those of the south-east coast of Ceylon, one is able to distinguish three well-marked bathymetric ranges of life along this coast.

a. Within the limits of the first, which extends from the surf-line to about 14 fathoms, almost every successful haul of the trawl will contain specimens of all of the following, several of them in great numbers:—

Veretillum; sea-anemones with sandy tests or commensal with hermit-crabs or *Dorippe*; *Astropecten*; *Nerocila*, *Squilla*, *Penæus*, *Pagurus*, *Dorippe*, *Philyra*, *Iphis*, *Calappa*, *Matuta*, *Egeria*, *Doclea*, *Neptunus*, *Goniosoma*; *Murex*, *Sepia*; various well-known Indian shore-fishes; *Hydrophis*, *Enhydrina*.

These are the characteristic forms of this zone.

Within these limits have been found an undescribed Trichonotid and three undescribed Pleuronectids, two of which are examples of a new generic type.

b. From 20 to 40 fathoms the hauls are usually small and the collections quite characteristic. Within these limits, with the exception of the common spiny *Murex* and a few Pleuronectidæ (*Psettodes erumei*, *Pseudorhombus javanicus*, *Cynoglossus oligolepis*, and *Synaptura quagga*), none of the first-mentioned forms have been taken. In almost every haul specimens of the following will occur:—simple Turbinolid Corals; *Stellaster*, *Clypeaster*; *Crangon*, *Thenus*, small Leucosines; *Uranoscopus cognatus*, *Platycephalus asper* or *P. spinosus*, *Brachypleura xanthosticta*, *Arnoglossus macrolophus*, *Læops Guentheri*, and sometimes *Champsodon vorax* and *Lophius indicus*.

Up to date the great majority of fishes taken in this zone have been found to be new to the Indian record or new to science; and it seems very probable that the same will prove true for the other groups. Unfortunately no *continuous* readings of the bottom-temperature were taken; but occasional experiments showed that up to 14 fathoms there was no difference between the temperatures at the surface and at the bottom, while at 23 fathoms the temperature at the bottom was lower than that at the surface by 3° Fahr.

c. From 70 to 100 fathoms the hauls again become large and varied, but the forms begin to show a pronounced bathybial facies, and nothing is seen of the forms which characterize the two shallower zones. So far, although the hauls of fishes have been big and varied, the only known Indian shore-fish encountered has been *Halieutæa stellata*. A successful trawling in this zone is most interesting; and from a rich harvest of marine animals—many of which are either moribund or quite dead on reaching the surface—we shall be able every time to pick out the following characteristic species:—a peculiar Penæid*, the Oxyrhynch crab

* Characterized by Prof. J. Wood-Mason as a most remarkable form closely allied to *Solenocera*.

Encephaloides *, a large Oxystome crab near *Philyra*; a delicate mussel, the carnivorous Gastropod Mollusk *Rostellaria*; and the fishes *Parascombrops pellucidus* and *Scianectes*. In the class of fishes, indeed, almost everything appears to be new, and everything is interesting. Here have been found a species of *Centropristis* and a species of *Prionotus*, both being types not hitherto regarded as Indian. The occurrence of *Trigla hemisticta* must also be noticed.

It is unfortunate that for this zone too we have no continuous temperature readings; but, so far as occasional experiments go, the temperature at the bottom appears to be from 15° to 16° Fahr. lower than the temperature at the surface.

The new fishes from this zone have been described in previous papers.

§ 2. *Descriptions of New Species.*

ACANTHOPTERYGII.

Family **Scorpænidæ**.

MINOUS, C. & V.

Minous coccineus, sp. n.

D. $10/\frac{1}{12}$. A. 12.

Head broad, its length about $3\frac{2}{5}$ in the total. Body compressed, its height just over $\frac{1}{4}$ of the same. The bones of the head strong, massive, rugose, "carious" in appearance; præorbital with two strong spines, of which the posterior is recurved and much the longer; the infraorbital ring forms a broad, massive, salient buttress, ridged and furrowed, but not spiny; preoperculum with a strong sharp spine at its angle and two smaller coarse ones below; interoperculum serrulated; operculum small, with two diverging weak stays; a deep crescentic "carious" excavation across the occiput; occipital and temporal spines strong, coarsely serrated.

Snout truncated; its breadth is greater than its length, which is less than that of the eye; lower jaw the more prominent, each limb with two or three barbels. Eyes deep-set, their major diameter one third of the head-length; a short broad tentacle above the pupil; supraorbital margin coarsely crenulated; infraorbital margin thin, sharp, very salient, incomplete behind and also in front, where there is

* *Encephaloides Armstrongi*, Wood-Mason, MS.

left a well-marked groove which recurves across the cheek; interocular space narrowest in the middle, where its width is barely $\frac{3}{4}$ the vertical diameter of the eye; occupied by numerous longitudinal serrated crests, with deep furrows intervening. Nostrils tubular.

Mouth broad; the maxilla does not reach the vertical through the middle of the orbit. Villiform teeth in the jaws and in a narrow band on the bevelled edge of the vomer.

Gill-openings moderately wide; gill-membranes united to the isthmus; fourth gill-cleft a small foramen. Integument thick, investing all the fins except the caudal. All the fin-rays simple.

Dorsal fins separated by a deep notch; the spinous portion is very irregular; the first spine is very small, the second and third, which are of nearly equal length—not quite half that of the head—are isolated from each other and from the rest of the fin; the fourth, fifth, and sixth, which are of nearly equal length *inter se*—almost half that of the head—form an isolated group; the next four, which are short and weak, form another isolated group; the spine of the second dorsal fin is more than half the length of the head and longer than the soft rays. Caudal truncated. Pectoral nearly as long as the head; its appendage, which is very thick and rigid, reaches to the second anal ray. Ventral adherent to the abdomen through the greater part of its extent, reaching to the vent.

Colours in life:—Crown and nape deep brown, throat milk-white, body and fins deep crimson, becoming very dark at the margins of the spinous dorsal, anal, and paired fins; inner surface of pectorals dark brown, with broad canary-yellow lines forming a hexagonal pattern. The crimson is dissolved out in spirit.

Air-bladder small. Two pyloric appendages.

Length 4·25 inches.

Off Ganjam coast, 28 to 30 fathoms; bottom sand and shells.

Family **Cottidæ.**

Lepidotrigla, Gthr.

Lepidotrigla spiloptera, Gthr.

Lepidotrigla spiloptera, Günther, Zool. Chall. Exp. vol. i. pt. vi. p. 42, pl. xviii. fig. C.

Var. nov. *longipinnis.*

One specimen, answering in every respect, even in the details of coloration, to Dr. Günther's description; but the pectorals reach to the ninth anal ray.

Off Ganjam coast, 18 fathoms; bottom sand, shells, sponge-incrusted rock, &c.

Family **Trichonotidæ.**

TÆNIOLABRUS, Steindachner.

Tæniolabrus, Steindachner, Sitz. Ak. Wiss. Wien, 1867, lv. i. p. 713.

Tæniolabrus cyclograptus, sp. n.

B. 7. D. 49–50. A. 39–40. L. lat. 57–59. L. tr. $\frac{5}{5}$.

Head low, elongate, tapering, its length nearly one fifth of the total without, nearly one sixth with, the caudal. Body low, elongate, eel-like, its height not quite two fifths the length of the head.

Snout twice as long as the eye, depressed, acute, its tip formed by the mandible; nostrils minute. Eyes superior, but with lateral visual axis, separated by a carinated ridge; their major diameter $6\frac{1}{2}$ in the head-length.

Mouth wide, its cleft subhorizontal; the lower jaw projecting nearly half an eye-length beyond the upper and closing against a prominent tubercle formed by the enlarged end of the premaxillary; the upper jaw reaches to the vertical through the middle of the orbit. Acute villiform teeth laterally in the premaxillæ and in the vomer and palatines; small canines on the premaxillary tubercle and laterally in the lower jaw, increasing in size in front, where they stand outside the closed mouth.

Gill-opening very wide, extending almost to the mandibular symphysis; branchiostegals and suboperculum much produced backwards; gill-rakers on first arch long, close, setiform. Pseudobranchiæ present.

Head naked; body covered with rather large, imbricating, cycloid scales. Lateral line traversing the middle of the body uninterruptedly, its tubes salient. All the fins with their rays slender, and, except in the pectorals, conspicuously prolonged.

The dorsal fin, which occupies almost the entire extent of the back, has the first four radial elements weak and flexible though unarticulated, and the remainder articulated but simple; the rays gradually decrease in length from the first, which is thrice, to the last, which is nearly twice, the greatest height of the body. The anal begins nearly a head-length behind the gill-opening, and occupies the entire extent of the tail; all its rays are articulated and branched at the tip, their average height being about half the average height of the dorsal.

Caudal hastate, with thirteen branched rays, of which the longest one, situated medially, is $4\frac{1}{2}$ in the total length. Pectorals pointed, nearly as long as the postrostral portion of the head. Ventrals subjugular, with one flexible spine and five rays, the longest of which is more than three fourths the length of the caudal.

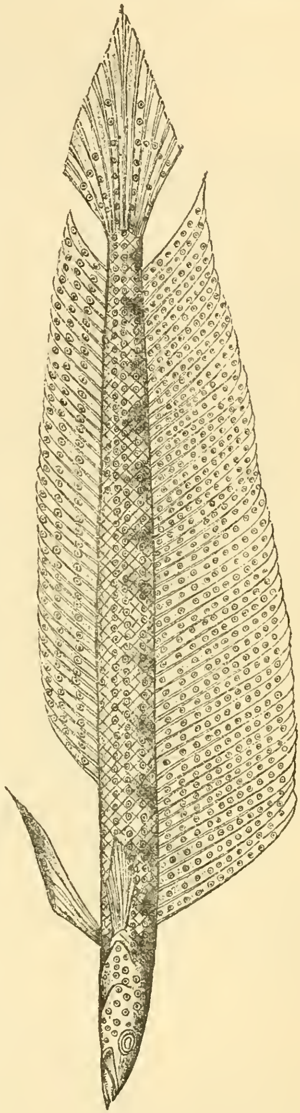


Fig. 1.

Stomach siphonal; no pyloric cæca; no air-bladder.

Colours in life:—Body, like the head, burnished metallic gold, vertical fins hyaline, both serried with brilliant torquoise-blue ocelli arranged in parallel longitudinal rows; ten such rows, of about fifty each, along the dorsal fin, three such, of sixty each, along the head and body, and three, of about forty each, along the anal fin; along the dorsal half of the body are twelve inconspicuous, equidistant, broad, dusky bands. In spirit the gold fades, the dusky bands become very dark and distinct, and the ocelli change to dark grey rings.

Length 6·1 inches.

Ganjam coast, 10 to 13 fathoms; bottom sand.

Dr. Steindachner (*loc. cit.*), who unfortunately had but one small specimen, which could not be spared for dissection, to examine, doubtfully referred *Tænio-labrus* to the Labridæ.

I have examined seven specimens and dissected one, and I find that the lower pharyngeal bones, which Dr. Steindachner was unable to investigate, are not coalesced. From the above description it will, I think, be admitted justifiable to class *Tæniolabrus* among the Trichonotidæ.

Family **Gobiidæ.**

Amblyopus, C. & V.

Amblyopus arctocephalus, sp. n.

D. $\frac{6}{43}$. A. 41. L. rect. 50–52.

Head angular, its opercular region somewhat inflated, its vertex compressed into a sharp carina, its length one sixth of the total.

Body compressed, its height, which is $7\frac{1}{2}$ in the total, diminishes very slightly from nape to base of caudal. Eyes completely hidden.

Snout broad, with the lower jaw prominent. Mouth-cleft oblique, wide, the length of the maxilla being $2\frac{2}{3}$ in that of the head; the upper lip with a short broad barbel on each side; the mandibular symphysis with a bony rugose knob. In each jaw a row of small, close, even, acute teeth, and external to these in the front of the premaxilla, on each side, two large canines, and in the mandible five, of which two are lateral and one (the largest) median.

Head naked; body covered with thin, smooth, hardly imbricate scales, which increase in size from before backwards.

Dorsal and anal fins low, enveloped in skin, confluent with the pointed caudal. Pectorals with the four or five upper rays as long as the maxilla, the lower rays extremely short. Ventrals jugular, small, cohering; their length is not quite one third the body-height.

Stomach large, saccular; no pyloric cæca. A large, globular, thick-walled air-bladder. Anal papilla large, bilobed. Eleven abdominal, seventeen caudal vertebræ.

Colours in life mottled pink, fins hyaline.

Length 5 inches.

Off Máhánaddi Delta, 50 fathoms; bottom mud. Off Vizagapatam coast, 20 to 25 fathoms; bottom mud.

Anacanthini.

Family **Ophidiidæ.**

Dinematichthys, Bleeker.

Dinematichthys piger, sp. n.

D. circ. 75. A. circ. 55. L. lat. circ. 90.

Head conoid, inflated, with loose integument; its length

4½ in the total. Body elongate, compressed; its height is hardly equal to the length of the postrostral portion of the head.

Snout broad, inflated, obtusely pointed; its length, which is one fifth that of the head, is twice that of the small sunken eye and barely equal to the width of the convex, pitted, interorbital space. Nostrils adjacent to the eye.

Mouth wide, oblique, with the jaws exactly conterminous in front; the maxilla, which is half as long as the head, is much expanded behind. Villiform teeth in the upper jaw and vomer and in a long row on the palatine; caniniform teeth in the lower jaw.

Gill-opening very wide; gill-covers much expanded; operculum with a long spine; gill-rakers few, small. Scales small, smooth, rather deciduous, covering the body and the preopercular region. Lateral line apparently ending in the anterior half of the body.

Dorsal and anal fins enveloped in thick skin; the dorsal begins in the vertical through the middle of the pectorals, the anal just in front of the vertical through the middle of the body. Caudal entirely free. Pectorals broad, truncated, half as long as the head. Ventrals uniradial, nearly as long as the head.

Colours in life uniform dark brown, almost black.

Length 2·4 inches.

Hiding under rocks in pools in coral-reefs of Great Coco Island, Andaman Archipelago.

Family **Pleuronectidæ.**

Arnoglossus, Blkr.

Arnoglossus macrolophus, Alcock.

Arnoglossus macrolophus, Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. pp. 280, 281, pl. xviii. fig. 2.

This species appears to be very common off the Ganjam coast in 25 to 35 fathoms. The elongation of the anterior rays of the dorsal fin is a secondary sexual character displayed by the adult males alone.

Arnoglossus brevirictis, sp. n.

D. 76–80. A. 60–62. C. 17. P. 10. V. 6. L. lat. 55.

Body rather elongate; its greatest height about 2¾ in the total with the caudal. Length of the head 4⅓ in the same standard and equal to its height.

Snout obtusely pointed, scaleless; its length is not quite two thirds the major diameter of the eye, which is one third the head-length. Eyes on the left side, separated by a very thin and sharp decliving ridge; the lower in advance of the upper.

Mouth small; the maxilla, which barely reaches behind the vertical through the anterior limit of the lower eye, is $3\frac{1}{2}$ in the head-length. Minute, even, close, uniserial teeth in both sides of both jaws.

Gill-membranes broadly united; gill-rakers small, smooth. Scales of moderate size, fairly adherent and strongly ctenoid on the coloured, cycloid and very deciduous on the blind side. Lateral line with a strong supra-pectoral curve.

The dorsal fin begins almost on the tip of the snout; its highest rays (in the female) are not quite equal to the corresponding anal rays, which are nearly one third the maximum body-height. Caudal obtusely rounded, its length one sixth of the total. The rays of all the vertical fins scaly. Right pectoral equiradial with, but much narrower and shorter than, the left, which is as long as the portion of the head behind the middle of the lower eye. Left ventral with the rays in a linear series along the middle abdominal line.

Colours in life:—Left side dusky brown, with indefinite blackish patches round the body inside the vertical fins and along the lateral line, and with black speckles on all the fins.

Two female specimens with enlarged ovaries.

Length 2·8 inches.

Off Ganjam coast, 30 fathoms; bottom sand and shells.

This species appears to be closely related to the preceding.

Rhomboidichthys, Blkr.

Rhomboidichthys polylepis, Alcock.

Arnoglossus polylepis, Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. pp. 290, 291, pl. xvi. fig. 1.

A large mature female with gravid ovaries was taken off the south-east coast of Ceylon in 32 fathoms.

In this female specimen the interorbital space is two fifths of the snout-length in width, deeply concave, scaleless; the maxilla measures one third the head-length; the first two rays of the dorsal fin (which in the male (?) are detached and curiously thickened at their bases) are small, unmodified, and continuous with the rest of the fin. The pectoral fins of both sides are also slightly more developed than in the male (?).

This species appears to be closely allied to the next following.

Rhomboidichthys angustifrons, Gthr.

Rhomboidichthys angustifrons, Günther, Zool. 'Challenger' Exp. vol. i. pt. vi. p. 46, pl. xxi. fig. B.

Off south-east coast of Ceylon, lat. 6° 6′ 30″ N., long. 81° 23′ E., 32 fathoms; bottom sand, shells, dead coral, &c.

Rhomboidichthys azureus, Alcock.

Rhomboidichthys azureus, Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. pp. 283, 284.

Off south-east coast of Ceylon, as above, 32 fathoms.

Also met with all along the Ganjam coast, in depths ranging from 11 to 33 fathoms, and in places where the bottom consists either of hard sand, or of broken shells, rock, and dead coral.

Examination of a large number of specimens shows the radial formula to be

D. 84–90. A. 64–70. C. 17. L. lat. 55.

The lateral line on the blind side has no suprapectoral curve, but simply rises gradually to the post-temporal region.

The males of this species, in addition to the brilliant blue spots on the snout, are altogether brighter coloured than the females; on the blind side too they show a large, subcutaneous, pyriform, black patch.

Rhomboidichthys valde-rostratus, sp. n.

D. 84. A. 64. L. lat. 48.

Body pyriform; its height very nearly half its length, including the caudal. Head slightly over $\frac{2}{9}$ of the same standard in length, and half again as high as long; its anterior profile almost vertical.

Snout abruptly prominent, in length barely $\frac{3}{4}$ the major diameter of the eye, bearing on its left side an advanced, up-curved, bifid horn of equal length. Eyes on the left side, prominent, in diameter about $\frac{2}{7}$ of the head-length; the lower nearly half its length in advance of the upper; internal orbital margins strong, thick, salient, and spiny. Interorbital space deeply concave, scaly, except for a narrow bridge of naked skin in its anterior part; its width is nearly a diameter and a half of the eye. Nostrils small; the anterior tubular, the posterior subtubular on the coloured side.

Mouth-cleft moderate, approaching the vertical; the length of the maxilla is nearly $\frac{1}{3}$ that of the head. Teeth numerous, close-set, even, acute, uniserial, in both jaws.

Gill-membranes united; gill-rakers few, short. Scales of moderate size, adherent; thick and strongly ctenoid on the coloured, cycloid on the blind side. Lateral line with a supra-pectoral curve; its scales small and faintly bilobed. The longest dorsal rays, which exceed the corresponding anal rays, are $\frac{1}{4}$ the body-height. Paired fins much more developed on the coloured side, where the pectoral has its upper rays prolonged equal to $\frac{1}{3}$ the length of the body measured without the caudal.

Colours in life:—Left side brown, with irregular black blotches, the three largest of which are on the lateral line, while the others form a series round the body; several transverse series of deep blue spots in the interorbital space anteriorly; right side with a transverse black band behind the mouth and with a number of indefinite dark blotches arranged in a large triangular patch in the middle of the body.

Total length 3·75 inches.

Off the south-east coast of Ceylon, 32 fathoms, as above.

This species is closely allied to the next preceding, and the single specimen appears to be a male.

At several stations off the Ganjam coast there have been taken some curious dwarf Pleuronectids which, in consequence of their diminutive size and the transparency of their tissues, one is at first inclined to regard as either larval or stunted forms. But in the relative proportions of the body, in the completed asymmetry (shown in the unilateral disposition of the eyes, the unilateral restriction of pigment, and the slight unilateral atrophy of the paired fins), in the perfect ossification of the skeleton, and in the character of the vertical fins, one sees indications of development sufficiently advanced to permit of tolerably accurate generic and specific discrimination. The outline of the body is like that of *Rhombus*, but more circular; the nature of the mouth and dentition and the disposition of the eyes are similar to *Rhomboidichthys*.

PSETTYLLIS, gen. nov.

Allied to *Rhomboidichthys*?

Body subcircular. Jaws and dentition symmetrical; mouth very small, the length of the maxilla being less than one fourth that of the head; teeth minute, in the jaws only. Eyes on the left side, separated by a broad concave space.

The dorsal fin commences on the snout; its rays and those of the anal simple. No scales. Lateral line with a sharp or faint curve above the pectoral.

Psettyllis pellucida, sp. n.

D. 85. A. 65. C. 17. P. 5. V. 6.

Body naked, subcircular, its height being ·96 of its length without the caudal. The height of the head is more than twice its length, which is about $4\frac{2}{3}$ in the same standard. Profile of the snout almost merged in the anterior profile of the body. Eyes small, situated on the left side of the head close to its anterior profile, the lower slightly in advance of the upper; interorbital space concave; its width is a little more than twice the major diameter of the eye.

Mouth minute, symmetrical; teeth minute, in both sides of the jaws.

Gill-membranes broadly united below. Lateral line with a slight open curve above the pectoral.

All the fins delicate; the vertical fins low; the paired fins small and nearly equally developed on both sides. Caudal as long as the head. The dorsal begins almost on the horizontal through the upper limit of the lower eye.

Quite transparent in life; iris black; on the left side a few variable black blotches on the body and numerous black blotches on the fins.

Length 1·58 inches.

Off Ganjam coast, 9 to 13 fathoms; bottom sand. Off Vizagapatam coast, 7 to 8 fathoms, bottom sand; and 20 fathoms, bottom mud.

Psettyllis ocellata, sp. n.

D. 85. A. 65. C. 18. P. 9? V. 6.

Body naked, subcircular, its height being ·78 of its length without the caudal. The height of the head is not quite twice its length, which is about one fourth of the same.

Profile of the snout merged in that of the head. Eyes small, on the left side of the head, close to its anterior profile, the lower slightly in advance of the upper; interorbital space concave; its width is barely twice the major diameter of the eye.

Mouth symmetrical, small, the length of the maxilla being $4\frac{2}{3}$ in that of the head; teeth minute, in both sides of the jaws.

Gill-membranes broadly united below. Lateral line on the coloured side with a strong, on the blind side with a wide shallow, curve above the pectoral.

All the fins delicate; the vertical fins low; the paired fins nearly equally developed on both sides, the left pectoral being nearly as long as the caudal, which is about one fifth of the total. The dorsal begins almost on the horizontal through the upper limit of the lower eye.

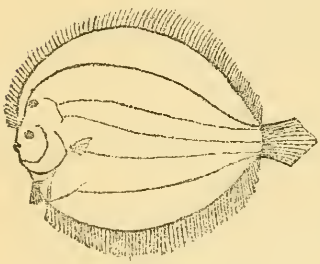
Transparent in life; on the left side, behind the supra-pectoral curve, a most perfect dark ocellus; two large round black spots on the straight part of the lateral line; a series of dark perfectly-formed black rings round the body, and outside these a series of dark round spots.

Length 1·5 inches.

Off Ganjam coast, 9 to 13 fathoms, as above. Off Vizagapatam coast, $7\frac{1}{2}$ to $9\frac{1}{2}$ fathoms; bottom sand.

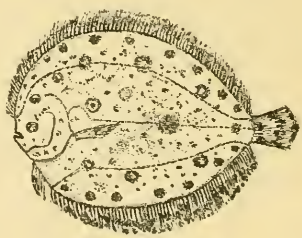
Specimens of these curious fishes were taken at altogether four stations between the middle of December and the end of February. The other Pleuronectids captured at the same time were species of *Rhomboidichthys*, *Solea*, *Synaptura*, and *Cynoglossus*.

Fig. 2.



Psettyllis pellucida.

Fig. 3.



Psettyllis ocellata.

Læops, Gthr.

Læops Guentheri, sp. n.

D. 94–98. A. 79–80. C. 16. P. d. & s. 13. V. d. & s. 6.

Body regularly elliptical, its height about $2\frac{3}{4}$ in the total without the caudal. Length of the head $4\frac{1}{2}$ to $4\frac{4}{7}$ in the same standard and almost exactly equal to its height.

Snout obtusely pointed, very short, its length about half the major diameter of the eye, which is about $\frac{1}{3}$ of the head-length. Eyes on the left side, separated by a ridge, the lower slightly in advance of the upper, which bulges into the dorsal profile.

Mouth small, twisted towards the right, its cleft approaching the vertical; the maxillary barely reaches the vertical from the anterior limit of the lower orbit. Villiform teeth in the jaws on the blind side only.

Gill-cleft narrow, the gill-membranes united together throughout. Minute very deciduous scales. Lateral line with a strong supra-pectoral curve.

The dorsal fin begins in front of the eye and ends on the base of the caudal; its first two rays are isolated; its longest rays, about the middle, are $\frac{1}{3}$ the greatest body-height and equal to the corresponding anal rays. Pectorals almost equally developed; the left, which is slightly longer than the right, equals the length of the head behind the middle of the lower eye. Ventrals equally developed; the left is in the same straight line with the anal. Caudal obtusely pointed; its length about $6\frac{1}{2}$ in the total.

Colours in life:—Deep ruddy brown; vertical fins and left ventral black.

Length of largest specimen 4·5 inches.

Found (1) in the Gulf of Martaban, 20 fathoms, bottom mud; (2) off Ganjam and Vizagapatam coasts in 15 to 30 fathoms, usually on muddy bottoms, but sometimes on sand, broken shells, &c.

This species is very similar to *Læops parviceps*, Günther, but the characters which distinguish it are so constant throughout a number of individuals, that one is obliged to recognize their specific value.

Solea, Gthr.

Solea cyanea, sp. n.

D. 77. A. 54. C. 18. P. 0. V. 5. L. lat. 78–80 *.

Body elongate; its height in the total is $2\frac{7}{8}$ with, $2\frac{1}{2}$ without the caudal. The length of the head is about $4\frac{1}{3}$ in the latter standard and about one fourth less than its height.

Snout semicircular in outline; its length is one third that of the head and twice the diameter of the eye. Eyes circular,

* To its termination behind the upper eye.

separated by a very narrow scaly space; the upper nearly half its length in advance of the lower.

The anterior nostril of both sides is a slender tube; the one on the coloured side, which is the longer, measuring a diameter of the eye.

Mouth curved, to form a blunt truncated rostral hook, which does not reach halfway to the vertical from the anterior limit of the upper eye; its angle extends well behind the vertical from the middle of the lower eye. Villiform teeth on the blind side only. Mid mento-jugular line fringed with ciliiform barbules.

Gill-openings narrow; the branchiostegal rays and membrane project beyond the opercular margin. Scales uniformly small, strongly ctenoid on both sides. Lateral line straight, ending on the coloured side an eye-length behind the upper orbit.

The dorsal fin begins on the tip of the snout in the form of a few filiform rays, and extends, as does the anal, to the base of the caudal; the highest rays are half the length of the caudal, which is $5\frac{3}{4}$ in the total; all the vertical fin-rays scaleless. No pectoral fins. Ventrals symmetrical, lateral, separated from the origin of the anal by a wide interval.

Colours in life:—Body and fins on right side very dark olive, with some blackish flecks arranged in five cross series; on the left side uniformly clouded with blue-black.

Length 3·8 inches.

Off Ganjam coast, 33 fathoms; bottom sand. Off Vizagapatam coast, 20 to 25 fathoms; sand, mud.

In spirit both sides dull blue-black, the left side being the lighter.

SYNAPTURA, Cantor.

Synaptura quagga (Kaup).

Æsopia quagga, Kaup, in Wiegm. Archiv, 1858, p. 98.
Synaptura quagga, Günther, Cat. iv. p. 485.

In the Journ. As. Soc. Beng. vol. lviii. pt. ii. p. 286, I erroneously stated that this species was to be found in 7 to 10 fathoms on the east coast of India. This should have applied to *S. zebra* (Bloch). *S. quagga* (Kaup) has been taken by the 'Investigator' only between 26 and 33 fathoms.

Synaptura altipinnis, sp. n.

D. 81. A. 66. C. 18. P. 9. V. 4. L. lat. 135 *.
L. tr. $\frac{31}{41}$.

Body oval; its height a little over one third the total measured to the tip of the caudal. Length of the head one sixth of the same, one third higher than long.

Snout obtuse, a little longer than the lower eye, which is one fifth the head-length in the major diameter; upper eye smaller, about a third its diameter in advance of the lower. Interorbital space less than half a diameter of the eye in width, scaly.

A very short tubular nostril on the coloured side; the other nostrils indistinguishable.

The mouth-cleft reaches beyond the vertical through the middle of the lower eye. Mid-mento-jugular line with thick-set ciliiform barbules.

Gill-opening very narrow; the gill-membranes on both sides expanded above and annexed to the bases of the pectorals. Scales very sharply ctenoid on both sides, slightly increased in size in the posterior half of the body. Lateral line as in *S. zebra*, on both sides.

Dorsal and anal fins confluent with the caudal up to its tip; the dorsal begins just in advance of the upper eye, its rays, like those of the anal, increasing very gradually in length from before backwards, the hindermost measuring more than one third of the greatest body-height and a little more than the corresponding anal rays. Caudal broad, fan-shaped, its length $6\frac{1}{2}$ in the total. Pectorals symmetrical, very small, the longest rays being not quite $\frac{3}{4}$ the major diameter of the eye. Ventrals also very small, about as long as the snout.

Colours in life:—Right side of body and fins striped, in the manner of *S. quagga*, in alternate cross bands of purple-brown and ash-brown, to the number of twenty-eight; caudal purple-brown, with large ash-brown blots.

One specimen, 7·25 inches long.

Off Vizagapatam coast, 25 fathoms; bottom mud.

* From origin on snout to base of caudal.

Cynoglossus [Ham. Buch.].

Cynoglossus versicolor, sp. n.

D. 112. A. 88. C. 10. V. 4.
L. lat. 75 to gill-opening.

Body tapering acuminately to the caudal; its height $4\frac{1}{9}$ in the total. Height of the head about one fourth greater than its length, which is about one sixth of the total.

Snout symmetrically rounded; its length is one third that of the head; rostral hook not extending behind the level of the mandibular symphysis. Eyes nearly circular, the diameter one seventh of the head-length; the upper a third of a diameter in advance of, and half a diameter apart from, the lower, which is so situated as to much erode the outline of the lip. On the coloured side only one nostril, in the form of a rather long slender tube situated in front of the lower eye; on the blind side two, the anterior of which is a short tube.

Mouth small, its angle nearer to the tip of the snout than to the gill-opening. Scales ctenoid on both sides. Two lateral lines on the coloured side, branching and anastomosing on the head; the upper, which ends just in front of the posterior fourth of the body, is separated from the lower, which is continuous to the base of the caudal, by twelve rows of scales. No lateral line on the blind side. One ventral fin united to the anal by a broad membrane. The highest [middle] anal rays slightly surpass the corresponding dorsal rays, which equal the snout in length.

Colours in life:—Left side yellowish brown, profusely marbled with chestnut-brown and sepia; a large ocelliform red-brown patch, with a yellow areola on the abdomen just behind the gill-opening.

Length nearly 5 inches. One specimen.

Off the Orissa coast, 11 fathoms; bottom hard sand.

Cynoglossus præcisus, sp. n.

D. 112. A. 88. C. 8. V. 4. L. lat. 65 to gill-opening.

Height of the body one fourth of the total. Height of the head one eighth greater than its length, which is nearly one fifth of the total.

Snout obtusely pointed; its length is $3\frac{1}{4}$ that of the head; rostral hook not extending behind the mandibular symphysis.

Eyes almost in contact, the upper slightly in advance of the lower, which is on the lip; their major diameter is more than one sixth the head-length. On the coloured side only one nostril, in the form of a rather long slender tube situated in front of the lower eye; on the blind side two, the anterior of which is a short tube.

Mouth small, its angle nearer to the tip of the snout than to the gill-opening. Scales ctenoid on both sides. Two lateral lines on the coloured side, which branch and anastomose on the head; the upper, which ends immediately behind the vertical through the middle of the body, is separated from the lower, which is continuous to the base of the caudal, by ten rows of scales. No lateral line on the blind side. One ventral fin united to the anal by a broad membrane. The highest [middle] dorsal and anal rays considerably exceed the length of the snout.

Colours in life:—Left side uniform sepia-brown.

Length nearly 5 inches. Two specimens.

Off Ganjam coast, 33 fathoms; bottom sand.

These two species are closely allied, both belonging to the subgenus *Trulla*, Kaup.

LIII.—*Report on the Corals from the Tizard and Macclesfield Banks, China Sea.* By P. W. Bassett-Smith, Surgeon R.N.

[Concluded from p. 374.]

Section Madreporaria Fungida.

Genus Siderastræa, Blainville.

Siderastræa?, sp. n.

A large, massive, incrusting specimen about 22 centim. in diameter, the upper surface uneven, with blunt rounded ridges, thickly covered with subpolygonal or compressed calices, from 3 to 6 millim. in width. Walls thin, but only visible here and there; they are apparently thick at the surface. The septa from 22 to 30 in number, very thin, platelike, their sides minutely spined, the margins subentire or very minutely serrate, their upper edges above the calice-walls sometimes confluent with adjoining septa. Apparently no columella, but numerous dissepiments. Calices deep; the larger septa reaching nearly to the centre.

The absence of a columella and the character of the septa, which are very different from those of *Siderastræa galaxea*, renders the generic position of this form uncertain; and there is an apparent absence of synapticula.

Tizard-Reef lagoon, depth 6 fath.

Genus FUNGIA, Lam.

Very few examples of this genus were obtained; the specimens were usually dead and incrusted by other organisms, so that their specific characters could not be determined.

Fungia scutaria?, Lam.

Fungia scutaria, Lam. Hist. des Anim. sans Vertèbr. t. ii. (2nd ed.) p. 372.

Tizard Bank, ½ fath.

Genus PAVONIA, Lam.

Pavonia papyracea, Dana.

1848. *Pavonia papyracea*, Dana, Expl. Exp. Zooph. p. 323, pl. xxii. fig. 3.

Entire and fragmentary fronds of this species were obtained, some living, others dead and incrusted by Nullipores.

Macclesfield Bank, depth 40 fath.

Pavonia pretiosa, sp. n.

Growing in small bushy clumps of narrow, contorted, ribbon-like branches, which do not coalesce with each other. The branches about 5 millim. in width, of paper-like thinness, either flattened or slightly incurved, the under surface finely striate, the striæ crested by blunt tubercles, the margins of the fronds very spinous from the projecting ends of the septa. The upper surface flat, or more generally incurved so as to form an open channel, the calices in single series varying from 3 to 10 millim. apart, about 1 millim. wide, their immediate borders slightly elevated; from 12 to 16 septa, their sides very minutely spinous. A small blunt tuberculate columella.

The single living clump is 60 millim. in height by 75 in width.

From the Tizard Bank, depth 27 fath.

Pavonia ramosa, sp. n.

Corallum small, branching, the branches narrow, generally upright, at their summits with open, divergent, finger-like processes. The branches thin, with strongly incurved margins, so that the outer or under surfaces are strongly convex, whilst their upper surfaces are deeply channelled, the margins spinous; the outer surfaces with well-marked costal striæ, which are crested with very minute spines. Calices in single series at the bottom of the channelled upper surface of the branches, from 3 to 10 millim. apart. Calices depressed, less than 1 millim. wide; from 8 to 12 septa. Columella inconspicuous, septa strongly and minutely spined laterally. The branches from 2·5 to 4 millim. in width.

This species differs from the preceding in the narrower, more incurved branches, the smaller calices with fewer septa, and the more strongly marked costæ of the under surface.

Macclesfield Bank, depth 26 fath.

Pavonia clivosa, Verrill.

1869. *Pavonia clivosa*, Verrill, Proc. Boston Soc. Nat. Hist. xii. p. 394; Trans. Connect. Acad. vol. i. (1866–71), p. 544, pl. ix. fig. 8.

Incrusting, forming large masses with an uneven lobate and ridged surface, consisting of successive crusts about 4 millim. thick. The upper surface crowded with calices about ·75 millim. wide and 2 millim. from centre to centre. The calices with from 10 to 22 septa, large and small, the septa finely spined laterally, confluent as usually in this genus. The columella a blunted tubercle, sometimes compressed.

This specimen, about 200 millim. in length, agrees in so many respects with Verrill's description that it may fairly be referred to it. I do not, however, distinguish any of the dissepiments or "transverse septa" referred to by Verrill.

Tizard Bank, depth 8 to 10 fath.

Pavonia, sp.

A fragment of a frond, thin, finely striate on the under surface, the upper surface alone with calices, irregularly situated between raised ridges running towards edge of frond. Same mode of growth as *P. divaricata*, but the calices restricted to one surface.

Macclesfield Bank, 26½ fath.

Pavonia, sp. n.

Growing as small hollow stems partially incrusting round Annelid tubes, the under surface finely striate; outer surface nodose and uneven, with numerous calices very irregular in position, sometimes in close contact, projecting slightly, circular or compressed, from 2 to 3 millim. wide; septa from 20 to 30, nearly sharp edges, laterally strongly echinulate, variable in this respect, sometimes showing dissepiments (?) or thin synapticula extending between the septa; calices deep; columella tuberculate or compressed, so as to be partially laminate, the septa confluent.

This form may be merely an abnormal mode of growth of a laminate frond which has become curved, so that the margins united to form a hollow stem. It does not seem to correspond to any described species.

Macclesfield Bank, 20½ fath.

Genus Cycloseris, Ed. & H.

Cycloseris cyclolites, Lam., sp.

1816. *Fungia cyclolites*, Lam. Hist. des Anim. sans Vertèbr. t. ii. p. 226, 2nd ed. p. 371.

1860. *Cycloseris cyclolites*, Ed. & H. Hist. Nat. des Corall. t. iii. p. 50, pl. D 12. fig. 3.

A single dead specimen 40 millim. in diameter and 10 millim. in height is perhaps referable to this species, though it is not more than half the height of typical examples of the species and the central fossette is more open.

From the Tizard Bank, depth 28 fath.

Cycloseris tenuis, Dana, sp.

1848. *Fungia tenuis*, Dana, Expl. Exp. Zooph. p. 290, pl. xviii. fig. 1.

1860. *Cycloseris hexagonalis*, Ed. & H. Hist. Nat. des Corall. t. iii. p. 51.

1881. *Cycloseris tenuis*, Moseley, 'Challenger' Rep. vol. ii. p. 191, pl. x. fig. 6 *a*.

There are several examples of this form, which range from 6 to 21 millim. in diameter and from 1·5 to 5 millim. in height. The specimens are free with the exception of a young individual, which has a short cylindrical stem and is growing on a sponge, and one dead specimen.

From the Tizard Bank, depth 27 to 28 fath.

Cycloseris sinensis, Ed. & H.

1851. *Cycloseris sinensis*, Ed. & H. Ann. des Sc. Nat. 3ᵉ sér. t. xv. p. 112.

One specimen, free, 26 millim. wide by 3·3 millim. high, and an apparently young individual, 6 millim. wide, attached by a short stem.

From the Macclesfield Bank, depth 26 fath.

Cycloseris Freycineti, Ed. & H., sp.

1851. *Diaseris Freycineti*, Ed. & H. Ann. des Sc. Nat. 3 sér. t. xv. p. 118.
1886. *Cycloseris Freycineti*, Quelch, Chall. Rep. vol. xvi. pt. 46, p. 121.

Fragments of this species only.
From the Tizard Bank, depth 27 fath.

Cycloseris distorta, Michelin, sp.

1843. *Fungia distorta*, Mich. Mag. de Zool. t. v. Zooph. pl. v.
1886. *Cycloseris distorta*, Quelch, Chall. Rep. vol. xvi. pt. 46, p. 120.

Small fan-shaped specimens, dead, the largest 14 millim. in diameter and 3 millim. in height.

From the Tizard Bank; one specimen from a depth of 43 fath., another from 28 fath.

Genus Leptoseris, Ed. & H.

Leptoseris striatus, MS.?

Two specimens, one living, one dead, were obtained from the Tizard Bank at a depth of 35 fath.

Leptoseris, sp.

A small pedunculated specimen, with a simple, oblong, cup-shaped calice 10 millim. long by 8 deep; the six primary septa slightly elevated near the centre, and between each pair six or seven smaller septa. It is probably a young form.

Tizard Bank, 28 fath.

Genus Phyllastræa, Dana.

Phyllastræa Okeni?, Ed. & H., sp.

1851. *Mycedium Okeni*, Ed. & H. Ann. des Sc. Nat. 3e sér. t. xv. p. 132.

There is only a small fragment, from the edge of the frond of a specimen, not sufficient for satisfactory determination.

Tizard Bank, 32 fath.

Phyllastræa tubifex, Dana.

1848. *Phyllastræa tubifex*, Dana, Expl. Exp. Zooph. p. 270, pl. xvi. fig. 4.

Specimens living, but only small fragments.
Macclesfield Bank, 26½ fath.

Genus Pachyseris, Ed. & H.

Pachyseris levicollis, Dana, sp.

1848. *Agaricia lævicollis,* Dana, Expl. Exp. Zooph. p. 338, pl. xxii. fig. 2.

A fragment of a frond, living.
Macclesfield Bank, 26½ fath.

Genus Oxypora, Sav. Kent.

Oxypora contorta, Quelch.

1887. *Oxypora contorta,* Quelch, Chall. Rep. Reef-Corals, p. 129, pl. v. fig. 2.

Only some small fragments of a living specimen were obtained.
Macclesfield Bank, 26 fath.

Genus Psammocora, Dana.

Psammocora planipora, E. & H.

Psammocora planipora, Ed. & H. Monogr. des Poritides, p. 68.

The mode of branching and the thickness of the branches differ from the description given of this species; but the structure of the calices and septa fairly correspond.
Macclesfield Bank, depth 26 to 32 fathoms.

Psammocora, sp.

The mode of branching and the thickness of the branches correspond with the previous species, but the columella is papillary, and it might therefore come within the definition of *Stephanaria*, Verrill; but this character hardly seems to possess a generic importance. This species seems to have been confused with *P. planipora*, and the differences between them are microscopic in character.
Macclesfield Bank, 27 fath.

Psammocora Haimeana, Ed. & H.

Psammocora Haimeana, Ed. & H. Monogr. des Poritides.
1879. *Psammocora Haimeana,* Klunzinger, Die Korallth. des rothen Meeres, pt. iii. p. 81, pl. ix. fig. 5.

The only specimen is incrusting and is apparently in its early stages of growth.
From the lagoon, Tizard Reef, 6 fath.

Fungid Coral, gen. et sp. ind.

Corallum turbinate, attached, the upper surface flattened, convex, the lateral surface faintly costulated. The upper surface 23 millim. wide, with a principal subcentral calice about 2 millim. wide, with one septa; also two smaller subordinate calices. The septa confluent, extending quite to the edge of corallum, closely arranged, composed of nodular trabeculæ, which appear to remain perforate. Columella papillary, inconspicuous.

I do not find any recent genus in which this coral can be included. It would apparently belong to the family Plesioporitidæ of Prof. Duncan (Rev. Madrep., Journn. Linn. Soc., Zool. vol. xviii. p. 165). As there is only one specimen it cannot be sacrificed for sections.

From Tizard Bank, 6 fath.

Section MADREPORARIA PERFORATA.

Genus BALANOPHYLLIA, Searles Wood.

Balanophyllia parvula?, Moseley.

1881. *Balanophyllia parvula*, Moseley, Chall. Report, Zool. vol. ii. p. 194.

Tizard Bank, 50 fath.

Balanophyllia scabrosa?, Dana, sp.

1848. *Dendrophyllia scabrosa*, Dana, Expl. Exp. Zooph. p. 390, pl. xxvii. fig. 2.

Two specimens, both living when obtained.

Tizard Bank, 40 fath.

Genus DENDROPHYLLIA, Blainville.

Dendrophyllia gravis, Bruggeman, MS. ?

One large branch more than 30 centim. in height and a smaller branch were obtained. Only in the upper portion were the polyps alive; of a blackish tint.

This form is similar to specimens in the British Museum marked as above, which may be a MS. name, for I have not met with any printed description of the species.

Tizard Bank, 26 fath.

Genus Montipora, Quoy & Gaimard.

Montipora papillosa, Lam., sp.

1816. *Agaricia papillosa*, Lam. Hist. Nat. des Anim. sans Vertèbr. t. ii. p. 243, 2nd ed. p. 382.

A single large explanate frond, in which the polyps are living only in patches.

Tizard Bank, depth 25 fath.

Montipora foliosa, Pallas, sp.

1766. *Madrepora foliosa*, Pallas, Elench. Zooph. p. 333.

Only a few small fragments of this form were obtained.

Macclesfield Bank, 20½ fath.

Montipora prolifica, Brugg., MS. ?

Macclesfield Bank, 26½ fath.

Montipora lima?, Lam., sp.

1816. *Agaricia lima*, Lam. Hist. Nat. des Anim. sans Vertèbr. t. ii. p. 243, 2nd ed. p. 382.

Only a small fragment of a thin frond, doubtfully referred to this species.

Macclesfield Bank, 26½ fath.

Montipora, sp.

Large plate-shaped expansion, about 12 millim. in thickness, the under surface partly naked, partly with wrinkled epitheca; upper surface thickly covered with spinous papillæ. Calices in the interspaces between these are nearly 1 millim. in width, with from six to nine septa.

Tizard Bank, depth 8½ fath.

Montipora Danæ, Ed. & H.

Montipora Danæ, Ed. & H. Monogr. des Poritides, p. 62.

Tizard Bank, ½ fath.

Montipora, sp.

Corallum very thin, explanate, not incrusting, about 1 to 1·5 millim. in thickness, very delicate porous upper surface. Calices small, short, about 1 millim. in width, with six septa. Approaches *M. lichen*, Dana, sp., but is much thinner and not incrusting. The under surface with delicate concentric epitheca, not spinous.

Macclesfield Bank, 40 fath.

Montipora porosa, sp. n.

Corallum forming a thin spreading frond from 1 to 2 millim. in thickness; surface uneven; over the greater part of the frond calices are developed on both sides, but occasional patches of a concentrically-wrinkled non-spinous epitheca are present; calices few, irregularly scattered, not prominent, about 5 millim. wide; septa only represented by twelve subequal, nearly horizontal spines round the margin; cœnenchyma minutely echinulate.

A single specimen taken alive.

Macclesfield Bank, 35 fath.

Montipora, sp.

Corallum incrusting, thin; upper surface uneven, with occasional rounded papillæ or tubercles. Calices about ·75 millim. wide, with six septa and sometimes smaller intermediate septa. Cœnenchyma finely echinulate.

Macclesfield Bank, depth 44 fath.

Genus Turbinaria, Oken.

Turbinaria stellulata, Blainv., sp.

1834. *Astræopora stellulata*, Blainv., var.

A massive convex specimen; surface reddish brown. Calices irregularly arranged, 1 to 2 millim. apart; margins slightly elevated, circular, nearly 2 millim. in width, very deep; twenty-four subequal vertical septa; well developed trabecular columella filling the base of calices.

This form agrees fairly well with the descriptions of this species, but the calices are closer arranged.

Tizard Bank, 5 to 10 fathoms.

Genus Madrepora, Linn.

In the collection are no less than thirty-two species of this genus, five of which were obtained in depths over 20 fath. and are all, I believe, new. Four of them were from the Macclesfield Bank, one from the Tizard Bank, and one was common to both; all these deep-water species were fragile, and one was particularly beautiful (*M. fragilis*).

Madrepora robusta, Dana.

1848. *Madrepora robusta*, Dana, Expl. Exp. Zooph. p. 475, pl. xxxix. fig. 3.

Tizard Bank, 5 fath.

Madrepora crebripora, Dana.

1848. *Madrepora crebripora*, Dana, Expl. Exp. Zooph. p. 470, pl. xxxi. fig. 1.

Sand-Kay, Tizard Bank, ½ fath.

Madrepora secunda, Dana.

1848. *Madrepora secunda*, Dana, Expl. Exp. Zooph. p. 481, pl. iv *a*. fig. 4.

Tizard Bank, 5 fath.

Madrepora scabrosa, Quelch.

1887. *Madrepora scabrosa*, Quelch, Chall. Rep. vol. xvi. p. 152, pl. x. fig. 2.

Tizard Bank, 6½ fath.

Madrepora horrida, Dana.

Tizard Bank, 2 fath.

Madrepora Ehrenbergii, Ed. & H.

1860. *Madrepora Ehrenbergii*, Ed. & H. Hist. Nat. des Cor. t. iii. p. 143.

Tizard Bank, 5 fath.

Madrepora dendrum, sp. n.

Arborescent, subcespitose; stem solid, strong; surface finely echinulo-striate, bearing curved, simple or subproliferous, gradually tapering branchlets, 2½ centim. long, 3 centim. thick, with compressed nariform calices, tending to form into rows showing two very long septa; apical calices 1 millim., exsert, stem distinct; under surface shows branches sinuously curved, with spreading margin, not coalescing, with few immersed calices.

Macclesfield and Tizard Banks, 20 to 27 fath.

Madrepora compressa, sp. n.

Pedunculated from wide base, dendriform, flattened and oblique, cespitose, branches coalescing; upper surface bearing rosette-like bunches of short tubiform calices with twelve septa; apical calices a little prominent, 1·5 millim. wide; under surface with few immersed calices.

Tizard Bank, 5 fath.

Madrepora, sp. n.

Near to *M. effusa*, Dana.

Macclesfield Bank, 26½ fath.

Madrepora plantaginea, Lam.

1836. *Madrepora plantaginea*, Lam. Hist. Nat. des Anim. sans Vertèbr. t. ii. p. 447.

Tizard Bank, 6 fath.

Madrepora valida, Dana.

1848. *Madrepora valida*, Dana, Expl. Exp. Zooph. p. 461, pl. xxxv. fig. 1.

Tizard Bank, 6 fath.

Madrepora paxilligera, Dana.

1848. *Madrepora paxilligera*, Dana, Expl. Exp. Zooph. p. 452, pl. xxiv. fig. 1.

Nam-Yit, Tizard, 1 fath.

Madrepora pyramidalis, Klunz.

1879. *Madrepora pyramidalis*, Klunz. Die Korallth. des roth. Meeres, Th. ii. p. 12, pl. i. fig. 2 &c.

Tizard and Macclesfield Banks, 2 fath.; also var. *depressa*, Kl.

Madrepora seriata, Ehrenberg, sp.

1834. *Heteropora seriata*, Ehr. Beit. z. Kenntn. der Corallenth. des roth. Meeres, p. 113.

Tizard Bank, 2 fath.

Madrepora tenuis, Dana.

1848. *Madrepora tenuis*, Dana, Expl. Exp. Zooph. p. 451.

Tizard Bank, 1 fath.

Madrepora nasuta, Dana.

1848. *Madrepora nasuta*, Dana, Expl. Exp. Zooph. p. 453, pl. xxxiv. fig. 2.

Tizard Bank, 5 fath.

Madrepora effusa, Dana.

1848. *Madrepora effusa*, Dana, Expl. Exp. Zooph. p. 455.

Tizard Bank, 5 fath.

Madrepora globiceps, Dana.

1848. *Madrepora globiceps*, Dana, Expl. Exp. Zooph. p. 454, pl. xxxiv. fig. 3.

Tizard Bank, 7 fath.

Madrepora acervata, Dana.

1848. *Madrepora acervata*, Dana, Expl. Exp. Zooph. p. 460, pl. xxxiv. fig. 43.

Tizard Bank, 8½ fath.

Madrepora aculeus, Dana.

1848. *Madrepora aculeus*, Dana, Expl. Exp. Zooph. p. 450, pl. xxxii. fig. 6.

Tizard Bank, 8½ fath.

Madrepora corymbosa, Lam.

Madrepora corymbosa, Lam. Hist. Nat. des Anim. sans Vert. t. ii. 2nd ed. p. 447.

Tizard Bank, 5½ to 9½ fath.

Madrepora prostrata, Dana.

1848. *Madrepora prostrata*, Dana, Expl. Exp. Zooph. p. 447, pl. xxxiii. fig. 1.

Tizard Bank, 6½ fath.

Madrepora cytherea?, Dana.

1848. *Madrepora cytherea*, Dana, Expl. Exp. Zooph. p. 441, pl. xxxii. fig. 3.

Tizard Bank, 6 fath.

Madrepora efflorescens, Dana.

1848. *Madrepora efflorescens*, Dana, Expl. Exp. Zooph. p. 441, pl. xxxiii. fig. 6.

Tizard Bank, 6 fath.

Madrepora spicifera (var. *abbreviata*), Dana.

1848. *Madrepora spicifera* (var. *abbreviata*), Dana, Expl. Exp. Zooph. p. 442, pl. xxxiii. figs. 4, 5, and pl. xxxi. fig. 6.

Tizard Bank, 5 fath.

Madrepora hyacinthus, Dana.

1848. *Madrepora hyacinthus*, Dana, Expl. Exp. Zooph. p. 444, pl. xxxii. fig. 2.

Tizard Bank, $9\frac{1}{2}$ fath.

Madrepora vastula ?, Quelch.

Madrepora vastula, Quelch, Chall. Rep. vol. xvi. p. 165, pl. x. fig. 4.

Tizard Bank, 7 fath.

Madrepora flabelliformis, Ed. & H., var.

1860. *Madrepora flabelliformis*, Ed. & H., var., Hist. Nat. des Corall. t. iii. p. 156.

Tizard Bank, 2 fath.

Madrepora labrosa, Dana.

1848. *Madrepora labrosa*, Dana, Expl. Exp. Zooph. p. 486, pl. xliii. fig. 3, pl. xxxi. fig. 10.

Tizard Bank, 5 fath.

Madrepora fragilis, sp. n.

Corallum shortly pedunculate, spreading horizontally, cespitose, delicate; branches radiating, at first round, becoming flattened towards margin, but never coalescing; surface finely echinulate; upper surface giving off closely long, simple, or proliferous calices, sinuously curved, either direct or from short thickened branchlets; length of calices up to 15 millim., tapering very slightly, with circular aperture, with thin lip and six delicate septa; under surface bare, convex, except for a few rather large immersed calices; at margin a few branchlets, very delicate, much compressed, and proliferous.

This is a very beautiful coral, and differs essentially from *M. speciosa*, to which it is nearest allied, by having branches never coalescing and the tubular calices being almost the same thickness throughout.

Tizard Bank, 27 fath.

Madrepora Rambleri, sp. n.

Corallum pedunculated, spreading horizontally, cespitose, delicate; branches much and closely divided, compressed and anastomosing; upper surface thickly crowded with short branchlets about 1 centim. high, with few appressed nariform calices terminating in one, two, three, or four long, tubular, proliferous, curved calices, often 15 centim. long, not dilated at base; aperture 1 millim. round, lip rather thick, septa six; under surface shows branches and branchlets uniting to form irregular and close network almost entirely bare of calices, which are immersed; surface minutely echinulate. Corallum dense, ends of calices tipped with lilac.

This species differs from "*speciosa*" in having the long tubular calices rising from short stems with appressed nariform calices, and the calices not being dilated at the base. From "*fragilis*" it is quite distinct.

Macclesfield Bank, 26½ fath.

Madrepora Rambleri, var.

Living, Macclesfield Bank, 20½ fath.

Genus Porites, Lam.

Porites mucronata, Dana.

1848. *Porites mucronata*, Dana, Expl. Exp. Zooph. p. 558, pl. liv. fig. 2.

Tizard Bank, ½ fath.

Porites conferta, Dana.

1848. *Porites conferta*, Dana, Expl. Exp. Zooph. p. 557.

Itu-Aba, Tizard Bank, 2½ fath.

Porites lutea, Quoy & Gaimard.

1833. *Porites conglomerata*, var. *lutea*, Quoy & Gaimard, Voyage de l'Astrol., Zooph. p. 249.

Tizard Bank, ½ fath.

Porites tenuis, Verrill.

1865. *Porites tenuis*, Verrill, Proc. Essex Inst. vol. v. pt. 3, p. 25.

Sand-Kay Reef, Tizard Bank, ½ fath.

Porites arenosa, Esper, sp.

1797. *Madrepora arenosa*, Esper, Pflanz. t. i. Suppl. p. 80.

Lagoon, Tizard Reef, 2 to 6 fath.

Porites lichen?, Dana.

1848. *Porites lichen*, Dana, Expl. Exp. Zooph. p. 566, pl. lvi. fig. 4.

Garvan Reef, Tizard Bank, 2½ fath.

Porites solida, Forsk., sp.

1775. *Madrepora solida*, var. *a*, Forsk. Descrip. Anim. p. 131.

Itu-Aba, Tizard Reef, 2 fath.

Porites crassa ?, Quelch.

Porites crassa, Quelch, Chall. Rep. Reef-Corals, p. 183, pl. xi. figs. 2, 2*a*.

Tizard Bank, 7 fath.

Genus Rhodaræa, Ed. & H.

Rhodaræa gracilis, Ed. & H.

1860. *Rhodaræa gracilis*, Ed. & H. Hist. Nat. des Cor. t. iii. p. 184.

One large globular specimen, with two thirds of its surface covered by a compact cœnenchyma. The corallites are not more than 2 millim. in diameter, and they thus correspond rather with this species than with *R. calycularis*, Lamk., sp., in which, according to Ed. & H., they are from 3 to 4 millim. in width. The description of the species given by Ed. & H. is very meagre.

From the Tizard Bank, Itu-Aba, depth 2 fath.

The specimen is in one place incrusted by *Heliopora cœrulea*.

Rhodaræa (?) *Lagrenii* ?, Ed. &. H.

Rhodaræa (?) *Lagrenii*, Ed. & H. Monogr. des Poritides, p. 43; iid. Hist. Nat. des Cor. t. iii. p. 184.

The specimen doubtfully referred to this species is ramose; the branches about 10 millim. thick, uneven, nodose, furcating, their lower portions completely enveloped by wrinkled compact cœnenchyma; the calices oblique, about 4 millim. wide.

Macclesfield Bank, 40 fath.

Genus Alveopora, Quoy & Gaimard.

Alveopora dædalea, Forsk., sp.

1775. *Madrepora dædalea*, Forsk. Descr. Anim. in itin. Orient. observ. p. 133, pl. xxxvii. fig. B.

1879. *Alveopora dædalea*, Klunzinger, Die Korallth. des rothen Meeres, Th. ii. p. 47, pl. v. figs. 25, 26.

Growing in branches and in lobate masses, the lower portions of which are covered with a delicate, wrinkled, nonperforate, epithelial membrane. Polyps only alive at summit of specimens.

Macclesfield Bank, at depths of 27 to 40 fath.

Alveopora retepora, Ell. & Sol., sp.

1786. *Madrepora retepora*, Ell. & Sol. Zoophytes, p. 166, pl. liv. figs. 3, 4, 5.
1846. *Alveopora retepora*, Dana, Expl. Exp. Zooph. p. 512.

Branching, also in irregularly lobate masses. Corallites subpolygonal, varying considerably in size, the smaller, 2 to 3 millim. in width, intermingled with the larger, which range from 4 to 5 millim. and occasionally to 6 millim.

Macclesfield Bank, 35 fath.

Alveopora Tizardi, sp. n.

Corallum growing in flattened irregularly lobate expansions; under surface uneven and covered by delicate wrinkled epitheca. Calices polygonal, from 1 to 1·3 millim. in diameter; twelve septa, of the usual spinous character, alternate longer and shorter, but none reach the centre of the calice; calice shallow, the space occupied by the septal spines; walls very cribrate, so that the corallum is light and spongy in character.

This species is mainly characterized by the small size of the corallites. Only a single specimen obtained.

Tizard Bank, 27 fath.

LIV.—*On new Longicorn Coleoptera from Madagascar.* By C. J. Gahan, M.A.

The species described in the following paper were for the most part contained in a small collection recently sent to Mr. Meyer-Darcis, who brought them to me for determination. The types of all the species will be placed in the British Museum collection.

Closterus longiramis, sp. n.

C. flabellicorni (♂) similis, sed differt colore multo pallidiore; oculis subtus plus approximatis; articulo tertio antennarum quam quarto breviore, ramo elongato munito.

Long. 29, lat. ad humeros 10 mm.

Hab. Madagascar (*G. F. Scott Elliot, Esq.*).

Head and prothorax dark brown; prothorax thickly punctured and glabrous above, furnished with a short tawny fringe at the anterior and posterior borders; the lateral margins spined in the middle, with the anterior and posterior angles sharply rounded and destitute of any trace of a spine. Elytra fulvous testaceous, somewhat darker towards the base, thickly punctured, and each with four or five feebly raised lines. Body underneath light reddish brown, with a rather sparse tawny pubescence, which is somewhat thicker and longer on the breast. Antennæ with the third joint a little shorter than the fourth, the ramus of the third joint as long as the body of the joint, the ramus of the fourth joint about as long as the body of the fifth joint, and the rami of joints fifth to ninth each longer than the body of the succeeding joint.

This species in size, form, punctuation, and pubescence agrees pretty closely with *C. flabellicornis*, Serv. The elytra and the underside of the body are, however, much lighter in colour; the eyes below are not more than half as far apart, and the structure of the antennæ is different. In the seven male specimens of *C. flabellicornis* before me the third joint of the antennæ is in every case about equal to or a little longer than the fourth, and is not furnished with a distinct ramus, but is merely produced at its inner apical termination into a very short angular process; the ramus of the fourth joint is never longer than half the fifth joint, and in no case is the ramus of any joint longer than the body of the succeeding joint.

Tereticus antennalis, sp. n.

Fuscus, creberrime punctulatus; capite, prothoraceque cum pectore fulvo-villosis; elytris fulvo-brunneis vel fuscis, pube fulva leviter obtectis; antennis dimidium corporis vix attingentibus, articulis a secundo ad decimum gradatim crescentibus, ramis longissimis, articulo undecimo sex præcedentibus conjunctis æquali. ♂.

Hab. Imerina Mountains.

Dark brown, closely and finely punctured. Head, prothorax, and breast with a somewhat sparse tawny villosity. Elytra with but the faintest trace of costæ; clothed with a rather sparse fulvous pubescence. Antennæ with the joints from the second to the tenth gradually increasing in length and each provided with a very long ramus; the tenth joint about equal in length to the scape, the eleventh as long as the six preceding taken together.

This species resembles the same sex of *T. pectinicornis*, Waterh., but is easily distinguished by the structure of the antennæ. In *pectinicornis* the branches of the antennal joints are much shorter and the third joint is almost as long as the scape and longer than any of the succeeding joints, the eleventh excepted.

M. Fairmaire has recently published a short diagnosis of a species of this genus (*T. rufulipennis*, Comptes Rend. Ann. Soc. Ent. de Belgique, 1889) which is apparently much more nearly allied to *pectinicornis* than is the species above described.

IMERINUS, gen. nov.

Female.—Head with the front transverse, scarcely concave above, divided longitudinally by a fine median groove, and separated from the epistome by a deep, transverse, slightly arcuate impression. Last joint of palpi subfusiform. Eyes coarsely faceted. Antennæ barely surpassing the elytra; first, third, and fourth joints subequal, each shorter than the fifth, the sixth and succeeding joints decreasing in length. Prothorax strongly constricted near base and apex, tubercled at the middle of each side, and with four or five tubercles on the disk. Anterior margin of pronotum slightly produced and rounded; posterior margin rounded in the middle and sinuate towards each side. Elytra each rounded at the apex and terminating in a short sharp spine. Legs increasing in length from the anterior to the posterior. Femora thickened below the middle. First joint of the posterior tarsus longer than the two succeeding joints combined. Prosternal process moderately broad, subcanaliculate along the middle, bilobately dilated posteriorly. The anterior cotyloid cavities closed in behind, strongly angulate externally. Intermediate cotyloid cavities widely open on the outside. Abdomen with the first ventral segment very long, the second much shorter, truncate, and thickly fringed with long hairs behind; the remaining ventral segments almost entirely concealed.

Of somewhat doubtful affinities, the genus will, I think, be best placed near the Phlyctenodides.

Imerinus granuliferus, sp. n.

Brunneo-ferrugineus, griseo subtiliter pubescens; prothorace dorso utrinque bituberculato, tuberculo antico bifido obtuso, tuberculo postico conico; elytris subtiliter sericeo-pubescentibus, minute subsparsimque punctatis, granulis in seriebus ordinatis. ♀.

Long. 25 mm.

Hab. Imerina Mountains.

Head and prothorax impunctate, the latter with an acute tubercle on the middle of each side and a strong transverse callosity close to the antero-lateral margin; with four tubercles above, of which the two anterior are obtuse and each somewhat bifid, the two posterior more acute; with, in addition, a feeble median cariniform elevation placed just before the posterior transverse depression. Elytra exhibiting delicate, silvery-grey, irregular fasciæ, which change their position according to the light in which they are viewed. The granules with which the elytra are furnished are wide apart, arranged in three rows on the disk of each and more irregularly on the sides. The second ventral and the terminal dorsal segment of the abdomen fringed with tawny-red hairs.

Arrhythmus punctatus, sp. n.

Fuscus; capite supra prothoraceque sat sparsim punctatis et subtiliter griseo-pubescentibus; disco prothoracis paullo ante medium acute bituberculato; elytris nitidis, flavescentibus, sat sparsim fortiterque punctatis, punctis, plagis duabus basalibus, maculis duabus parvis ad medium et apice fuscis; pedibus flavis, clavis femorum fuscis; antennis corpore duplo fere æqualibus, flavis, articulis primo et secundo cum apicibus ceterorum infuscatis. ♂.
Long. 10-20 mm.

Hab. Imerina Mountains.

Prothorax gradually and slightly narrowed from the base to the apex, with two distinct and rather sharp tubercles on the anterior part of the disk. Elytra strongly and somewhat sparsely punctured, yellowish, with a plaga on each side at the base, a small spot on each at the middle, the apex, and all the punctures dark brown; the elytra are scarcely constricted before the apex, the latter therefore does not appear to be expanded; the apices of each are subacuminately rounded and produced near the suture into a short blunt spine. The body underneath is covered with a greyish pubescence; the underside of the prothorax is somewhat transversely rugose, and the sides of the metasternum are sparsely and strongly punctured. The antennæ are about twice as long as the body, yellowish, with the first two joints and the apices of the others brownish; the scape is rather narrow at the base, gradually thickened up to the apex, and rather thickly but not rugosely punctured.

From *A. rugosipennis*, Waterh., and *A. pallimembris*, Fairm., this species may be distinguished easily by the shape of the prothorax and by the nature of the punctuation, as well as by other minor characters. Of the two specimens that I have seen one is very much larger than the other. It is probable that varieties may occur in which the dark brown of the elytra occupies a much larger extent.

Mastododera? simplicicollis, sp. n.

M. laterali similis, sed differt prothorace absque tuberculis; capite antice plus elongato; pedibus antennisque gracilioribus.
Long. 18, lat. $5\frac{1}{2}$ mm.

Hab. Imerina Mountains.

The chief structural character by which this species could be separated from *Mastododera* is the absence of tubercles from the prothorax. The latter is rounded at the sides, feebly dilated in the middle, and narrowly constricted at the base; it is convex above, with evidence of a feeble groove or depression along the middle of the disk. The legs are elongate and rather slender, the posterior femora reach to the apex of the elytra, and the last joint of the posterior tarsus is longer than the three succeeding joints combined.

The species is smaller and narrower than *M. lateralis*, Guér., but is coloured in almost exactly the same way. The lateral fulvous band of the elytra is, however, narrower and stops short before reaching the apex.

Glaucytes basalis, sp. n.

Niger; capite supra prothoraceque dense punctatis; elytris minus dense punctatis, fusco-violaceis basi rufo-testaceis, vitta angusta suturali griseo-pubescente, apicibus truncatis, quadridentatis; capite fronte vittaque utrinque, thorace subtus, et vitta utrinque abdominis argenteo-griseo-pubescentibus.
Long. 12–15 mm.

Hab. Fianarantsoa, Imerina Mountains.

This species has a strong resemblance to *G. humeralis*, Buq., but is more elongated; the prothorax is a little more strongly and more thickly punctured, and has no silky, white vitta on each side. The elytra are brownish rather than blue in colour.

In the male specimen, from the Imerina Mountains, the antennæ surpass the apex of the elytra by about the last two or three joints. In the females they do not reach to the apex of the elytra.

CEDEMON, gen. nov.

Head moderately concave between the antennal tubercles. Front rectangular. Eyes emarginate, coarsely faceted, with the lower lobes longer than broad, rounded below. Antennæ a little longer than the body in the male, barely reaching to the apex of the elytra in the female, subfiliform and subcylindric, with the scape clavate, reaching almost to the middle of the prothorax, with the third joint longer than the scape, the fourth rather shorter than the scape, the fifth and succeeding joints gradually decreasing in length. Prothorax with a distinct conical tubercle at the middle of each side, feebly tubercled on the disk. Elytra rather short, regularly convex, gradually narrowed and subtruncate behind; the shoulders slightly projecting. Femora clavate-fusiform. Intermediate tibiæ entire. Claws of tarsi divergent. Anterior cotyloid cavities strongly angulate externally. Prosternal process simply arched. Intermediate cotyloid cavities open on the outside.

The female differs from the male by its slightly shorter antennæ, its somewhat shorter elytra, and by having the last abdominal ventral segment longer and sinuately emarginate at the apex. (In the male this segment is rounded and not emarginate.)

In the difficulty of finding a more satisfactory position for this genus, I am content to place it near *Phymasterna*. From *Phymasterna* and all the genera of the same group it differs by the complete absence of any notch or groove from the intermediate tibiæ, by the more elongate and coarsely granulated eyes, and by the club-like form of the scape of the antennæ. The general form of the single species of the genus is suggestive also of certain genera of the Crossotides; but, owing to the structure of the claws, it can scarcely be admitted into that group.

Cedemon tristis, sp. n.

Nigro-velutinus, tarsis et annulis antennarum albo-flavescentibus exceptis; prothorace supra leviter trituberculato; elytris sparsim punctatis.

Long. 16, lat. 7 mm. (♂), long. 14, lat. 6 mm. (♀).

Hab. Imerina Mountains.

With a deep uniform velvety black pubescence. Head sparsely and not very distinctly punctured; with a very fine median impressed line running from the base to the occiput. Antennæ with the eighth and eleventh joints wholly, and the basal halves of the third, fourth, and sixth yellowish testaceous and clothed with a whitish pubescence; the rest of the antennæ velvety black. Prothorax with three feeble tubercles above—two anterior, one median posterior. Elytra each a little prominent at the middle of the base, as well as at the shoulder, sparsely punctured on the basal half, subtruncate at the apex. Tarsi (the claws excepted) testaceous yellow, with a whitish pubescence. Prosternal process simple; mesosternal obtusely tubercled near its posterior end.

Eumimetes albisparsus, sp. n.

Piceo-fuscus, pube grisea subtiliter obtectus; elytris maculis parvis albescentibus dispersis singulisque scopulis rotundatis pilorum nigrorum duobus—uno humerali, altero medio paullo pone basin.
Long. (♂) 18, (♀) 21 mm.

Hab. Imerina Mountains.

Dark brown, with a faint greyish pubescence. Prothorax almost impunctate, with a very short fringe of whitish hairs to the anterior and posterior borders, with a moderately strong tubercle on each side. Scutellum bordered with a white pubescence posteriorly. Elytra sparsely and strongly enough punctured, clothed with a faint greyish pubescence, and with numerous small scattered whitish spots; each with two small rounded tufts of black hairs, of which one is at the shoulder, the other placed a little distance from the base on the middle of the disk. Breast and abdomen with some minute scattered, glabrous, and shining spots, each surrounding a shallow puncture. Antennæ in the male about a third longer than the body, in the female barely surpassing the elytra.

This species seems to be undoubtedly congeneric with *Eumimetes sparsus*, Klug, notwithstanding the tufts of hairs on the elytra and the somewhat stronger tubercles to the prothorax. In *Eumimetes* also must, I think, be placed *E. humeralis*, Vollenh. (*Phymasterna*), for which *Phymasterna sexpunctata*, Fairm., is probably a synonym.

Stenosoma apicalis, sp. n.

Griseo leviter pubescens, brunneo-variegata; prothorace utrinque minute tuberculato; elytris elongatis, angustis, parallelis, ad suturam longitudinaliter subcanaliculatis, apicibus truncatis, angulis externis breviter spinosis; antennis corpore longioribus, subtus sparsissime ciliatis, scapo quam articulo tertio longiore.
Long. 7–10, lat. 2–$2\frac{3}{4}$ mm.

Hab. Antananarivo (*Kingdon*).

Unless a special genus is formed for its reception this species must, I think, remain in *Stenosoma*. It has completely the aspect of species of this genus, differing chiefly by the more elongate scape of the antennæ and the external spines to the apices of the elytra. In a specimen with the antennæ not much longer than the body, which I suppose to be a female, there is no excavation at the apex of the abdomen.

The species is characterized further by some raised lines on each elytron, of which one near the suture is more distinct than the rest, the intervals between which are somewhat irregularly punctured. In addition to the numerous small brown dots each elytron has four small brownish patches—one oblique basal, one oblique median, the third also oblique at some distance from the apex, the last at the apex.

Diadelia x-fasciata, sp. n.

Angusta, elongata, fulvo-griseo leviter pubescens; maculis minimis brunneis variegata; prothorace supra leviter trituberculato; elytris singulis fasciis duabus brunneis valde obliquis ad suturam connexis, apicibus subobliquiter truncatis; antennis corpore longioribus, articulis basi pallidis, apicibus brunneo-ferrugineis.
Long. 12, lat. 4 mm.

Hab. Imerina Mountains.

I am not certain that I do right to refer this species to *Diadelia*. It has slightly larger eyes and a narrower front to the head than has *D. biplagiata*, and the mesosternal process is almost flat and is destitute of a tubercle. The elytra bear indications of raised lines, in the intervals between which they are irregularly and not very thickly punctured. There is a slight hump or swelling on the disk of each elytron at a short distance behind the base. The apices of the elytra are less obliquely truncate than in *biplagiata*. The species may further be recognized by the fulvous-grey pubescence, minutely speckled with brown, and by the two oblique narrow brownish bands on each elytron—one beginning close to the margin just in front of the middle and directed backwards to the suture, the other at some distance behind the middle and directed forwards towards the suture, where a short longitudinal band joins the two.

Ancylistes bellus, sp. n.

A. bicuspi similis, sed differt inter alia elytris fere impunctatis, fascia transversa mediana nigro-velutina.

Hab. Antananarivo (*Kingdon*).

Head with the eyes small, the front large and slightly convex. Prothorax broad and convex in front, abruptly and strongly constricted at the base, obtusely and feebly dilated above the middle of each side; the disk marked with numerous longitudinal and slightly curved striæ. The elytra, strongly and transversely depressed behind the highly elevated and acute basal tubercles, are crossed at the middle by a rather narrow velvety black band; this is preceded on each side by a transverse white line which, close to the suture, gives off an oblique white line in the direction of the basal tubercle; and in the angle thus formed, which has an inner fulvous-brown border, there is a third very short white line. The part of the elytra between the innermost oblique lines is velvety black. With the exception of a narrow bluish-grey transverse spot the whole of the elytra succeeding the median black band is covered by a delicate fulvous-brown pubescence. The elytra are furnished in addition with some widely scattered long fulvous bristles. A few punctures are to be seen on the basal third. A pubescent white line passes along the dorsal margin of each of the legs. The femora are subfusiform, pedunculate at the base.

This species at first sight resembles very much *A. bicuspis*, Chevr., but is easily distinguished by the difference in the punctuation of the elytra and other characters.

LV.—*Descriptions of four new Species of Terrestrial Mollusca from South Africa, with Observations on* Helix Huttoniæ (Bens.). By James Cosmo Melvill, M.A., F.L.S., and John Henry Ponsonby, F.Z.S.

Amongst numerous specimens of terrestrial and fluviatile shells recently collected at or near Port Elizabeth by Mr. J. Crawford are many undoubtedly new to science. Some of these were in the first instance placed in the hands of M. Morelet, who last year contributed a paper on this subject to the 'Journal de Conchyliologie.' Since then Mr. Crawford, who has received much valuable assistance from Messrs. Farquhar, Leslie, and Langley, from various neighbouring localities, has remitted fresh material, of which the following four species may be regarded as the primary outcome; and we are hoping before long to offer a second communication with further descriptions of other forms new to science.

We must not forget to thank Mr. Edgar A. Smith, F.Z.S., of the Zoological Department, British Museum, for kind assistance.

Vitrina cingulata, sp. nov.

V. testa globulosa, convexa, tenui, olivaceo-hyalina, supra peripheriam distinctissime rubro-cingulata; spira emersa; anfractibus lævibus, subventricosis; apertura subrotundata.

Long. 15, lat. 20 mill.

Hab. Port Elizabeth.

This extremely handsome species is most nearly allied to *V. Cumingii* (Beck) from the Philippines, and no doubt would by some authors be placed in the genus *Helicarion*. Dr. Bœttger, who has obligingly examined our specimens, confirms our opinion as to its distinctness from any hitherto known species. From *V. Pœppigii* (Menke), which it resembles in form, it differs in its larger size and smooth surface; from *V. cornea* (Pfr.), in addition to the above-mentioned particulars, in being of a different form, thicker substance, and possessing a less oblique aperture.

Vitrina zonamydra, sp. nov.

V. testa globosa, convexa, robustiore quam *V. cingulata*, fuscescente, supra peripheriam obscure fusco-cingulata; spira convexa, ampliore quam in specie præcedente (*V. cingulata*); anfractibus ventricosis, lævibus; apertura subrotunda.

Long. 10, lat. 17 mill.

Hab. Port Elizabeth.

This species differs from the preceding in its duller, more robust substance, ampler convexity of whorls, difference in colour, and extremely indistinct brown-red band, which is barely visible without close inspection. It is easily distinguished from specimens of *V. natalensis* (Kr.), with which, however, it has affinity.

Helix (*Pella*) *Huttoniæ* (Benson).

Upon carefully examining numerous specimens under this label in the National Collection, we were convinced firstly that it is a true *Vitrina*, and secondly that three series of shells from Port Elizabeth that we had at one time considered true species should be relegated to varietal rank as follows:—

Vitrina Huttoniæ (Bens.).

Var. *a. rufofilosa*, var. nov.

V. testa subglobosa, pallide hyalina, tenui; spira convexa, conspicua; anfractibus subconvexis, lævibus, tenuissime arcuatim striatis, ad peripheriam rubro-lineatis; apertura ovata.

Long. 10, lat. 14 mill.

Hab. Port Elizabeth.

This form may possibly have been confounded with *V. pellicula* (Fér.), a native of the Cape region; it is not difficult, however, to always discriminate them. We have seen a good many specimens of this, which is probably one of the commonest of the genus in its locality, and they are all uniformly conspicuous for the red turgid character of the suture at the periphery.

Var. *β. meridionalis*, var. nov.

V. testa pulcherrime hyalina, tenuissima, pallide straminea, lævi; spira convexa; anfractibus lævibus, rotundis, nitidis; apertura ovata.
Long. 10, lat. 12 mill.

Hab. Port Elizabeth.

From the first var. (*rufofilosa*) this form differs in its smaller size, more glossy texture, greater smoothness of whorls, and entire absence of the red margined suture. It is likewise much flatter.

Var. *γ. aloicola*, var. nov.

V. testa depresse subovata, olivaceo-cornea, parum nitente; spira convexa, planulata; anfractibus subrotundatis, læviusculis; apertura lunari-ovata.
Long. 12, lat. 16 mill.

Hab. Port Elizabeth (frequens!).

This differs from the two preceding in being of more depressed and flattened growth and olivaceous horny texture; it is also a coarser-moulded shell. It is known amongst Port-Elizabeth collectors as the Aloe snail, since it feeds on the Liliaceous plants (*Aloe*, *Haworthia*, &c.) which so abound on the arid rocky plains around.

We are by no means sure that these three all belong to *V. Huttoniæ* (Bens.), and would invite the attention of collectors to these puzzling forms, in the hope that especial regard may be paid to the animal.

We should at present place the South-African species of *Vitrina* (including *Helicarion*) in the following order:—

V. cingulata, sp. nov. Algoa Bay.
V. natalensis (Krauss). Natal.
V. zonamydra, sp. nov. Algoa Bay.
V. Pœppigii (Menke). Natal.
V. transvaalensis (Craven). Transvaal.
V. Vandenbrockii (Craven). Transvaal.

V. cornea (Pfr.). Natal.

V. pellicula (Fér.). Cape District.

V. Huttoniæ (Bens.) [*Helix Huttoniæ*]. Port Elizabeth.
 α. rufofilosa. Port Elizabeth.
 β. meridionalis. Port Elizabeth.
 γ. aloicola. Port Elizabeth.

V. Planti (Pfr.). Natal.

Helix (*Pella*) *Crawfordi*, sp. nov.

H. testa anguste umbilicata, globoso-depressa, hyalina, supra nitente, subtus olivaceo-sericea, utrinque omnino lævi; spira vix elata, apice obtuso; anfractibus quinque, convexiusculis; apertura lunari, labro simplici, acuto, margine columellari suberecto, supra late reflexo, laminam triangularem (sicut in *H. bisculpta*) formante.
Long. 11, lat. 16 mill.

Hab. Port Elizabeth.

A very distinct large smooth-whorled snail, not easily to be compared with any other Cape species. We have great pleasure in uniting with this the name of its discoverer, J. Crawford, Esq., to whose indefatigable researches we are indebted for the whole of the material in this paper.

Helix (*Trochonanina*) *pretoriensis*, sp. nov.

H. testa imperforata, conico-trochiformi, olivaceo-fusca; spira elevata, conica, obtusa; anfractibus sex, transversim tenuiliratis, convexiusculis, ultimo carinato: apertura quadrangulari, labro simplici, margine columellari subreflexo.
Long. 3, lat. 2·75 mill.

Hab. Pretoria, Transvaal.

Entirely unlike any South-African species with which we are acquainted. A very interesting though minute trochiform species.

LVI.—*On* Ebalia nux, *Milne-Edwards: a Reply to the Rev. Canon Norman.* By R. I. Pocock.

In the reply with which Canon Norman has favoured me in the October number of this Magazine sundry charges are brought forward of a nature more or less detrimental to my character, and consequently demanding a rejoinder on my part.

In the first place Canon Norman denies that his words of approbation for the manner in which his MS. name was treated by Messrs. Marion and Milne-Edwards can be taken as reflecting discredit upon me—thereby laying me open to the charge of entering upon a controversy without provocation, and of taking offence where none was intended.

In reply to this I may say that if I was alone in my opinion as to this allegation of discourtesy I should be compelled, in the face of Canon Norman's denial, to suspend judgment on the point. But since precisely the same interpretation was independently put upon the sentence referred to by my friend who first drew my attention to the publication of Mr. Bourne's paper, I cannot do otherwise than retain the opinion that I first formed. This fact, moreover—namely the circumstance that exactly the same significance was independently attached to Canon Norman's words by an individual absolutely unconcerned in the matter—goes far to destroy any semblance of truth there might be in the suggestion that the idea of an accusation of discourtesy is merely a product of my guilty conscience, a suggestion which would perhaps have seemed plausible enough if the notion had emanated solely from myself. But if further refutation of this were needed, I might add that I am quite unable to see how my conscience can have influenced me in the matter, for, as I carefully pointed out in my last letter, my mode of employing the *nomen nudum*—*Ebalia nux*—was strictly in accordance with my notions of the dictates of courtesy and common sense; and consequently I had no idea that Canon Norman could possibly find grounds on that score for complaining of ill-treatment at my hands. In short, I do not see how I can have no idea of a thing and yet be conscience-stricken with regard to it.

With regard to Canon Norman's assertion that he took particular pains that his words should *not* bear the construction that was to my knowledge independently put upon them on two occasions, I think the less said the better. I merely refer to the circumstance now with the object of bringing it before the notice of those who are interested in collecting cases of the inadequacy of language to express thought.

In the second place, in connexion with the letter that I wrote to him, I can assure Canon Norman that I never received an answer to it. The postcard that he recollects sending to me I too remember well; but it related to a species of *Mysis* from the Firth of Clyde, and not to *Ebalia nux*.

In the third place, Canon Norman wishes to know which specimens of *Ebalia nux* I chose for description. I am sorry for having left this matter in doubt; but when I said that two specimens had been "selected as types" I thought I was employing phraseology perfectly intelligible to every systematic zoologist. Since, however, I clearly fell into error by taking this for granted in Canon Norman's case, I am glad that he has shown me the necessity for explaining that the expression was tantamount to saying that the description had been drawn up from these specimens. I imagine, however, perhaps wrongly, that Canon Norman does not altogether approve of my conduct in describing specimens that he had sent to Mr. Miers at the Natural History Museum; for he appeals to the judgment of others to decide as to the courtesy of this act. Now I cannot help thinking that if Canon Norman had stayed for a moment to ask himself what could be my reasons for thus describing these specimens, he would have done me the justice to see that I was acting altogether for the best. But to state at length all the considerations which influenced me in the matter would involve a long explanation of my personal opinions as to the value and significance of *types* of species—an explanation which would be wholly out of place on an occasion like the present. Consequently I shall content myself with saying briefly that my reasons for not describing the 'Flying Fox' specimen were in the main three in number:—(1) There was but one specimen, and that a damaged one; (2) this specimen, as I pointed out, differs slightly, but certainly, in sculpturing, from the Mediterranean specimens that I had seen; and (3) I consequently thought it both expedient and just, when adopting the name Canon Norman had proposed, to affix it definitely to specimens to which he had himself applied it.

And, lastly, Canon Norman accuses me of carelessness for not consulting the work in which Prof. A. Milne-Edwards has admirably figured *Ebalia nux*—a work which should certainly not have been neglected by a man writing on Atlantic Crustaceans with a "magnificent library at his elbow." In reply to this I cannot do better than quote *verbatim* an extract from a letter which I received some three or four weeks ago from Prof. A. Milne-Edwards. Being unable to find the figure of *Ebalia nux* from the reference that Canon Norman gives, I wrote to Prof. Milne-Edwards on the point, and he courteously and promptly replied as follows:—" . . . . J'ai effectivement figuré l'*Ebalia nux* dans un ouvrage intitulé *Recueil de figures de Crustacés nouveaux ou peu connus, in* 4°, 44 *Planches, Avril*, 1883. Cet ouvrage n'a été tiré qu'à 50 exemplaires que j'ai de suite envoyé aux naturalistes qui, à cette époque, s'occupaîent de carcinologie.

Quelques exemplaires seulement ont été mis en vente, aussi l'ouvrage est il devenu rare et presque introuvable. Je n'en ai qu'un seul exemplaire ce qui m'empêche de vous l'envoyer, mais je vous adresse la planche relative à l'*Ebalia nux* qui pourra vous être utile. . . ."

This sufficiently accounts for the fact that there is no copy of this work in the library of the Natural History Museum nor yet in the library either of the Royal, or Linnean, or Zoological Society. So that, under the circumstances, I think I can hardly be blamed for not having seen it.

LVII.—*On the Generic Name of* Asterias sanguinolenta, *O. F. Müller.* By F. Jeffrey Bell.

For more than thirty years the common blood-red starfish of the North-European seas has, by general consent, been called *Cribrella sanguinolenta* (or *C. oculata* by some who ought to know better). Internal evidence too often shows that "synonymy" is synonymous with "copying;" so perhaps this general consent only means that one of those who have written on the subject during the last thirty years has had the opportunity of consulting Dr. Lütken's valuable works. Mr. Sladen, who may be complimented on the meaning he is able to put into a couple of brackets, seems to have had some original doubts, for he writes in his massive 'Challenger' Report (p. 540)

"Genus *Cribrella* (Agassiz), Forbes,"

which, being "writ large," means, I presume, this generic name was invented by Agassiz and appropriated by Forbes; and if it does mean that, it expresses, in a very succinct manner, a perfectly correct statement.

When, however, one finds a man with what look like stolen goods one is apt to make a searching inquiry into his title. Do this in the present case and you get a disastrous result!

Agassiz wrote (Mém. Soc. Neuchatel, i. (1835), p. 191):—

"5. Linkia, Nardo.—*Cribrella*, Ag. Msc."

This clearly means, "what Nardo in 1834 called *Linkia* I (Agassiz) have, in MSS., called *Cribrella*;" and the two terms were in Agassiz's estimation equivalent.

How are cases of this kind to be dealt with? The rules of the British Association declare that "a later name of the same extent as an earlier [is] to be wholly cancelled;" so Agassiz would have done better had he kept his expressive name to himself, and *Cribrella* must fall out of our nomenclature altogether.

But in this case what is to be done with *Asterias sanguinolenta*? One would imagine that it was in sad want of a generic name when Edward Forbes perpetrated the robbery which is now only (after half a century!) revealed to a world that has been taught to revere his name. In mitigation we may say that it might have so seemed to him; for, just before his work was issued from the press, and certainly after it left his hands, Gray proposed the name of *Henricia* for the *Asterias oculata* of Pennant, which is the *Asterias sanguinolenta* of O. F. Müller *; and, indeed, he thought perhaps he was justified, for he had placed the species in Nardo's genus *Linckia* (Mem. Wern. Soc. viii. p. 120) in 1839, and discovered his error and the fact that *Cribrella* was a synonym for that name a little later.

The claims of Gray's name are incontestable; the necessity for changing the significance of such a well-known term as *Cribrella* is most distressing, and I am very sorry that it has fallen to my lot to have thus to upset a nomenclature which we all know and which, I fear, I shall in my heart continue to use.

I cannot conceive how or why succeeding writers have let the matter stand in this disorderly manner so long. Some —to cite the most careful of them, Mr. Sladen—write *Cribrella* (pars); but certainly Agassiz does not include anything, either recent or fossil, under his generic name which can by any possibility be supposed to be congeneric with *A. sanguinolenta*.

The correct synonymy of the genus appears to stand thus:—

HENRICIA.

Henricia, Gray, Ann. & Mag. Nat. Hist. vi. (1840), p. 184.
Linkia, Forbes, not Nardo, Mem. Wern. Soc. viii. (1839), p. 120.
Cribella, Forbes, not Ag., Brit. Starf. (1841), p. 106.
Cribrella, Lütken, Grönl. Echinod. (1857), p. 30, et mult. al. usque ad Sladen in Chall. Rep., Ast. (1889), p. 540.
Echinaster, M. Tr. Syst. Ast. (1842), p. 22 (pars).

* The dates appear to be:—the part of Ann. & Mag. Nat. Hist. (vi. p. 184) which contained Gray's name *Henricia* was published Nov. 1840; Forbes's p. 100, on which *Cribella* appeared, was probably published Dec. 1st, 1841. Messrs. Gurney and Jackson have been so obliging as to give me the dates of publication of the six parts of Forbes's 'British Starfishes;' they were published on the first of each month from October 1840 to March 1841. But the work as a whole must be quoted 1841.

LVIII.—*Descriptions of some new Genera of* Pyralidæ. By W. Warren, M.A., F.E.S.

In the course of rearrangement of the collection of Pyralidæ in the British Museum the formation of many new genera was found to be a matter of necessity. Three only of these, *Thliptoceras*, *Eurycraspeda*, and *Callinaïas*, have as yet been published, and will be found in Col. Swinhoe's paper in the Trans. Ent. Soc. for 1890. In view of the approaching publication of a new volume of the 'Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum,' it has now become necessary to expedite the appearance of the descriptions of a few more of these new genera, to which reference will have to be made in the forthcoming work, and these (nineteen in number) are herewith characterized. Diagnoses of the remainder will be published at the earliest opportunity.

Parasarama.

In point of structure, markings, and general appearance identical with *Sarama*, Moore; distinguished at once by the absence of the antennal processes which occur in the males of that genus.

Type *P. cuproviridalis* ♀, Moore (*Locastra*, M.), = *Locastra margarita* ♂, Butler.

Opsibotys.

In place of the old generic term *Botys*—the original type of which is the Geometer now known as *Lythria purpuraria*—it is proposed to substitute the term *Opsibotys* (i. e. *Botys* in appearance) for all those species of Lederer's first division, viz. those with porrect, rostriform, labial palpi, which are left when all other separable genera have been removed.

Type *O. fuscalis*, Schiff. (*Pyralis*).

Rhectothyris.

Superficially very much like Lederer's genus *Trithyris*; distinguished by entirely different labial palpi. In *Rhectothyris* these are shortly rostriform, porrect, while in *Trithyris*, Led., they are upcurved close in front of the face. Fore wings very elongate, being four times as long as broad, with the hind margin very oblique and slightly bulging in the middle; wings crossed by two broken hyaline fasciæ.

Type *R. gratiosalis*, Wlk. (*Samea*?).

Sciorista.

Allied to *Stenophyes*, Led., and *Sameodes*, Snell.

Fore wings elongate ; costa decidedly convex before apex, which is slightly produced : labial palpi large, porrect horizontally, third joint undistinguishable; maxillary small, visible above the base of the labial : antennæ filiform, slightly pubescent in the male. Distinguished superficially by the possession of all three stigmata, often metallic scaled, and a complete dark marginal band.

Type *S. signatalis*, Wlk. (*Botys*).

Leucocraspeda.

Fore wings pointed, subfalcate ; costa slightly concave before apex ; hind margin bowed ; scaling fine, silky ; fringes of both wings silky white.

Markings : two dark transverse lines, the second peculiarly rounded externally ; two stigmata ill-defined, the reniform crescent-shaped.

In neuration and structure of palpi identical with *Opsibotys*.

Type *Leucocraspeda illectalis*, Wlk. (*Botys*).

Protonoceras.

Distinguished by the form of the labial palpi ; these are unusually long, obliquely porrected upwards ; the second joint feathered beneath, three times as long as the head ; terminal joint about one third of the second, inclined forwards and bluntly pointed, longer in the male than in the female.

Maxillary palpi large, erect ; tongue and ocelli present. Characterized additionally in the male, (1) by the antennæ, of which the basal joint is inflated, and the shaft itself, at one third from the base, slightly angulated and flattened ; (2) by the presence on the head of three pointed tufts of scales, one in the centre of the forehead in front between the antennæ and one behind each antenna.

Type *P. tropicalis*, Wlk. (*Botys*).

Hemiscopis.

Labial palpi large, stout, porrect, much pointed in front ; maxillary porrect above the labial ; forehead with scales produced into a point ; ocelli and tongue present ; antennæ laminated. Fore wings with apex produced, but not acutely ; hind margins of both wings rounded, rather bulging in the middle: scaling smooth and glossy, when fresh iridescent, burnished.

Type *H. suffusalis*, Wlk. (*Scopula*).

Loxoscia.

Fore wings elongate triangular; costa straight, much longer than the inner margin, convex before apex; hind margin decidedly oblique, curved: hind wings rounded: labial palpi upcurved in front of face; terminal joint short, conical, but distinct; maxillary erect, small, and thin; tongue and ocelli present; antennæ long, slender; in the male pubescent beneath, with fine ciliations. Scaling silky, not dense; markings, two stigmata and two transverse lines, the second always very oblique, running more or less parallel to the hind margin, with the space beyond in both wings filled up with darker. The American species have a small tuft of scales projecting from the inner margin, and ocelloid stigmata, and may have to be separated.

Type *Loxoscia scinisalis*, Wlk. (*Botys*).

Mimorista.

Resembles *Sciorista*, Warr., in pattern and colouring, but distinguished by the shape of the labial palpi, which are short, porrected obliquely upwards, but not curved along the forehead; the third joint invisible, lost in the second, the top of which is cut straight off or but slightly rounded.

Type *Mimorista botydalis*, Guen. (*Samea*).

Haritalodes.

Near to *Pantographa* (Led.), but with more rounded apex to the fore wings and rounder hind margin of hind wings. Abdomen shorter and stouter, with the second and last segment in the female, the second and penultimate segment in the male, with a black (or brown) ring. Markings: three ocelloid stigmata, two transverse lines, the latter approaching the former on the inner margin, a submarginal fascia, a thick marginal line, and all the nervures beyond the middle brownish black: hind wing with three curved lines and an ocellus.

Type *Haritalodes multilinealis*, Guen. (*Botys*).

Philædropsis.

Distinguished from both *Haritala*, Moore, and *Orthospila*, Warr., with both of which it is closely allied, by the much longer fore wings, with more oblique hind margin, as well as by the absence of any trace of submarginal fascia. It agrees with *Orthospila* in the possession of the black abdominal spots and in the distinctly darker markings, but the second line is not angulated but sinuous.

Type *Phædropsis chromalis*, Guen. (*Asopia*).

Orthospila.

Closely related to *Haritala*, Moore, but larger, with broader and ampler wings; distinguished, (1) by the character of the markings, which are distinct and straight, not curved, the second transverse line being twice sharply angulated; (2) by the presence of a black spot on the last segment of the abdomen of the female and on the penultimate segment of the male, whereas in *Haritala* the abdomen is unmarked. Both genera agree in having a curved submarginal fascia between the second line and the hind margin; but in *Haritala* the fasciæ are all four yellow on a white ground and undulating; the costa with three distinct costal black spots.

Type *Orthospila plutusalis*, Wlk. (*Zebronia*).

Tetridia.

Distinguished by at least four peculiarities in the structure of the male: these are, (1) the extraordinary length of the antennæ, which considerably exceed that of the fore wings; (2) the shape of the labial palpi, like a hawk's beak; (3) the lateral tufts of hairs on the third segment of the abdomen; (4) the bed of raised scales on the *upper* surface of the fore wing at the anal angle. The outline of the wings recalls the Noctuid genus *Cucullia*.

Type *T. vinacealis*, Moore (*Botys*).

Pseudanalthes.

Analthes, Led., has the labial palpi in the male resembling those of *Nosophora*, Led.: in *Pseudanalthes*, however, they do not differ from those of the female, being curved upwards in front of the face and sickle-shaped, with the last joint long and pointed. The antennæ of the male, judging from Lederer's description, must be very much like those of his genus *Spargeta*, which I have not seen; but the male abdomen is without the anal tuft characteristic of that genus.

Type *Pseudanalthes idyalis*, Wlk. (*Botys*).

Pardomima.

Fore wings with straight costa, blunt apex, and rounded hind margin; labial palpi stout, upcurved in front of face; male antennæ shortly pubescent; lines and margins of stigmata coarse, the former abruptly bent; last abdominal segment of female and last two of the male dark marked above.

Distinguished from *Arthromastix lauralis* (*Salbia lauralis*, Guen.) and *Nothomastix chromalis* (*Botys chromalis*, Wlk.), with which it otherwise agrees, by the simple male antennæ and untufted legs.

Type *P. amyntusalis*, Wlk. (*Botys*).

Orphanostigma.

Intermediate between *Hedylepta*, Led., and *Chnaura* and *Æthaloessa* of the same author. Distinguished from *Hedylepta* by the absence of the long thoracic tegulæ in the male, and from the others by the shorter, rougher, and blunter labial palpi. In colouring and markings it agrees more with the former, but *Hedylepta* shows a distinct orbicular stigma, which is entirely wanting in *Orphanostigma*.

Type *O. abruptalis*, Wlk. (*Asopia*?).

Aplomastix.

Allied to *Stenia* and *Blepharomastix*, Led., but with upcurved instead of porrect palpi; from *Pterygisus*, Butler, with which it agrees in the form of the palpi, it is distinguished by having in the male thickly laminated antennæ, not ciliated, but simply finely pubescent beneath, and with the basal joint swollen.

Type *A. moninalis*, Wlk (*Asopia*).

Opisthedeicta.

This genus is akin to the first division (A) of Snellen's *Oligostigma*, cf. Tijd. v. Ent. xix. 1876, p. 189, for which I have proposed the generic term *Microdracon*. *Opisthedeicta*, however, is characterized by a peculiar formation in the hind wings of the male. The intraneural space between the first and third median nervules, from their origin to close upon the hind margin, is bare of scales above and below, and in the centre of this bare patch underneath there is visible a short fine black dash. In the formation of the labial palpi and antennæ it agrees with *Microdracon*.

Type *Op. poritialis*, Wlk. (*Oligostigma*).

Paracymoriza.

Type *P. vagalis*, Wlk. (*Oligostigma*).

The above generic name is proposed for Lederer's *Cymoriza*, the species of which are by no means congeneric with Guenée's original genus of the same name.

LIX.—*On the Fossil Fishes found at Achanarras Quarry, Caithness.* By R. H. Traquair, M.D., F.R.S.

About a mile to the west of the well-known pavingstone quarries of Spital Hill, and nearly three miles south of Halkirk, in Caithness, is the summit of a lesser elevation, the Hill of Achanarras; and on the slope of this hill, very near the top, is a small quarry, the fossil fish-remains occurring in which form the subject of the present short communication.

The comparatively few feet of rock exposed in this quarry afford a remarkable assemblage of fossil fishes, specimens of which do not occur in the older collections from the Scottish Old Red Sandstone; and, so far as I am aware, Achanarras as a locality for such remains has hardly yet been noticed in print*.

The first intimation I had of the existence of this locality was from Dr. Marcus Gunn, a Caithness man, but now a well-known London oculist, who some years ago brought me some specimens of a strange little fossil vertebrate from the quarry in question, which some who had seen it were inclined to compare to a "baby *Coccosteus*." Subsequently Dr. Gunn's cousin, Mr. John Gunn, Assistant Secretary to the Royal Physical Society of Edinburgh, brought some additional specimens to the Museum of Science and Art, among which were fragments of *Rhadinacanthus longispinus* (Ag.) and *Dipterus Valenciennesii* (Sedgw. & Murch.). From the Messrs. Gunn I learn that the quarry was first opened in 1874.

After this I began to be able to recognize specimens of fishes from Achanarras by the peculiar mineral character of the rock in which they are imbedded, which is unlike that of

* The only reference which I have seen to Achanarras as a locality for fossil fishes is contained in a short paper by Mr. John Gunn, "On the Rocks of Central Caithness," Brit. Assoc. Report, 1885, p. 1030. He observes that "at Achanarras a curious fossil *Coccosteus* is found in a small slate quarry."

any other fish-bearing schist with which I am acquainted, and to observe that they were finding their way into collections, even in London, though without the precise locality being indicated. In the autumn of 1889 Achanarras was visited by the officers of the Geological Survey of Scotland, and I have received the kind permission of the Director-General to examine a collection of fishes from it, presented to the Survey by the Thurso Flagstone Quarrying Company, who are the lessees of the quarry. It was not, however, until the month of August of the present year that I had myself the opportunity of visiting the spot. On this occasion, when on a visit to Mr. Gunn and his family at Dale, which is about two miles from Achanarras, I spent several days exploring the débris of the quarry, and, besides many specimens of the "baby *Coccosteus*" (*Palæospondylus Gunnii*), Mr. Gunn and I discovered three examples of *Diplacanthus striatus*, a species rare in the Caithness beds, besides several specimens of a species of *Mesacanthus* and other fishes. Shortly afterwards I received, for the Natural History Department of the Museum of Science and Art, a large donation of Achanarras fishes from the Thurso Flagstone Quarrying Company.

I must also acknowledge my indebtedness for material to Mr. James Reid, of Allan House, Blairgowrie, who for some years back has greatly interested himself in collecting the fossil fishes and plants of the Old Red Sandstone, and to Mr. Munro, of Achanarras Farm; and I have carefully looked through the collection made by Mr. Edwards, of Leigh, near Manchester, at present deposited in the museum at Owens College.

List.

1. *Dipterus Valenciennesii* (Sedgw. & Murch.)
2. *Mesacanthus*, sp.
3. *Cheiracanthus Murchisoni*, Ag.
4. *Diplacanthus striatus*, Ag.
5. *Rhadinacanthus longispinus* (Ag.).
6. *Pterichthys Milleri*, Ag.
7. *Coccosteus decipiens*, Ag.
8. *Homosteus Milleri*, Traq.
9. *Glyptolepis paucidens* (Ag.).
10. *Osteolepis macrolepidotus*, Ag.
11. *Diplopterus Agassizii*, Traill.
12. *Cheirolepis Trailli*, Ag.
13. *Palæospondylus Gunnii*, Traq.

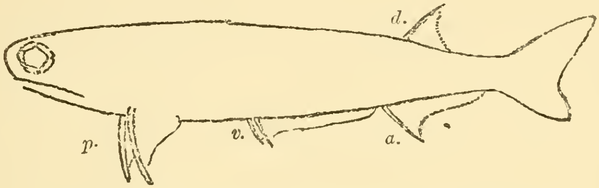
Remarks on the foregoing Species.

1. *Dipterus Valenciennesii.*—This is by far the most common fish at Achanarras, and, so far as the external characters of the species are concerned, the specimens are the most beautiful which I have seen from any locality in Scotland. They occur from 6 to 15 inches in length.

2. *Mesacanthus*, sp.—Specimens of a small *Mesacanthus* are not uncommon, but hardly in a sufficiently good state of preservation for accurate identification as to species. In size and the commonly twisted or contorted condition of the body they resemble *M. pusillus*, Ag., of the Moray-Firth beds.

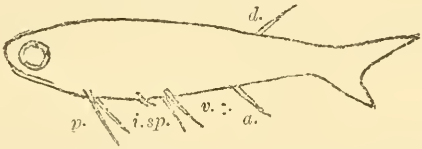
The genus *Mesacanthus* was instituted by myself in 1888* for those small species previously referred to *Acanthodes* (*A. pusillus*, Ag., *A. Mitchelli*, Eg., *A. Peachii*, Eg.) which,

Fig. 1.



Outline of *Acanthodes sulcatus*, Ag., much reduced.
p, pectoral spines; *v*, ventral spines; *a*, anal; *d*, dorsal.

Fig. 2.



Outline of *Mesacanthus Mitchelli*, Eg., natural size.
i. sp., intermediate spines; the other letters as in fig. 1.

though resembling that genus in having one dorsal spine placed posteriorly to the anal, have in addition a pair of minute intermediate spines on the belly between the pectoral and ventral ones. Messrs. Smith Woodward and Sherborn have, however, in their recently-published 'Catalogue of

* Geol. Mag. dec. iii. vol. v. p. 511.

British Fossil Vertebrata,' rejected *Mesacanthus* as a genus, and restored its species to *Acanthodes*.

I take this opportunity of expressing my dissent from this view, and to point out that, although the presence of intermediate ventral spines is to my mind quite sufficient for generic distinction, it is not the only important difference between those Old Red species and the true *Acanthodes* of the Carboniferous and Permian formations. A glance at the outlines of *Acanthodes* and *Mesacanthus* given in figures 1 and 2 will suffice to bring out the following remarkable distinctions in the position of the fin-spines. In *Acanthodes* the dorsal and anal spines are situated proportionally nearer the caudal fin than in *Mesacanthus*, while the ventral spines are small and situated remotely from the anal, so that the ventral fin itself forms a long low fringe; while in *Mesacanthus*, on the other hand, the ventral spines are nearly as large as the anal, and situated considerably nearer to *it* than to the pectorals. The remarkable fact is therefore that in *Mesacanthus* it is the small intermediate spines, and not those usually reckoned as "ventral," which correspond in size and position to the ventral spines in *Acanthodes*, the idea being indeed almost suggested that in the former genus the additional spines are the posterior and not the anterior pair situated on the belly. I do not propose to maintain such a theory, but certainly I must hold that the larger size and different position of the ventral spines, together with the presence of the intermediate pair, are ample grounds for the generic separation of *Mesacanthus* from *Acanthodes*.

3. *Cheiracanthus Murchisoni*, Ag.—Several specimens of a *Cheiracanthus* have occurred which I refer to *Ch. Murchisoni* on account of the form and proportional size of the spines, though the scale-ornament is not preserved.

4. *Diplacanthus striatus*, Ag.—Three specimens clearly identifiable with this, the common *Diplacanthus* of the Orkney as well as of the Moray-Firth beds.

5. *Rhadinacanthus longispinus* (Ag.).—Several fragments showing the characteristic spines and scale-ornament.

Messrs. Woodward and Sherborn have in their work already quoted also rejected the genus *Rhadinacanthus* which I proposed for the *Diplacanthus longispinus* of Agassiz on account of the apparent absence of the second or inner pair of pectoral spines, which are so conspicuous in the typical

D. striatus. Mr. Smith Woodward has since pointed out to me that in one specimen of *longispinus* from Gamrie, in the British Museum, a rudimentary second pectoral spine is present; but, considering the small size of this projection from the pectoral arch and the difference in the shape and sculpture of the other spines, I do not yet see my way to retracting the genus.

6. *Pterichthys Milleri*, Ag.—So far as I am aware no true *Pterichthys* has hitherto been recorded from the Caithness beds, as the *Pterichthys Dickii* of C. W. Peach, from John o' Groats, has been referred by me to another genus, *Microbrachius.* But there can be no doubt as to the identity of the Achanarras specimens with the common *Pterichthys* of the Orkney and Moray-Firth beds, in which must also be included *Pt. testudinarius*, Ag., *cornutus*, Ag., *latus*, Ag., and *quadratus*, Egert.

7. *Coccosteus decipiens*, Ag.— Detached plates of this species are common in many other localities in Caithness; but from no place in the whole of Scotland have I seen specimens which display the general configuration of the fish to better advantage. If a pectoral spine or "Ruderorgan" existed in *Coccosteus*, such as Prof. von Koenen thinks may yet be found in Scotch specimens, surely it could not fail to be seen in those from Achanarras. But not even a suspicion of such an appendage can be detected.

8. *Homosteus Milleri*, Traq.—A large but rather disturbed specimen of this from Achanarras is contained in the collection of the Geological Survey of Scotland.

9. *Glyptolepis paucidens* (Ag.).—Remains of this, the common *Glyptolepis* of the Caithness beds, are not uncommon in the quarry at Achanarras, one entire specimen in the Edinburgh Museum measuring 24 inches in length and having the acutely lobate pectorals beautifully displayed. There can be no doubt that this species is closely allied to the *G. leptopterus*, Ag., of the Moray-Firth beds; but the laniary teeth of the latter, so far as I can ascertain, seem to be rounded in section up to nearly the tip, while those of *G. paucidens* become acutely trenchant very soon above their base.

10. *Osteolepis macrolepidotus*, Ag.—In my paper on the

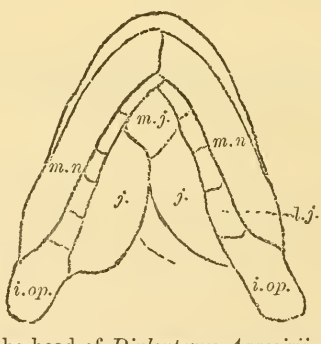
nomenclature of the fishes of the Old Red Sandstone I stated that I had never convinced myself of the occurrence of this species in Caithness at all; and there can be no doubt that the *Thursius macrolepidotus* (Sedgw. & Murch.) of the Thurso beds has often been mistaken for it. From Achanarras, however, two specimens—one in the Edinburgh Museum, the other in my own collection—are undoubtedly referable to *Osteolepis macrolepidotus*, Ag., which may be easily distinguished from the smaller *O. microlepidotus*, Pander, by the more oblong form of the cephalic shield and the more acute angle formed by a V-shaped sensory groove immediately behind the pineal foramen. *O. macrolepidotus* is the species characteristic both of the Orkney flags and of the Moray-Firth nodules.

11. *Diplopterus Agassizii*, Traill.—In Mr. Edwards's collection, at present exhibited in the Owens College Museum, there is a specimen of *Diplopterus Agassizii* evidently from Achanarras. It is merely an impression of a fish lying upon its back, yet shows at least one point of interest.

In a paper on *Megalichthys* published some years ago I stated that "Although omitted in Miller's and Pander's figures lateral jugular plates are undoubtedly present in *Osteolepis* and *Diplopterus* as well as in *Megalichthys*" *.

In no specimen of *Diplopterus* have I seen the lateral jugulars better marked than in the one here referred to, the

Fig. 3.



Under surface of the head of *Diplopterus Agassizii*, reduced one third. *m.n.*, mandible; *i.op.*, interoperculum; *j.*, principal jugular; *m.j.*, median jugular; *l.j.*, lateral jugular plates.

head of which I have represented in outline in fig. 3. Here it will be seen that they are not symmetrical on the two sides,

* Geol. Mag. (3), vol. i. 1884, p. 117.

there being five on the right and only four on the left. They are proportionally narrower than in *Megalichthys*, but not so narrow as in *Osteolepis*.

12. *Cheirolepis Trailli*, Ag.—Two specimens of this from Achanarras are in the Museum of Science and Art, and one in the collection of the Geological Survey, and I also observed some fragments of the same species in the débris of the quarry. I have no hesitation in referring these specimens, the first of the genus ever observed in Caithness, to the same species as that which is so common in the Orkney as well as in the Moray-Firth beds.

13. *Palæospondylus Gunnii*, g. et sp. n. (fig. 4, magnified).—This is hitherto the only novelty which has turned up in the quarry, and it is of excessive interest, though unfortunately it must take its place among the fossil fishes *incertæ sedis*. It might indeed be asked, Where is the evidence that it is even a fish? though there is no doubt of its being a Vertebrate.

Fig. 4.

Palæospondylus Gunnii, Traq., twice nat. size.

This little organism varies from 1 to $1\frac{1}{2}$ inch in length, of which measurement the head occupies about a fifth. Little can be made out of the structure of the head, which looks like a flat crushed mass of bony bars; it is a little longer than broad, with a slight lateral hour-glass constriction, rounded in front and truncate behind; from the front two small, short, pointed processes project, one on each side, like a pair of little feelers, while behind a little shield-like body passes back over the first three or four vertebræ. Nothing at all comparable to jaws, upper or lower, can be seen. The vertebral axis, which passing back from the head becomes attenuated to a fine point posteriorly, is composed of distinctly ossified and separate vertebral centra, which, however, appear to me to be hollow or ring-like, as in *Chondrenchelys* &c. In the anterior two thirds of the vertebral column the neural arches are distinctly seen in the type specimen, but they are not furnished with prominent spines; but in the latter third very slender obliquely-directed spines make their appearance both neurally and hæmally.

Not the smallest trace of limbs has been seen in any specimen.

It is very difficult to give an opinion on the affinities of this strange little organism, except that it is a Vertebrate and probably a fish. It is certainly not a Placoderm, its resemblance to a supposed "baby *Coccosteus*" being entirely deceptive. The appearance of the head does remind us in a strange way of the primitive skull of *Myxine*, a resemblance which is rendered still more suggestive by the apparent complete absence of lower jaw or of limbs or limb-girdles. But a Myxinoid with ossified skeleton including differentiated vertebral centra is, it must be owned, a rather startling idea! But as it requires a name in the meanwhile, I cannot think of any one more appropriate than *Palæospondylus Gunnii.*

LX.—*The Fauna of Amber.* By Herr RICHARD KLEBS, of Königsberg *.

THE above is the title of a paper read before the Entomological Section of the 'Versammlung deutscher Naturforscher und Aertzte,' at Heidelberg, on Sept. 21, 1889. With a view to obtaining a large amount of material thoroughly suitable for working, Herr Klebs had communicated with Messrs. Stantien and Becker, of Königsberg, who enjoy the monopoly of the amber trade, and who placed their entire stock at his disposal. The result has been that during the last twelve years several hundred thousand pieces containing specimens have passed through his hands, and of these he has arranged and catalogued about twenty-five thousand of the best-preserved and most valuable. In addition to this Herr Klebs has arranged and catalogued other collections, including that formed by Künow, which comprises twelve thousand specimens, and has recently been purchased by the Prussian government.

Thirty years ago a paper was read by Löw before the same society on the Dipterous fauna of amber. Unfortunately it was but a passing glimpse which Löw was able to give of the Tertiary forms of this order of insects, which attained so high a degree of development during that period; and Löw died before completing his work. But what little he then communicated excited general interest. Herr Klebs instances the genera *Electra* and *Chrysothemis*, which are

* Condensed from the 'Biologisches Centralblatt,' Bd. x. nos. 13 and 14, pp. 444–448, August 15, 1890.

intermediate forms between gnats and Brachycerous flies. Hagen has more recently given us a very exhaustive treatise on quite a small group of amber insects—the Psocidæ; while the ants have been examined by Meyer. Apart from a few small memoirs, this includes the whole of the work which has hitherto been done on this interesting subject. Berend's work on the organic remains in amber, published in 1854, is of but little value for purposes of identification.

The chief obstacle which has hitherto militated against the proper working out of these treasures, of such extreme importance for palæontology and zoology, lay in the fact that the bulk of the material was not selected with sufficient care and was altogether insufficiently prepared. Künow was the first to polish the pieces of amber containing specimens in such a way that they can be examined with the microscope with almost greater facility than preparations of existing forms. It was owing to this that Hagen, in his recent work on the Psocidæ, the material for which was entirely derived from the Künow collection, was able to furnish such interesting data for the phylogeny of this group from the Tertiary period to the present time. In preparing the specimens as much as possible of the surrounding amber was first removed, and then, after polishing, they were imbedded in a hard resinous matrix of approximately the same refractive index as amber. By this means the amber enclosing the specimen is permanently preserved from efflorescence and that loss of transparency, which have worked such havoc among old and valuable collections. Herr Klebs has so arranged this process that it can be employed for the preservation of blocks of amber containing a number of specimens, by which scientific examination is facilitated, while the specimens themselves are rendered very suitable for exhibition purposes in museums.

After these introductory remarks Herr Klebs proceeds to summarize the results of his investigations.

Among the creatures imprisoned in amber the Diptera are most numerously represented, and material to the amount of at least twenty thousand perfectly preserved examples has been collected. Nematocera and Brachycera are present in about equal numbers. The Pupipara and Aphaniptera are so far conspicuous by their absence. As regards the richness in species of certain of the genera represented in amber, it was found by Löw that, for example,

Chironomus has at least 40 species.				
Ceratopogon	,,	,,	26	,,
Cecidomyia	,,	,,	9	,,
Sciara	,,	,,	21	,,
Mycetophila	,,	,,	23	,,
Sciobia	,,	,,	16	,,
Sciophila	,,	,,	15	,,
Platyura	,,	,,	16	,,

Of Dolichopodidæ Löw was able to distinguish at least sixty-eight different species. The rest of the families of Diptera, with very few exceptions, also have their representatives in the fauna of amber. Species have been discovered quite recently which attract attention owing to their peculiar shape, and which, to the best of Herr Klebs's knowledge, are widely separated from existing forms. He instances a large Dipteron lately discovered which possesses extraordinarily large antennæ branched like the antlers of a stag *.

Of the Hymenoptera all the groups are represented, with the exception of the Braconidæ and Evaniadæ. The Uroveridæ, however, are limited to two large species of *Sirex* which Herr Klebs has lately discovered.

The Coleoptera, with about four thousand examples, possess representatives of a number of families. Out of a total of seventy-five families twenty-six are so far missing. These are:—

Cicindelidæ.	Lucanidæ.
Hydrophilidæ.	Scarabæidæ.
Clavigeridæ.	Cebrionidæ.
Anisotomidæ.	Melyridæ.
Sphaertidæ.	Cioidæ.
Scaphidiidæ.	Pimmellidæ.
Rhyssodidæ.	Diaperidæ.
Mycetophagidæ.	Helopidæ.
Thorictidæ.	Lagriidæ.
Throcidæ.	Rhipiphoridæ.
Georyssidæ.	Meloidæ.
Parnidæ.	Salpingidæ.
Heteroceridæ.	Corylophidæ.

But besides the Coleoptera which have been allotted to

* [In all probability Herr Klebs is mistaken in speaking of these processes as *antennæ*. They are most likely special cuticular developments, as in the case of the remarkable genus *Elaphomyia*, founded by Saunders for certain forms discovered by Wallace in the Malay Archipelago, the types of which are in the British Museum. These have a pair of antler-shaped chitinous processes springing from the head, quite distinct from the antennæ, which are in the normal position.—Transl.]

their respective families Herr Klebs finds himself unable to assign about 33 per cent. of the beetles which he has examined, in spite of their excellent preservation. Although, in consequence of the material differences which they exhibit, they can scarcely belong to the families already represented, it is nevertheless quite possible that many a representative of the missing families may be hidden away among them. Herr Klebs cites the genus *Lymexilon* as an instance of the way in which occasionally solitary forms, hitherto unknown as Tertiary, suddenly turn up in some numbers. He discovered the first amber specimen of *Lymexilon* in the autumn of 1888; a year later he had discovered no less than six specimens of the genus, comprising at least three different species. *Lymexilon* is at the present time an extremely rare genus, which lives in rotten oak, and of which only a solitary local species has hitherto been found in Europe.

Of the Neuroptera, the Phryganidæ, of which about five thousand examples have been discovered, are the most numerous; next come the Hemerobiidæ, with about fifty specimens, the Panorpidæ, with twenty-five, and occasional examples of Semblidæ.

The Orthoptera are represented by nearly two thousand five hundred specimens, the Blattidæ being most numerous; next, arranged in order of frequency, come the Lepismidæ, Gryllidæ, Poduridæ, Locustidæ, Pseudoperlidæ, Phasmidæ, Forficulidæ, and lastly the Mantidæ. No specimens of Campodidæ nor Acrididæ have as yet been found, though possibly specimens of *Niceletia* and *Campodea* may have been included among the larvæ.

Among about one thousand specimens of Pseudoneuroptera the Termites are most numerous, numbering about two thirds of the whole, while Thripsidæ, Psocidæ, Perlaridæ, Ephemeridæ, and Libellulidæ are present in about equal numbers, the Psocidæ being perhaps somewhat more numerous than the rest. The Embiidæ are very rare.

The Lepidoptera, to the number of about one thousand specimens, are all with one exception Micros, belonging to the families Tortricidæ, Tineidæ, and Psychidæ. The solitary Macrolepidopteron, which is one of Herr Klebs's recent discoveries, is a tolerably large *Arctia*.

The Rhynchota, with about twelve hundred examples, exhibit representatives of all the subdivisions, with the exception of the Pediculina. Aphididæ and Homoptera (Cicadidæ) are the most numerous; next come the Hemiptera, and lastly the Coccidæ. Myriopoda, both Chilopoda and Chilognatha, are represented by about one hundred and fifty specimens.

Of Arachnoidea at least two thousand five hundred specimens have been found, the majority of which belong to the Araneida, which are remarkably rich in genera and species. Herr Klebs mentions that at least six species of the extinct genus *Archæa* have been observed. The Acarina too are numerous, and it is interesting to note that Herr Klebs has recently discovered an *Ixodes*. The Phalangida are represented by about thirty specimens and the Pseudoscorpionida by about the same number. Of the true Scorpions only a single example is known, and has been described by Menge as *Tityus cogenus*. Pedipalpi and Solifugæ are wanting as yet.

The Crustacea, with the exception of one Amphipod, which Zaddach has worked out, are represented by Isopods only. About fifty specimens, belonging to a number of genera and species, have been found.

Of larvæ and larva-cases some fifteen hundred specimens have been found; but Helminthes, such as *Mermis* and *Anguillula*, are only occasionally met with.

The Mollusca are represented by twelve specimens, belonging to eleven different species. Among these Herr Klebs has distinguished and described the genera *Pormocella, Hyalina, Strobilus, Myorocystis, Vertigo, Balæa*, and *Electræa*, his determinations being for the most part confirmed by Sandberger. In addition to these he has recently acquired a couple of beautifully preserved Mollusks; one of these is a *Vertigo* and the other very closely allied to the large Streptaxids.

Vertebrate inclosures in amber are extremely rare and are principally confined to solitary feathers and tufts of hair; the only other specimen belonging to this group with which Herr Klebs is acquainted being a lizard, which Dr. Böttger, of Frankfurt, supports him in considering to be very closely allied to *Knemidophorus*, an exclusively American and for the most part tropical form. Of the seventeen known species one is also found in North America.

So far as can be judged from the representatives of the amber fauna hitherto examined, their nearest allies at the present day occur in North America and Eastern Asia. Notably is this the case in the Diptera. This fact had already been noticed by Löw, who, when examining the North-American Diptera, discovered isolated representatives of a number of genera (*Electra*, *Chrysothemis*, &c.) which he had previously believed to be exclusively Tertiary. Baron Osten-Sacken has since confirmed Löw's conclusions, and in looking over the material which Löw had collected has discovered very numerous relations between the amber fauna and that of North

America. Herr Klebs's examination of the amber Mollusca produced a similar result, and in this case Eastern Asiatic types were also found. There is, however, nothing at all surprising in this—it was only to be expected; for relations have long been known to exist between the fauna and flora of North America and Eastern Asia on the one hand and between this and our Central European Tertiary fauna and flora on the other. Herr Klebs instances the tuberculated *Unios*, the Paludinæ, &c. Still more striking would be this agreement if the at present merely provisional assignment of the above-mentioned lizard to the immediate neighbourhood of *Knemidophorus* should be confirmed upon closer examination. The works of Caspary and Conwenz on the flora of amber also lead mainly to the same result.

Herr Klebs concludes by remarking that, with the exception of the Psocidæ and Gasteropoda, some fifty specimens in all, no portion of the amber fauna has as yet been exhaustively worked out; and he appeals to entomological specialists in particular to put themselves in communication with him, in order that the study of the rich material which he has amassed may be undertaken in a manner befitting its importance.

LXI.—*Observations on some Fossil Fishes from the Lower Carboniferous Rocks of Eskdale, Dumfriesshire.* By R. H. Traquair, M.D., F.R.S.

Since the publication of the first part of my "Report" on the fossil fishes obtained by the Geological Survey of Scotland in Eskdale and Liddesdale a considerable quantity of new material has been collected in this district, as well by the Survey as also by Mr. Jex, collector to Mr. Damon, of Weymouth, and by Mr. T. Stock and others. Prior to the publication of a second part of the "Report," I propose in the present instance to make a few remarks on some of the specimens which were procured from the late Mr. Robert Damon for the Edinburgh Museum of Science and Art.

Acanthodes nitidus, A. S. Woodward.

Characterized by having the ventral spines more posteriorly situated than in other Carboniferous species of the genus. I had intended naming this species, but as my friend Mr. A. Smith Woodward informs me that he had independently diagnosed and named it in the second part of his 'Catalogue of the Fossil Fishes in the British Museum,' now in the press, I have pleasure in adopting his name.

Rhadinichthys elegantulus, Traq.

Rhadinichthys Geikiei, Traq. Trans. Roy. Soc. Edinb. xxx. 1881, p. 25, non Proc. Roy. Soc. Edinb. ix. 1877, p. 438.
Rhadinichthys Geikiei, var. *elegantulus*, Traq. Trans. Roy. Soc. Edinb. xxx. 1881, p. 27.
Rhadinichthys delicatulus, Traq. ibid. p. 29.

In the Proc. Roy. Soc. Edinb. 1889–90, pp. 397, 398, I have given my reasons for referring the original *Rhadinichthys Geikiei* to *Rh. carinatus*, Ag., and also for believing that the Eskdale fish is a distinct species, for which the term *elegantulus*, which I had used to designate a variety, must now be adopted. From this species I can no longer separate *Rh. delicatulus*.

Acrolepis ortholepis, Traq.

Elonichthys ortholepis, Traq. Geol. Mag. (3) vol. i. 1884, p. 7.
Acrolepis ortholepis, Traq. Proc. Roy. Soc. Edinb. 1889-90, p. 398.

The Edinburgh Museum possesses a splendid specimen of a large Palæoniscid, 25½ inches in length, which, from the scale-ornament, I must refer to the same species as the fish in the British Museum to which six years ago I gave the name of *Elonichthys ortholepis*. In the present specimen, however, the great thickness of the scales, along with their shape, indicate that its position is in *Acrolepis*, a position corroborated by the absence of serrations along the posterior margins of the scales. The original "*Elonichthys*" *ortholepis* is, it may be added, an immature example 12 inches in length.

Styracopterus fulcratus, Traq.

Holurus fulcratus, Traq. Trans. Roy. Soc. Edinb. xxx. p. 46.

The original specimen of *Holurus fulcratus*, Traq., in the collection of the Geological Survey of Scotland is a mere fragment. By a mistake its locality was given as Glencartholm, whereas it was in reality found at Tarras Foot.

The Geological Survey officers have since acquired a number of additional specimens from the same locality which show that the species does not belong to *Holurus*, but to a new genus closely allied to *Benedenichthys* *, Traq., from the Carboniferous Limestone of Belgium. As these specimens belong to the Survey, I must defer their description to the forthcoming second part of the "Report."

* *Benedenius*, Traq., in de Koninck's 'Faune du Calcaire carbonifère de la Belgique,' pt. i. 1878, p. 15. A critic in the Ann. & Mag. Nat. Hist. (5) vol. vi. 1880, p. 97, having pointed out that the name "*Benedenius*" is preoccupied, I propose to alter it to *Benedenichthys*, and at the same time to state that I have become convinced that, though it presents many resemblances to the Platysomidæ, it is after all more Palæoniscid, and should be restored to the family Palæoniscidæ.

MESOPOMA, gen. nov.

Body fusiform, suspensorium only very slightly oblique, but the maxilla shaped as in typical Palæoniscidæ. Dorsal fin nearly opposite the anal.

I propose to separate from the genus *Canobius* the species *pulchellus* (*op. cit.* p. 51) and *politus* (*op. cit.* p. 53), on account of the more typically Palæoniscid configuration of their facial bones. I should have included them in *Rhadinichthys* were it not for the very slight obliquity of the suspensorium, which excludes them from the definition of the genus along with another species from the Pumpherston oil-shales, which I recently described as *Rh. macrocephalus* *. These species will therefore in future stand as *Mesopoma pulchellum*, *politum*, and *macrocephalum*.

Mesolepis tuberculatus, sp. n., Traq.

Of this I have seen no really complete specimens. Such as have occurred show a small deep fish, about 4 inches in length and 2 in depth, with a large head occupying about one third of the entire length. From the structure of the head, so far as it is seen, the position of the dorsal fin which commences at the culminating part of the back, and the shape of the scales, which are high and narrow, there can be no doubt as to the species being referable to *Mesolepis*. The scales differ from those of any known species in being ornamented externally with a sharply defined tuberculation, the tubercles often tending to become confluent transversely.

Locality. Glencartholm, Eskdale. Type in Edinburgh Museum.

Mesolepis has not hitherto been recorded from strata below the horizon of the Millstone Grit.

Mesolepis rhombus, sp. n., Traq.

Length 5 inches; depth of body just in front of dorsal fin $2\frac{1}{2}$ inches; length of head contained a little more than three times in the total. Dorsal fin commencing at culminating point of back, high in front, then falling away to a fringe which ends close to the tail-pedicle; anal fin short-based, triangular, acuminate; caudal deeply cleft, heterocercal. Ventral fins small; pectorals not seen. Scales rather small, narrow, their surface ornament badly preserved, but apparently consisting of rounded tortuous ridges, sometimes passing into tubercles, whose direction is mainly parallel with the anterior and posterior borders of the scale. Dentition not visible; head conformable to the type of *Mesolepis*.

* Proc. Roy. Soc. Edinb. for 1889-90, p. 398.

This second new species of *Mesolepis* is at once distinguishable from *M. tuberculatus* by the scale-ornament, and from the Coal-measure species *M. Wardi*, Young, by the greater proportional size of the head and the peculiar smallness and narrowness of the scales.

Locality. Glencartholm, Eskdale. Type in Edinburgh Museum.

Cheirodopsis Geikiei, Traq.

More perfect examples of this interesting Platysomid show that not only were the dorsal and ventral peaks of *Cheirodus* wanting, but that it possessed well developed ventral fins which are absent in the allied genus.

Tarrasius problematicus, Traq.

Prof. Zittel, in the ichthyological part of his 'Handbuch der Palæontologie,' has provisionally placed this extraordinary fossil fish in the Dipnoi *. More recent acquisitions show that such a view of its position is quite untenable, the pectoral fin, unknown previously, being rounded and with only a very small basal lobe.

We now know the form of the entire fish, and, though the osteology of the head is not sufficiently clearly exhibited to decide its systematic position with absolute certainty, the obtusely lobate character of the pectoral fin seems to point towards the Crossopterygii. The teeth are small and obtuse. The anterior part of the body is naked, the small Acanthodian-like scales only commencing behind the abdominal region. There is no trace of ventral fins.

The locality of the original specimen was in the "Report" erroneously stated to be Tarras Foot. All the examples as yet known were found at Glencartholm; nevertheless the name of the genus must stand.

LXII.—*Descriptions of new Species of* Crocidura. By G. E. Dobson, M.A., F.R.S.

Crocidura Grayi.

Like *C. Horsfieldii* †, but considerably larger, although the tail is not longer than in that species and is similarly nearly naked; the fur (so far as can be ascertained from an inspec-

* I. Abtheilung, 3 Band, p. 129.

† *Crocidura Horsfieldii*, Tomes, = *C. retusa*, Peters.

tion of specimens preserved in alcohol) is very similar in length and in colour to that of that species; the lateral gland is as well developed as in the males of *C. Horsfieldii*, perhaps somewhat larger, in the single female available for examination (which is, however, not quite full-grown) there is no trace of one.

Fur above reddish brown, beneath greyish brown, the basal three fourths of the hairs somewhat slaty. Skull much larger than that of *C. Horsfieldii*; teeth (see my 'Monograph of the Insectivora,' part iii. fasc. 1, pl. xxviii. fig. 11) like those of that species, the last upper incisor nearly equal to the anterior maxillary tooth in vertical extent, but less than it in cross section.

Length (of an adult male, the type): head and body 68 millim., tail 51, ear 10, elbow to end of middle digit (without claw) 18, manus (without claws) 8, pes (without claws) $13\frac{1}{2}$.

Hab. Philippine Islands. From Mr. Cuming's collection in the British Museum (Natural History).

I name this species in memory of the late Dr. J. E. Gray, F.R.S., of the British Museum.

Crocidura Petersii.

Slightly larger than *C. Doriana*, resembling that species in the peculiar position of the lateral gland, but differing from it in the form of the teeth and in the much greater length of the foot. The measurements of the skull are different (see below) and much greater than those of fully adult specimens of *C. Doriana*, although the specimen from which this description is taken is not full-grown, thus indicating a much larger species; the bones of the skull also are much thicker, very unlike the diaphanous skull of *C. Doriana*.

Ears short and clothed with short hairs only; the tail is thinly covered with very short hairs, but comparatively plentifully set with long brown hairs, which extend along three fourths its length; the fur on the back is reddish brown, beneath ashy with a brownish tinge.

The anterior cusp of the first upper incisor extends far beneath the posterior basal cusp; the latter is very peculiarly shaped (see 'Monograph of the Insectivora,' pt. iii. fasc. 1, pl. xxviii. fig. 17), its anterior margin is absolutely straight, and its cusp is well developed; the anterior maxillary tooth is larger than the third incisor in cross section and equals it in vertical extent.

The following are the measurements of the type, a not quite full-grown male specimen:—

Length: head and body 92 millim., vent to tip of tail 52, ear 9, elbow to end of middle digit (without claw) 24, manus (without claws) 10, pes (without claws) 17; skull, total length between perpendiculars 27, occipital crest to anterior extremity of premaxilla 24, greatest width of skull $11\frac{1}{2}$, length of upper tooth-row $13\frac{1}{2}$, mandibular condyle to anterior extremity of first lower incisor 19, length of lower tooth-row $12\frac{1}{2}$.

Hab. Western Africa (the Gaboon).

Type no. 5552 in the collection of the Berlin Museum.

I name this species in memory of the late Prof. W. C. H. Peters, Director of the Zoological Museum at Berlin.

Crocidura Martensii.

About the size of *C. sericea*, but differing from that species in the colour of the fur and in the form of the teeth. Fur dark brown, with shining extremities, on the lower surface similar with greyish tips, on the whole resembling the fur of *C. æquatorialis*; tail thinly covered with short brown hairs above intermixed with long white ones, beneath whitish, with very short brown hairs; ear-conch clothed with very short fur, except where a few moderately long hairs spring from the margin of the upper internal fold; manus and pes clothed with short pale yellow-brown fur. The lateral gland is of moderate size and in the usual position. The first upper incisor has a much shorter anterior cusp than in *C. sericea*, and the other teeth are quite differently shaped to those of that species, as may be seen by comparing 'Monograph of the Insectivora,' pt. iii. fasc. 1, pl. xxviii. fig. 15, with pl. xxvii. fig. 5. The anterior maxillary tooth (penultimate premolar) is somewhat larger in cross section at the base than the third upper incisor, but it scarcely equals it in vertical extent, its cusp considerably exceeds the anterior basal cusp of the last premolar, its posterior margin is convex and close to the last premolar. The posterior basal cusp of the first incisor is rather small, and there is a small internal basal process.

Length (of an adult male specimen preserved in alcohol): head and body 75 millim., tail 58, ear 9, elbow to end of middle digit (without claw) 18, manus 7, pes 13, distance of summit of cusp of first incisor from that of last premolar 5.

Hab. Cape of Good Hope. Type no. 5588, preserved in the collection of the Zoological Museum at Berlin.

I name this species in honour of Prof. E. von Martens, of the Berlin Museum.

Crocidura pilosa.

About the size of *C. fumigata* or very slightly larger. The body is densely clothed with rather long fur, dark red-brown above, and slightly paler with shining tips beneath, the basal four fifths of the hairs on both upper and lower surfaces are bluish with a greyish tinge. The ears are more thickly clothed with short hairs than usual in specimens of this genus, and the same remark applies to the tail, which is well covered with coarse short hairs, which lengthen and form a short pencil at the extremity, interspersed through basal two thirds are long fine hairs; the feet are well covered with short hairs; the hairs of the tail are dark brown above and slightly paler beneath; on the feet similar to those on the upper surface of the tail.

The skull closely resembles that of *C. fumigata* in size, but differs in the greater elevation of the premaxillary bones (see 'Monograph of the Insectivora,' pt. iii. fasc. 1, pl. xxviii. fig. 9); the teeth differ from those of that species in some peculiarities of form and implantation, better understood by comparing *op. cit.* pl. xxviii. fig. 9, with fig. 8, than from any description; the anterior cusp of the anterior incisor is conspicuously shorter than in *C. fumigata.*

Length (of an adult f male specimen preserved in alcohol): head and body 60 millim., tail 48, ear 7½, elbow to end of middle digit (without claw) 18½, manus 8, pes 13½, length of skull between perpendiculars 20, occipital crest to end of premaxilla 17, greatest width of skull 9, length of upper tooth-row 8.

Hab. Transvaal. Type no. 6200, preserved in the collection of the Zoological Museum at Berlin.

BIBLIOGRAPHICAL NOTICES.

A Treatise on the Common Sole (Solea vulgaris), *considered both as an Organism and as a Commodity.* By J. T. Cunningham, M.A. &c.

In requesting and obtaining the liberal aid of Government and public corporations, as well as that of private individuals throughout Britain, the founders of the Biological Laboratory at Plymouth entailed a certain amount of responsibility—more especially with regard to the first-mentioned; and this work is an earnest of that responsibility. The author of the treatise came to his task with experience gained at the Granton Laboratory and the rich grounds in and off the Forth, and this experience crops up here and there in the work, and adds to the interest as well as to the value of the observations. The work consists of a more or less scientific study of the common sole and an account of the present condition of the sole-fishery, together with the possible practical application of the former to the purpose of maintaining or increasing the supply of soles available for the market.

The first six chapters, constituting Part I., require little comment, being a semipopular account of the classification of flat-fishes, the history of the genus *Solea*, and a description of the species with synonymy. It would have been an acquisition to have figured *Solea Greenii*. In Part II. the osseous system and the fibrous and muscular tissues are elaborately described, and a somewhat detailed account given of the oblique muscles, their attachments and connexion with the distortion of the eye and orbit. The description of the viscera and vascular system is mainly valuable in connexion with the unravelling of the mystery which has more or less shrouded the males and the male organs. It was the exceeding smallness of the ripe testes that had puzzled the non-scientific observer, and even some who could not be included in this class. The life-like half-figures of the male and female by Miss Willis, together with the descriptions of Mr. Cunningham, will be of much service to future workers. An account of the nervous system, the skin and its parts follows, comparisons of the scales of various species of soles being made by aid of figures. The sense-organs on the under surface of the snout are shown not to differ from those of the dermal tube of the lateral line.

The sixth chapter of Part II. contains the embryology of the sole. When this was written the author had not seen the ovum immediately after its escape from the ovary, but from a postscript on p. 135 he had been more successful this year (1890). Other naturalists, however, had previously seen it at this stage, and agree that it corresponds with the condition of such forms as the cod in regard to the protoplasm. He calls the zona radiata the vitelline membrane, but does not refer to his former view that it is an extra-vitelline product. The particles of oil which form a kind of ring in the sole's egg are occasionally somewhat more distinct than shown by the author, and vary a little in size, as described in a previous publication, viz. from ·0015 to ·0004 inch. He does not now hold the view that oil-globules occur in the perivitelline space. Moreover he now locates the oil-globules beneath the trunk of the embryo sole. He prefers the term "segmental cavity" to Prof. Ed. E. Prince's less ambiguous term "germinal cavity." The pigment of the larval sole immediately after hatching appears to differ materially in Scotland (*vide* Trans. Roy. Soc. Edinb. vol. xxxv. pl. xvii. fig. 13, Feb. 1890), since it is not truly yellow, but dull stone-grey or dull yellowish white, and this afterwards changes into the ochreous hue so characteristic of the post-larval sole (*vide* 'Report of the Scotch Fishery Board,' July 1889, pl. iii. fig. 9).

The author did not succeed in keeping the larvæ alive more than a few hours until this spring (May 1890), and then only till the yolk "was almost absorbed." Elsewhere experience differs, and the sole has been found to be one of the hardiest larvæ under treatment. He has also overlooked the late larval stage referred to at the end of the previous paragraph; but he has made an interesting addition in securing a young sole $\frac{3}{4}$ inch long from Mevagissey, showing most of the features of the adult.

He next describes the ova of *Solea variegata*, which measure 1·28 to 1·36 millim. in diameter, and differ from those of the common sole in having oil-globules of considerable size scattered separately over the yolk ; but the ova of *Solea lutea*, which are similar though smaller (those measured by Mr. Holt being ·78 to ·84 millim.), have apparently not been captured near Plymouth, where young specimens are "fairly common."

In Part III. the geographical distribution of the soles and their habits are considered. He speaks of the sole as rarely, if ever, captured by any other instrument than the trawl ; but, like the plaice, it can be captured by the hook with suitable bait—some of the finest examples at St. Andrews being procured in this way. His remarks on the food of the sole are interesting and only require the addition that the lobworm is a prominent feature in its dietary.

In Chapter IV. an account of the breeding of the sole is given, and he is probably right that under certain conditions, as in the flounder and plaice, a large part of the ovary ripens its contents simultaneously. The spawning-period is lengthened—those in the south, according to the author, spawning in February, March, and April, while in Scotland the period ranges from May to August. The small size of the testes of the male is remarkable, and the statement quoted from Nordman that a species of sole adhered during copulation is noteworthy. With the exception of the experiments in the spring of 1890, as stated in the postscript, the hatching of the soles at Plymouth was difficult.

The author is of opinion that soles spawned in March have completed their metamorphosis by the middle of May, when they are $\frac{1}{2}$ to $\frac{9}{16}$ inch long, and that on May 31st they are $\frac{3}{4}$ inch, and that in one year they grow about 5 inches in length. Those $6\frac{3}{4}$ to $9\frac{3}{4}$ inches are just over two years. He thinks that soles 14 inches long are four years old, and those 20 inches long about six years. His diagnosis in regard to the first year is, however, uncertain.

Part IV. is devoted to what is called Economical subjects, and in this part considerable condensation might have been effected. In artificial fertilization the author crushed the testes, as indeed is the common plan with the gurnard and others at St. Andrews, and which Dr. Wilson found equally satisfactory in the mussel. An ingenious apparatus, slightly differing from Captain Chester's, of the United-States Fish Commission, is figured and explained by the author. Experience elsewhere shows that success can be obtained with open vessels, and the more simple such apparatus is the better. He is of opinion that a railway journey jolts and mechanically injures the pelagic eggs ; but this may be exceptional, since in 1884, and often since, ova fertilized far out at sea have afterwards been safely sent by railway from distant places, such as Aberdeen or Macduff, to St. Andrews.

The author thinks that the sole-fishery is declining, and some pungent remarks are made in regard to fishery statistics which were only lately put on a proper footing—thanks to the late Lord Dalhousie's Commission. He rightly suggests the desirability of fertilizing the ova of ripe forms captured in the trawl, and returning them to the sea, an idea which originated with the Americans in regard to the cod. Little training would really be necessary for this, since the skippers of trawling-vessels and not a few line-fishermen in Scotland readily and successfully carry out artificial fertilization.

The plates attached to the work are eighteen in number, and of these twelve are coloured. Certainly no expense has been spared in regard to the first nine—the work of an accomplished artist, Miss Willis. A smaller number of coloured figures of the common sole perhaps might have sufficed. In the structural figures great care has been exercised by the author, though the effect after lithographing is sometimes a little harsh, *e. g.* in plates x. and xii. Some of the figures in the last three plates (done in Jena) are very neat, though there are a few small structural omissions, such as the absence of the hypural and epiural elements in the transparent tails of the young flounders in pl. xvii. fig. 5 and pl. xviii. fig. 1.

In the preparation of this treatise the author has had to consult popular favour and at the same time promote the advancement of science. On the whole he has accomplished his task with much perseverance and ability: and though there are omissions of moment and a tendency to take somewhat limited views of various questions, still the work is creditable and noteworthy both in regard to the fisheries and zoology. W. C. M.

A Zoological Pocket-Book, or Synopsis of Animal Classification. By Dr. Emil Selenka and J. R. Ainsworth Davis. Charles Griffin & Co.: London, 1890.

This is a translation by Mr. Ainsworth Davis of the third edition of Dr. Selenka's 'Zoological Pocket-Book.' It consists of a series of classificatory schedules, comprising definitions of the phyla, classes, and orders of the animal kingdom, together with explanatory remarks and tables. At the end of the book Mr. Davis has added some useful "Notes on Distribution," and also a table showing the "Geological Range of the chief Animal Groups." The book is interleaved with blank paper for the reception of brief synopses of "voluminous lecture-notes, or, in some cases, definitions of families and smaller subdivisions." The size of the book (small octavo) renders it an extremely handy little volume, and different-sized type is usefully employed in order to emphasize the various classificatory divisions. The book is, of course, intended for students, but its value will largely depend upon the way in which it is used. Thus, for a "short-course" man, struggling with the anatomy of his half-dozen types, schedules such as these would scarcely be necessary, and, if used, would probably be productive of much confusion. The more advanced student, on the other hand, who has received a good general grounding in zoology, will be certain to find this little book of much assistance in preparing for examination. In the face of the enormous amount of original work now being done in science, it may seem a heresy to assert that the days of learning for learning's sake are over. Such is nevertheless the melancholy fact, the result of the modern struggle for existence and competitive examinations. For the vast majority of mankind education has become simply a means to an end, which is bread-and-butter. Were it not so we should be inclined to consider these schedules superfluous, and to hold it far better for the student that he should be able to tabulate his knowledge for himself. As it is, any labour-saving appliance, anything which renders the passing of examinations easier, is for the good of the student, and for the sake of the student we welcome this book.

The book consists of some two hundred and thirty pages, blank leaves included, though not numbered. As they are intended to be used, it would have been far better if they had been. The first ten pages are devoted to the Protozoa. We then come to a genealogical tree, intended to exhibit the probable phylogenetic connexion of the various classes of the Metazoa. This shows most of the orders usually included under the comprehensive title "Vermes," distributed along the various branches; while in the centre we find the word "Vermes" printed in large type and apparently springing from nowhere, though the Chordata are shown as springing from it. The result is somewhat confusing. On the next page we have a table likely to be of greater value to the student, as it exhibits the chief typical differences in the reproductive, blood-vascular, nervous, and other systems of the Metazoan phyla. Another very useful table exhibits the chief facts in the life-histories of the most important parasitic Trematodes and Cestodes and other parasitic Worms. With the exception of the last ten pages the rest of the book is devoted to classificatory schedules, giving brief definitions of the phyla, classes, and orders, illustrated with the names of and notes on the more interesting and typical genera and species. We believe that the experience of college tutors and others has shown that schedules such as these are of much use to candidates for honours in natural science; and these schedules appear to us to be well done. Certain minor inaccuracies, however, have caught our eye. For instance, since the nephridia of Rotifera commence with flame-cells, it is wrong to speak of the excretory tubes as "opening into an archicœlic body-cavity." Again, the female gnat does not "*sting*;" we might as well apply the term to the cobra. Since the test of the Ascidian, one genus excepted, is chiefly cellulose, it is not enough to define it as of a "gelatinous or cartilaginous nature." In the Reptilia-schedule, besides stating that *Hatteria* has "biconcave vertebræ and no copulatory organs," mention might have been made of the ossification of the quadrato-jugal cartilage, seeing that it is a feature found in no other recent lizard. To speak of *Coronella austriaca*, the English smooth snake, as the "smooth *viper*," is misleading, to say the least of it. The last ten pages of the book are devoted to some Notes on Distribution and a table showing the "Geological Range of the chief Animal Groups." In the latter Mr. Davis has attempted to do too much in so small a space. The Notes on Distribution are stated by Mr. Davis to have been mainly prepared from Wallace. They contain a mass of facts in a very small compass, and by their aid the intelligent student will, with the minimum of trouble to himself, be able to "get up" several general questions which the hearts of examiners in zoology love. Nevertheless we should much like to have Mr. Davis's reasons for including the lion among the species peculiar to the Ethiopian Region.

MISCELLANEOUS.

Is Asterias tenuispina, *Lamk., a British Species?*

In reply to Prof. Jeffrey Bell's inquiry (p. 424) I should say most certainly that *Asterias tenuispina*, Lamk., is *not* British. I have never seen or heard of an authentic specimen. It is true, as Prof. Jeffrey Bell remarks, that Gray in his 'Synopsis' writes "Inhab. *British coast*, Mediterranean;" but upon what evidence is this assertion made? I conclude upon a synonym he gives, "*Ast. spinosa*, Pennant." What, then, has Pennant to say?—"*Ast.* with *five* rays of almost equal thickness, beset with numerous spines." *Five* will not do for *A. tenuispina*. Moreover, Pennant does not appear to have seen the form himself. He gives two references—one to Borlase's 'Cornwall,' tab. xxv. fig. 18, the other to Linck, tab. iv. no. 7. Borlase is not in my library, but a reference to Linck shows a figure of a five-rayed starfish, certainly not *A. tenuispina*, of which he writes:—"Vivæ sunt subcæruleæ. Ejusdem speciei duplo majores se invenisse fatetur, primum in Oceano occidentali Hybernico, post juxta Pensans in Cornubio." Here seems to be the origin of Gray's mistaken statement that *Asterias tenuispina* is found on our coast. Linck's figure and his words "Vivæ sunt subcæruleæ" appear to me conclusively to prove that the starfish which he called *Pentadactylosaster spinosus regularis* was a small specimen of *A. glacialis*.

Asterias tenuispina, Lamarck, has six to eight arms and is a littoral form. Such a distinct species could scarcely have evaded discovery if it occurred on our shores. It is a well-known Mediterranean Asterid, which would appear to have had a southern origin. It is said to have occurred in the Madeiran, Canary *, and Cape-Verd Islands, and in the Florida Sea (*Ludvig*); and also at Bermuda, Abrolhos, Mauritius, Java, Molucca, Australia, and Hong Kong (*Perrier*). In the Mediterranean it is recorded from many places on the Italian and Sicilian coasts and in the Adriatic. My own specimens are from Naples (*Staz. Zool.*) and Mahon, Spain (*Señor Pedro Antiga*), this last being the only known occurrence of the species in the western Mediterranean; but Quatrefages records it much further

* It is figured by d'Orbigny from the Canaries, Webb and Berthelot, Hist. Nat. des Iles Canaries, Echinodermes, pl. iii. figs. 14–20.

north in the Atlantic, namely Les Passages, near San Sebastian; Paul Fischer, however, has not met with it on the closely adjoining south-west coast of France.

It may be added that Lamarck, in his original description of the species, speaks of its being confounded with *A. glacialis*, and points out the differences between the species. A. M. Norman.

Burnmoor,
Nov. 3, 1890.

Since writing the above, on turning to Dujardin and Hupé, I find that they, as I have done, refer Linck's and Pennant's form to *A. glacialis.*

Aspidiotus bicarinatus *a Lepidopterous Larva.*

To the Editors of the Annals and Magazine of Natural History.

10 Observatory Gardens,
Campden Hill, Kensington, W.,
November 6, 1890.

Gentlemen,—On looking through the collection of Coccidæ in the Students' Insect-Room at the Natural-History branch of the British Museum my attention was drawn to two insects labelled *Aspidiotus bicarinatus.* The tickets attached to these insects showed them to be the veritable types described by Walker in the supplement of the British Museum 'Catalogue of Homoptera,' p. 306, as *Aspidiotus bicarinatus.* But upon examination I found them to be the dried larvæ of a Limacodid moth closely resembling those of the Indian species *Narosa conspersa.* The caterpillar of this moth has a coriaceous integument with two well-developed dorsal ridges. As the specimens in question were received from North China, they are probably the larvæ of some allied species.

It is difficult to understand how the mistake could have originated. In its dried state the caterpillar has certainly some superficial resemblance to a Coccid; but its head and mouth-parts at once proclaim its true character. E. E. Green.

Note on Irrisor Jacksoni, *sp. n.* By R. Bowdler Sharpe.

In a letter just received from Mr. F. J. Jackson he has given some very interesting notes on birds, some of which he believes to be new to science. The *Irrisor* is certainly undescribed, and I herewith name it after the explorer.

Irrisor Jacksoni, sp. n.

Ad. Similis *I. Bollei*, sed minor rostro breviore, tectricibus alarum intimis chalybeis nec cuprescentibus distinguendus.

Long. tot. 13·0, culmin. 1·35, alæ 4·85, caudæ 7·4, tarsi 0·8.

Hab. Kikuyu Country, Eastern Africa.

INDEX TO VOL. VI.

Acanthosphæra, new species of, 51.

Achatina, on species of, from South Africa, 390.

Æolesthes, characters of the new genus, 250.

Alcock, A., on the bathybial fishes of the Bay of Bengal, 197; on the bathybial fishes of the Arabian Sea, 295; on undescribed shore-fishes from the Bay of Bengal, 425.

Allotinus, new species of, 262.

Alveopora, new species of, 458.

Amalia, on the species of, 282.

Amber, on the fauna of, 486.

Amblyopus, new species of, 432.

Anadenus, notes on some species of, 277.

Ancylistes, new species of, 465.

Animals, on burrows and tracks of Invertebrate, in Palæozoic times, 115.

Annelids, on the occurrence of pelagic, 174.

Antigonus, new species of, 348.

Aphengium seminudum, remarks on, 379.

Aphnæus, new species of, 105.

Aplomastix, characters of the new genus, 478.

Ariolimax, notes on some species of, 277.

Arnoglossus, new species of, 433.

Arrhythmus, new species of, 461.

Arthropods, on the compound eyes of, 123.

Ascaris, on the histological constitution of certain Nematodes of the genus, 276.

Aslauga, characters of the new genus, 261.

Aspidiotus bicarinatus a Lepidopterous larva, 503.

Asterias sanguinolenta, on the generic name of, 472.

—— tenuispina, note on, 424, 502.

Aulastomatomorpha, characters of the new genus, 307.

Bartlett, E., on a new species of Guiraca, 168.

Bassett-Smith, on Corals from the China Sea, 353, 443.

Bather, F. A., on Thenarocrinus callipygus, 222.

Bathyonus, new species of, 211.

Bathyseriola, characters of the new genus, 202.

Bathytroctes, new species of, 303.

Bean, T. H., on a new Cottoid fish, 118.

Bell, Prof. F. J., on Asterias tenuispinis, 424; on the generic name of Asterias sanguinolenta, 472.

Benham, Dr. W. B., on the genera Trigaster and Benhamia, 414.

Benhamia, on the genus, 414.

Birds, new, 168, 350, 503; on the acceptance or rejection of insects by, 324.

Books, new: — Jelly's Synonymic Catalogue of Recent Marine Bryozoa, 194; Lendenfeld's Monograph of the Horny Sponges, 418; Cunningham's Treatise on the Common Sole, 497; Selenka and Davis's Zoological Pocket-Book, 500.

Boulenger, G. A., on a new species of Glauconia, 91; on two new fishes, 169; on a new species of Mormyrus, 193; on the genus Pseudoxyrhopus, 311; on the occurrence of Eublepharis macularius in Transcaspia, 352; on the distinctive cranial characters of Iguanoid lizards, 412.

Bouvier, E. L., on the circulatory system of the carapace in the Decapod Crustacea, 190.

Brandt, Prof. E. K., on the anatomy of Sesia tipuliformis and Trochilium apiforme, 185.

Brephostoma, amended characters of the genus, 201.

"British marine area," on a model of the, 120.

Broom, R., on the fate of the quadrate in mammals, 409.

Bryozoa of the Hunstanton Red Chalk, on the, 114; on North-Italian, 117.

Buliminus, new species of, 156.

Bulimus, new species of, 152.

Bulimus exilis, on variations in, 124.
Buthus, new species of, 98.
Bürger, Dr. O., on the anatomy and histology of Nemertines, 394.
Butler, A. G., on the genus Dyschorista, 96; on the acceptance or rejection of insects by birds, 324.
Caddis-fly, on a viviparous, 139.
Callionymus, new species of, 209.
Carpenter, Dr. P. H., on the anatomical nomenclature of Echinoderms, 1.
Cedemon, characters of the new genus, 462.
Centronotus gunnellus, on the young stages of, 182.
Centropristis, new species of, 199.
Cerastus, new species of, 153.
Ceroplesis, new species of, 108.
Chætognaths, on the occurrence of pelagic, 174.
Claus, Prof. C., on the organization of the Cyprides, 108.
Closterus, new species of, 458.
Coccidium, new species of, 194.
Coccodus, new species of, 117.
Cockerell, T. D. A., notes on slugs, 277, 380.
Cœlodon, notes on the genus, 248.
Coignou, Miss, on a new species of Cyphaspis, 113.
Coleoptera, new, 23, 107, 247, 374, 458.
Coracias, new species of, 351.
Corals from the China Sea, on, 353, 443.
Cribrella sanguinolenta, on the generic name of, 472.
Crinoids, on a new genus of British fossil, 222.
Crocidura, new species of, 494.
Crustacea, on the circulatory system of the carapace in the Decapod, 190.
Cynoglossus, new species of, 442.
Cyphaspis, on a new species of, 113.
Cyprides, on the organization of the, 108.
Cyprinodon, new species of, 169.
Dallas, Mr. W. S., obituary notice of, 118.
Davis, J. W., on a new species of Coccodus, 117.
Dawson, Sir J. W., on burrows and tracks of invertebrate animals in Palæozoic times, 115.
Dendy, A., on a new Australian Peripatus, 121.
Dermatorus, characters of the new genus, 298.
Desmophyllum, new species of, 367.
Diadelia, new species of, 465.
Dinematichthys, new species of, 432.
Diplommatina, new species of, 246.
Diploplegma, characters of the new genus, 48.
Diplopterus Agassizii, note on a specimen of, 484.
Dobson, G. E., on new species of Crocidura, 494.
Dorydictyum, characters of the new genus, 54.
Doryplegma, characters of the new genus, 53.
Dorysphæra, characters of the new genus, 52.
Dresser, H. E., on the Racquet-tailed Rollers, 350.
Durbania, new species of, 265.
Dyschorista, notes on the genus and new species of, 96.
Ebalia nux, notes on, 101, 312, 469.
Echinoderms, on the anatomical nomenclature of, 1.
Elaphidion, new species of, 32.
Elateropsis, new species of, 27.
Ennea, new species of, 161.
Entomis, new species of, 321.
Entomostraca, on the Palæozoic bivalved, 317.
Epitola, new species of, 106, 271.
Eublepharis macularius, on the occurrence of, in Transcaspia, 352.
Eumimetes, new species of, 464.
Evolution, on the inconsistencies of utilitarianism as the exclusive theory of organic, 125.
Eyes of Arthropods, on the compound, 123.
Fishes, new, 118, 169, 193, 197, 295, 417, 425, 479, 491; of the Bay of Bengal, on the bathybial, 197; of the Arabian Sea, on the bathybial, 295; from Dumfriesshire, on some fossil, 491.
Fish-fauna in the Hawkesbury beds of New South Wales, 423.
Fleischmann, Dr. A., on the relationship of the Rodentia to the Marsupialia, 289.
Fletcher, J. J., on Peripatus Leuckarti, 352.
Fol, H., on the anatomy of horny sponges of the genus Hircinia, and on a new genus, 172.

Gahan, C. J., on new Longicorn Coleoptera, 23, 247, 458.
Galaxea, new species of, 368.
Gasterosteus aculeatus, on a species of Coccidium infesting, 195.
Geological Society, proceedings of the, 113.
Gibbus, new species of, 161.
Glauconia, on the African species of, 91.
Glaucytes, new species of, 462.
Gobius, on the ova of, 34; new species of, 208.
Godwin-Austen, on new Land-Mollusca, 244.
Gonidomus, new species of, 161.
Green, E. E., on Aspidiotus bicarinatus, 503.
Guiraca, new species of, 168.
Gulick, Rev. J. T., on the inconsistencies of utilitarianism as the exclusive theory of organic evolution, 125.
Gunnel, on the young stages of the, 182.
Gyracanthus, new species of, 417.
Haliomma, new species of, 51.
Halosaurus, new species of, 309.
Hapalus, new species of, 156.
Haplochilus, new species of, 170.
Haritalodes, characters of the new genus, 476.
Harmosternus, characters of the new genus, 30.
Helix, new species of, 469.
—— Huttoniæ, observations on, 467.
Hemiscopis, characters of the new genus, 475.
Hinde, Dr. G. J., on Radiolaria from the Lower Palæozoic rocks of the south of Scotland, 40.
Hircinia, on the anatomy of horny sponges belonging to the genus, 172.
Holt, E. W. L., on the ova of Gobius, 34.
Hormathus, characters of the new genus, 32.
Hyalimax andamanicus, new variety of, 389.
Hyalinia, new species of, 150.
Idalina, substituted for Idalia, 74.
Iguana, on the distinctive cranial characters of lizards allied to, 412.
Imerinus, characters of the new genus, 460.
Insects, on the acceptance or rejection of, by birds, 324.
Irrisor, new species of, 503.
Jammes, L., on the histological constitution of certain Nematodes of the genus Ascaris, 276.
Jones, Prof. T. R., on some Devonian and Silurian Ostracoda, 116; on some Devonian Entomides, 317.
Kirby, W. F., on new African Lycænidæ, 261.
Klebs, R., on the fauna of amber, 486.
Læops, new species of, 438.
Larinopoda, new species of, 266.
Lepidoptera, new, 96, 103, 261, 346, 474.
Lepidotrigla spiloptera, new variety of, 429.
Leucochitonea, new species of, 348.
Leucocraspeda, characters of the new genus, 475.
Limacella, new species of, 384.
Lizards, on the distinctive cranial characters of Iguanoid, 412.
Locust, on the leaf-winged, 275.
Loxoscia, characters of the new genus, 476.
Lutra, new species of, 115.
Lycænesthes, new species of, 105.
Lydekker, R., on a Crocodilian jaw from the Oxford Clay, 113; on two new species of Labyrinthodonts, 113; on Ornithosaurian remains from the Oxford Clay, 114.
M'Intosh, Prof., on the occurrence of the pelagic Annelids and Chætognaths in St. Andrews Bay, 174; on the British species of Spinther, 182; on the young stages of the Gunnel, 182.
Macrurus, new species of, 214, 299.
Madrepora, new species of, 452.
Mammalia, new, 114, 171.
Mammals, on the fate of the quadrate in, 409; new, 171, 494.
Marsupialia, on the relationship of the Rodentia to the, 289.
Massicus, new species of, 260.
Mastododera, new species of, 462.
Melvill, J. C., on new terrestrial Mollusca, 466.
Mesacanthus, remarks on the genus, 481.
Mesolepis, new species of, 493.
Mesoplodon, new species of, 115.
Mesopoma, characters of the new genus, 492.
Mimorista, characters of the new genus, 476.
Minous, new species of, 428.

Mollusca, revision of British, 60, 327; new, 93, 146, 244, 277, 380, 390, 466.
Monomitopus, characters of the new genus, 297.
Montipora, new species of, 451.
Mormyrus, on a new species of, 193.
Myriopoda from Ecuador, on, 141.
Narcetes, characters of the new genus, 305.
Nassopsis, characters of the new genus, 93.
Nebroda, new species of, 346.
Nemertines on the anatomy and histology of, 394.
Neobythites, new species of, 210.
Neocerambyx, remarks on the genus, 249.
Newportia, new species of, 143.
Newton, E. T., on new Mammals from the Red and Norwich Crags, 114.
Norman, Canon A. M., revision of British Mollusca, 60, 327; on a model of the "British marine area," 120; on Ebalia nux, 342; on Asterias tenuispina, 502.
Notanolica, new species of, 139.
Opeas, new species of, 160.
Opisthedeicta, characters of the new genus, 478.
Opisthostoma, new species of, 245.
Ornithosaurian remains from the Oxford Clay, on, 114.
Orphanostigma, characters of the new genus, 478.
Orthospila, characters of the new genus, 477.
Ostracoda, on some Devonian and Silurian, 116.
Palæospondylus Gunnii, description of, 485.
Parasarama, characters of the new genus, 474.
Pardomima, characters of the new genus, 477.
Paroneirodes, characters of the new genus, 206.
Pavonia, new species of, 444.
Pedaria, new species of, 374.
Pella, new species of, 469.
Peripatus, new species of, 121.
—— Leuckarti, notes on, 352.
Phædropsis, characters of the new genus, 476.
Phoca, new species of, 115.
Plocæderus, new species of, 107, 255.
Pocock, R. I., on two new Scorpions, 98; on Ebalia nux, 101, 469; on Myriopoda from Ecuador, 141.
Polyzoa of the Hunstanton Red Chalk, on the, 114.
Ponerodon, characters of the new genus, 203.
Ponsonby, J. H., on new terrestrial Mollusca, 466.
Promyllantor, characters of the new genus, 310.
Prophysaon, on some species of, 277.
Prosternodes, new species of, 25.
Proteides, new species of, 349.
Protonoceras, characters of the new genus, 475.
Psammocora, new species of, 448.
Psettyllis, characters of the new genus, 436.
Pseudaletis, new species of, 103.
Pseudanalthes, characters of the new genus, 477.
Pseuderesia, new species of, 262.
Pseudoxyrhopus, on the genus, 311.
Pterichthys, on a new theory of, 314.
Pyralidæ, new genera of, 474.
Pyrosoma, on the development of, 236.
Quadrate in Mammals, on the fate of the, 409.
Quelch, J. J., on the leaf-winged locust, 275.
Radiolaria from the Lower Palæozoic rocks of the south of Scotland, on, 40.
Reptilia, new, 91.
Rhachis, new species of, 152.
Rhectothyris, characters of the new genus, 474.
Rhomboidichthys, new species of, 435.
Rodentia, on the relationship of the, to the Marsupialia, 289.
Salensky, Prof. W., on the development of Pyrosoma, 236.
Sarcomus, characters of the new genus, 173.
Sardine, on a species of Coccidium infesting the, 196.
Scianectes macrophthalmus, description of, 216.
Sciorista, characters of the new genus, 475.
Sciurus, new species of, 171.
Scopelengys, characters of the new genus, 302.
Scopelus, new species of, 217.

Scorpio, new species of, 100.
Seriatopora, new species of, 363.
Sesia tipuliformis, on the anatomy of, 185.
Sharp, Dr. B., on variations in Bulimus exilis, 124; on the exuviæ of snakes, 124.
Sharpe, Miss E. M., on new butterflies, 103, 346.
Sharpe, R. B., on a new species of Irrisor, 503.
Shells from Central Africa, on land- and freshwater-, 146.
Siderastræa, new species of, 443.
Slugs, notes on, 277, 380.
Smith, E. A., on new shells, 93, 146; on species of Achatina from S. Africa, 390.
Snakes, on the exuviæ of, 124.
Solea, new species of, 439.
Solenoptera, new species of, 27.
Spalgis, new species of, 347.
Sphærozoum, new species of, 57.
Spinther, on the British species of, 182.
Sponges, on a new genus of horny, 172.
Spongoplegma, new species of, 48.
Staurodoras, new species of, 49.
Stauroplegma, characters of the new genus, 49.
Stenodontes, new species of, 23.
Stenogyra, new species of, 157.
Stenosoma, new species of, 464.
Streptaxis, new species of, 160.
Streptostele, new species of, 95.
Stylophora, new species of, 362.
Styptosphæra, new species of, 47.
Subulina, new species of, 157.
Symphyllia, new species of, 369.
Synaptura, new species of, 441.
Synchirus, characters of the new genus, 119.
Tæniolabrus, new species of, 430.
Tarrasius problematicus, notes on, 494.
Tauredophidium, characters of the new genus, 212.
Taurotagus, new species of, 247.
Tereticus, new species of, 459.
Teriomima, new species of, 268.
Terminology of the Echinoderms, on the, 1.
Tetridia, characters of the new genus, 477.
Thaumastomias, characters of the new genus, 220.
Thélohan, P., on two new species of Coccidea infesting the stickleback and the sardine, 194.
Thenarocrinus, characters of the new genus, 223.
Thomas, O., on a new squirrel, 171.
Tingra, new species of, 267.
Traquair, Dr. R. H., on a new species of Gyracanthus, 417; on fossil fishes from Caithness, 479; on fossil fishes from Dumfriesshire, 491.
Trigaster, observations on the genus, 414.
Triposphæra, characters of the new genus, 54.
Trochilium apiforme, on the anatomy of, 185.
Trochonanina, new species of, 151.
Trogontherium, new species of, 115.
Turbonilla, new species of, 95.
Uranoscopus, new species of, 205.
Uroxys Rodriguezi, remarks on, 380.
Vine, G. R., on the Bryozoa of the Hunstanton Red Chalk, 114.
Vitrina, new species of, 466.
Warren, W., on new genera of Pyralidæ, 474.
Watase, S., on the compound eyes of Arthropods, 123.
Waterhouse, C. O., on new Coleoptera, 107; on new species of Pedaria, 374.
Waters, A. W., on North-Italian Bryozoa, 117.
Wood-Mason, Prof. J., on a viviparous Caddis-fly, 139.
Woodward, A. S., on a new theory of Pterichthys, 314; on the discovery of a Jurassic fish-fauna in the Hawkesbury beds of New South Wales, 423; on the fossil fishes of the Hawkesbury series at Gosford, New South Wales, 423.
Zeritis, new species of, 104.

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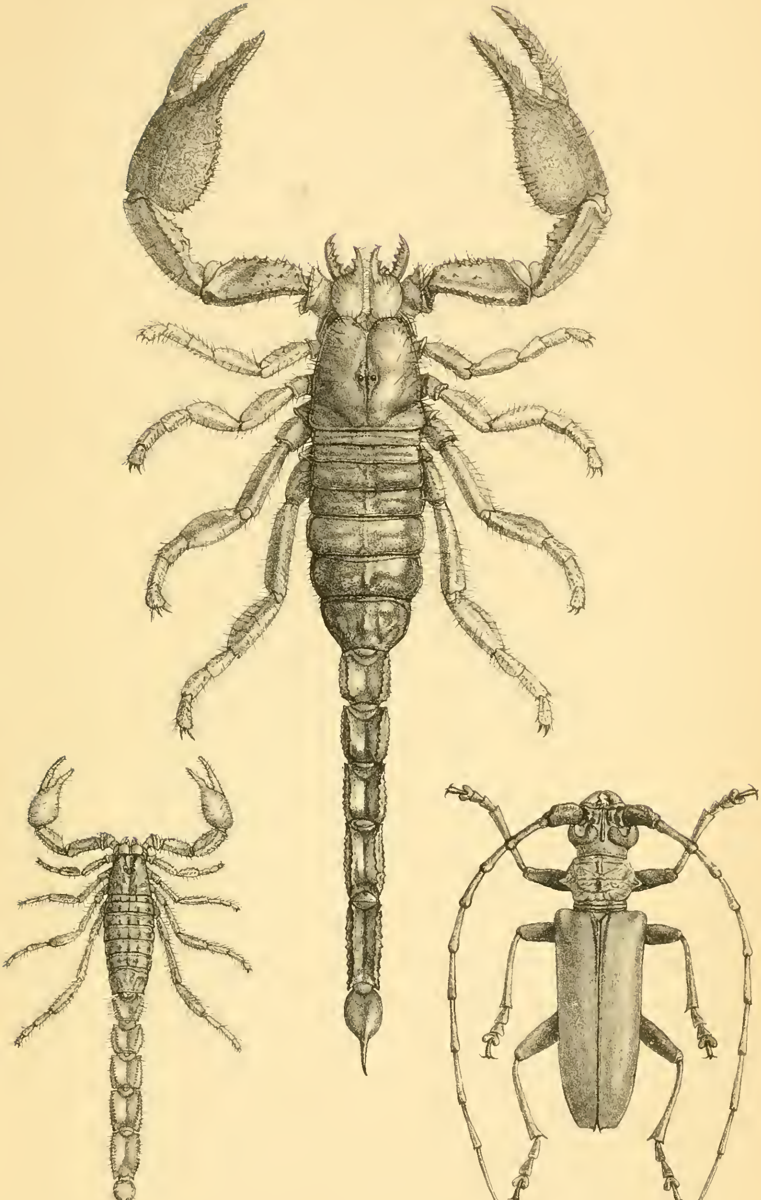

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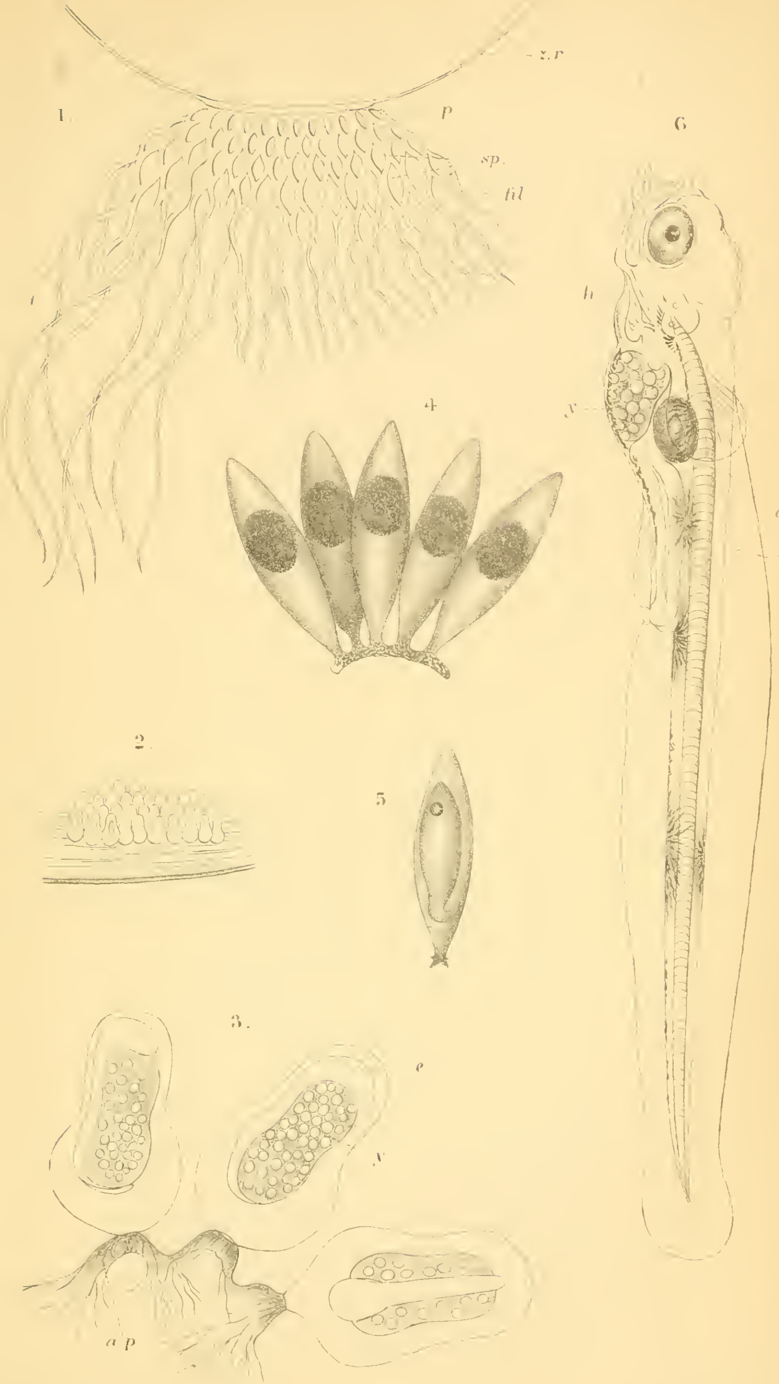

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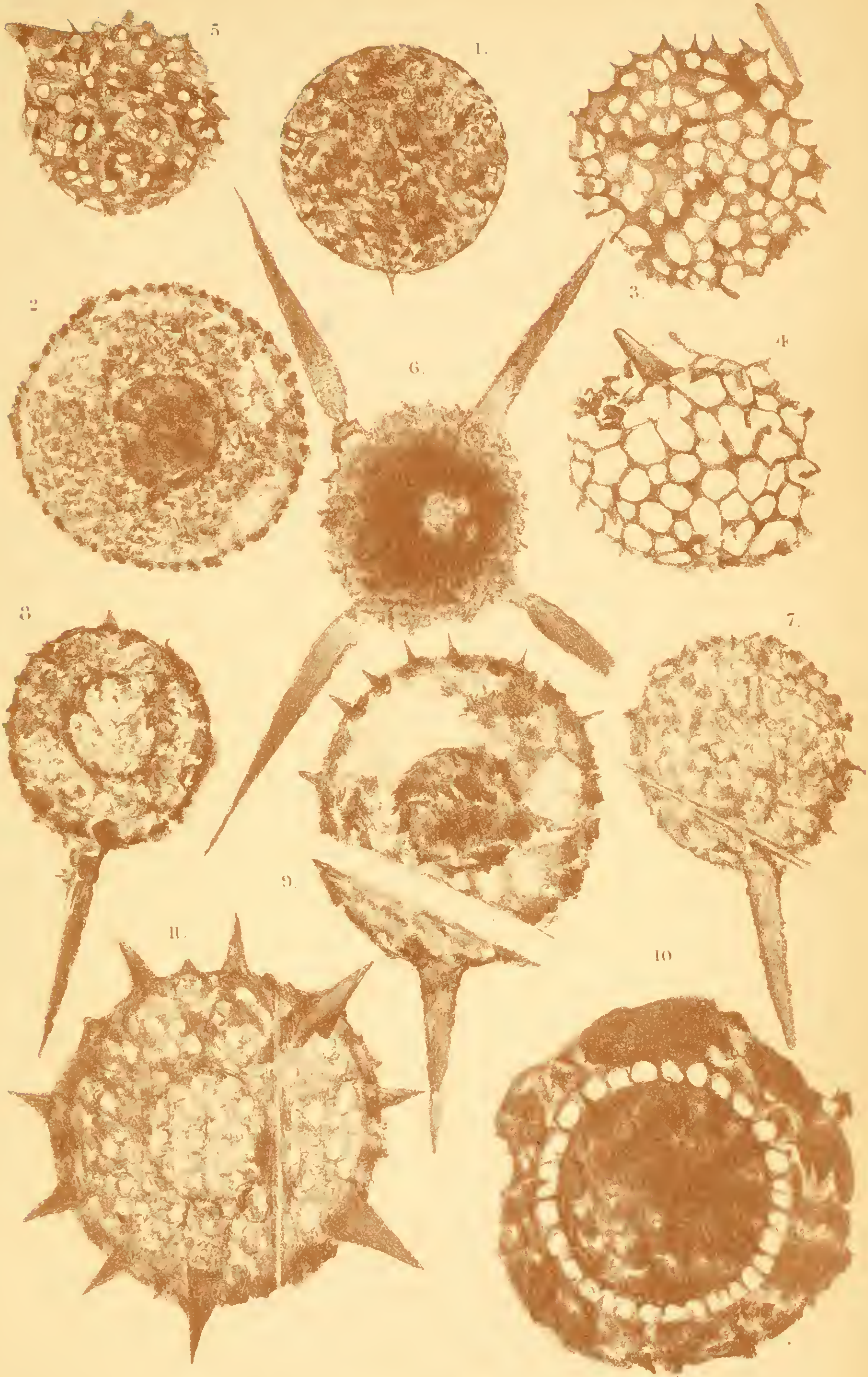

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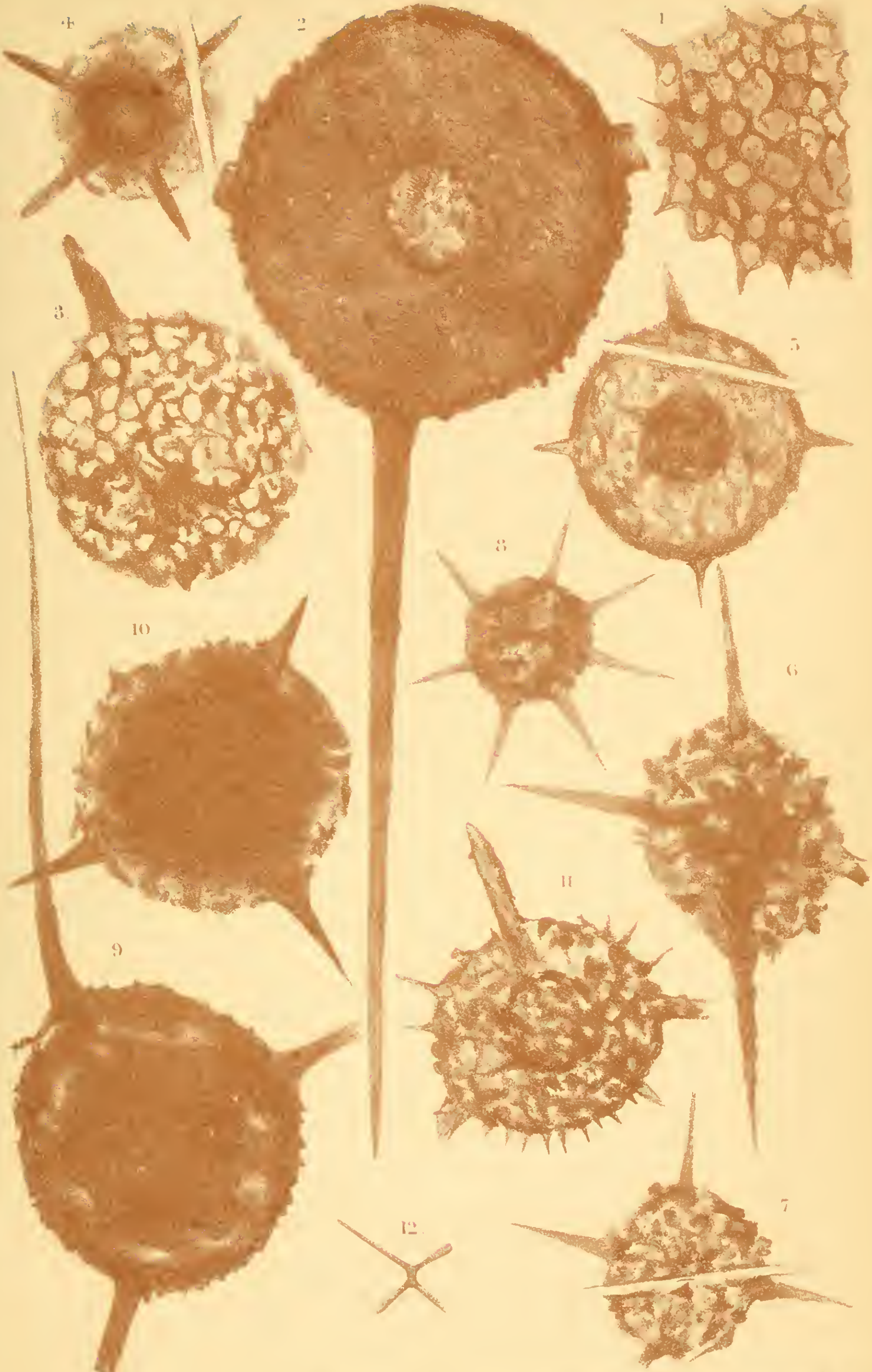

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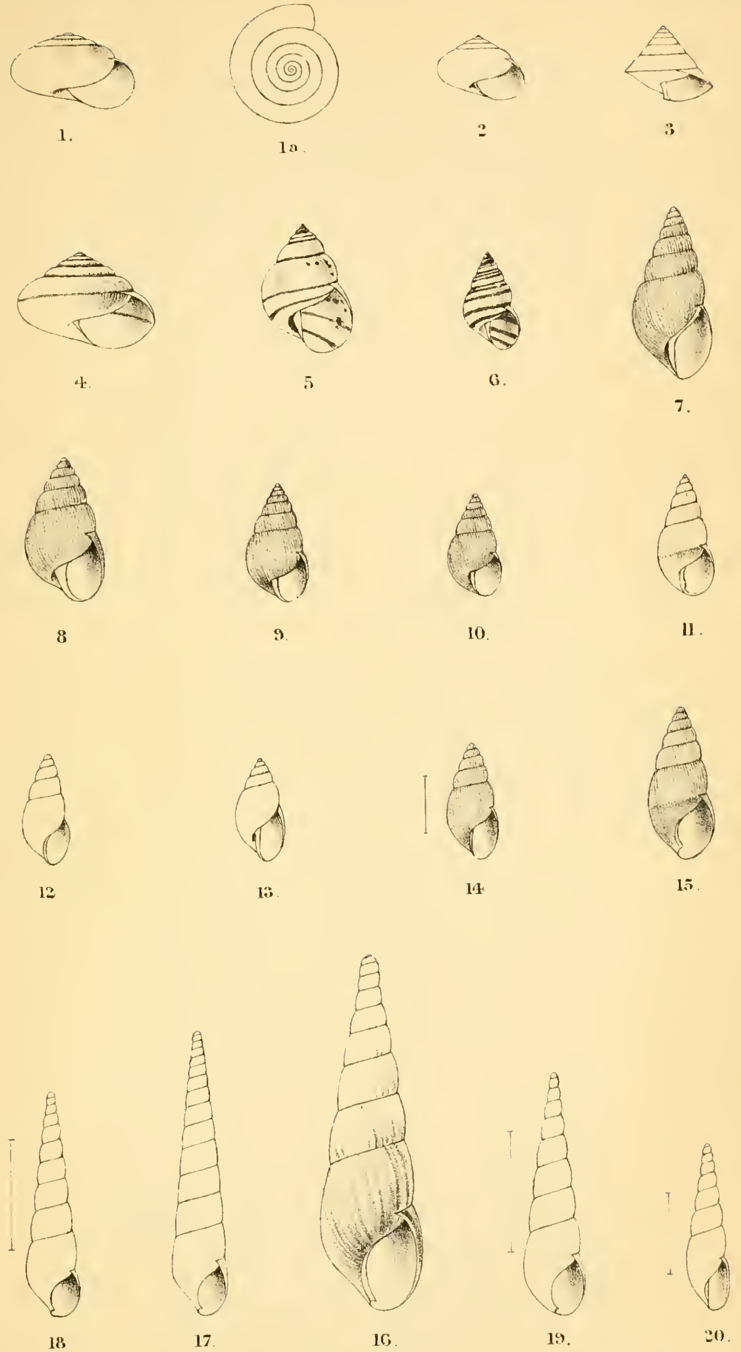

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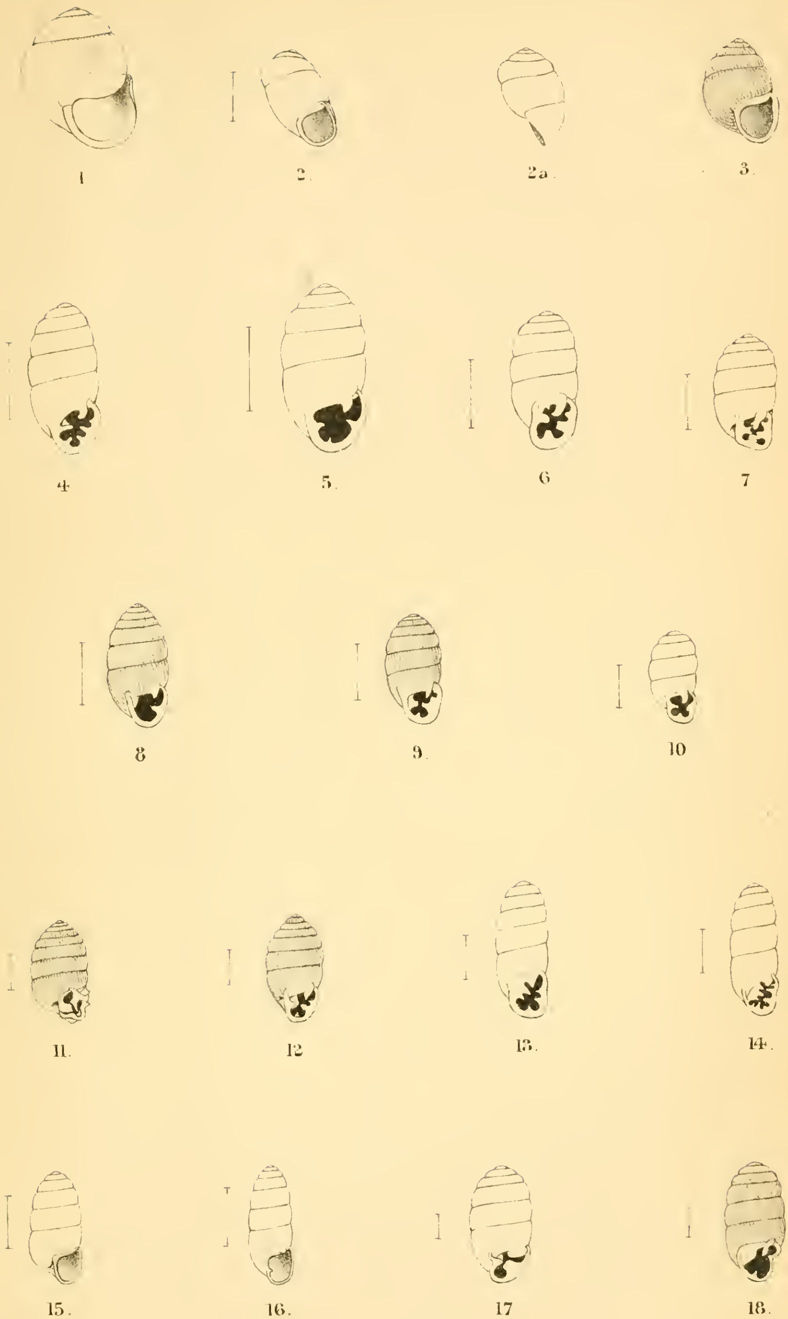

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Ann & Mag. Nat. Hist. S. 6. Vol. 6. Pl. VII.

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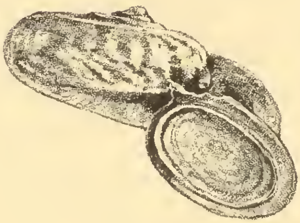

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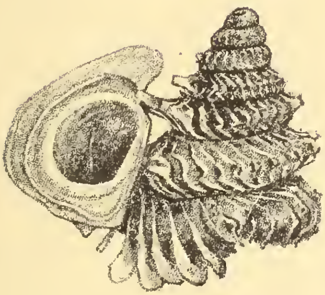

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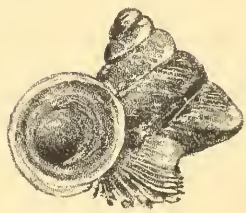

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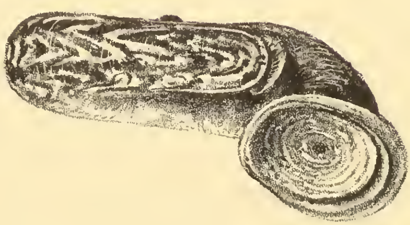

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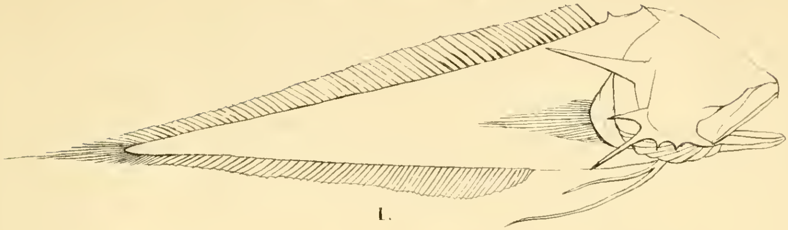

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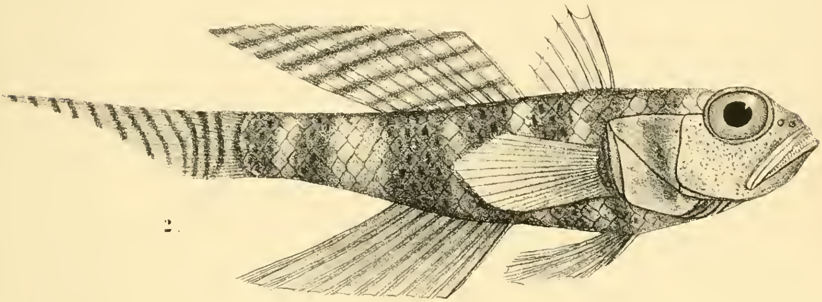

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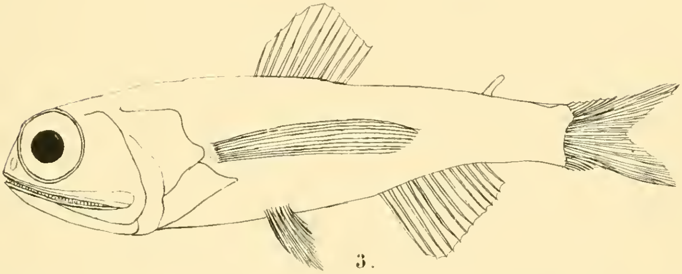

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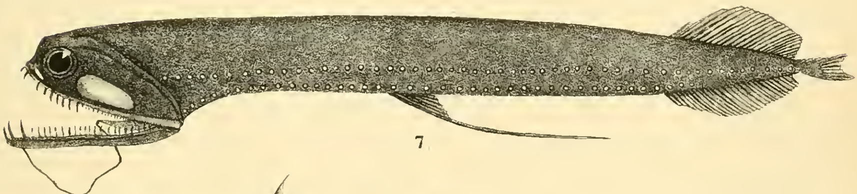

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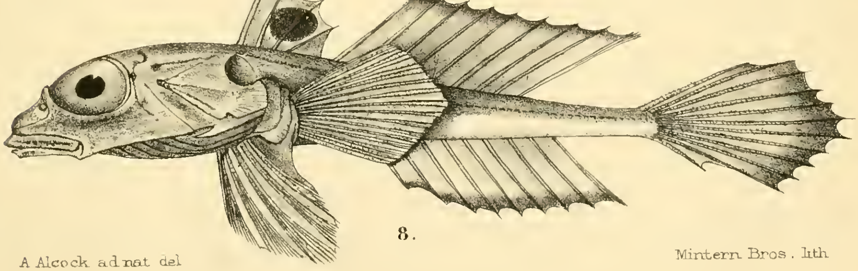

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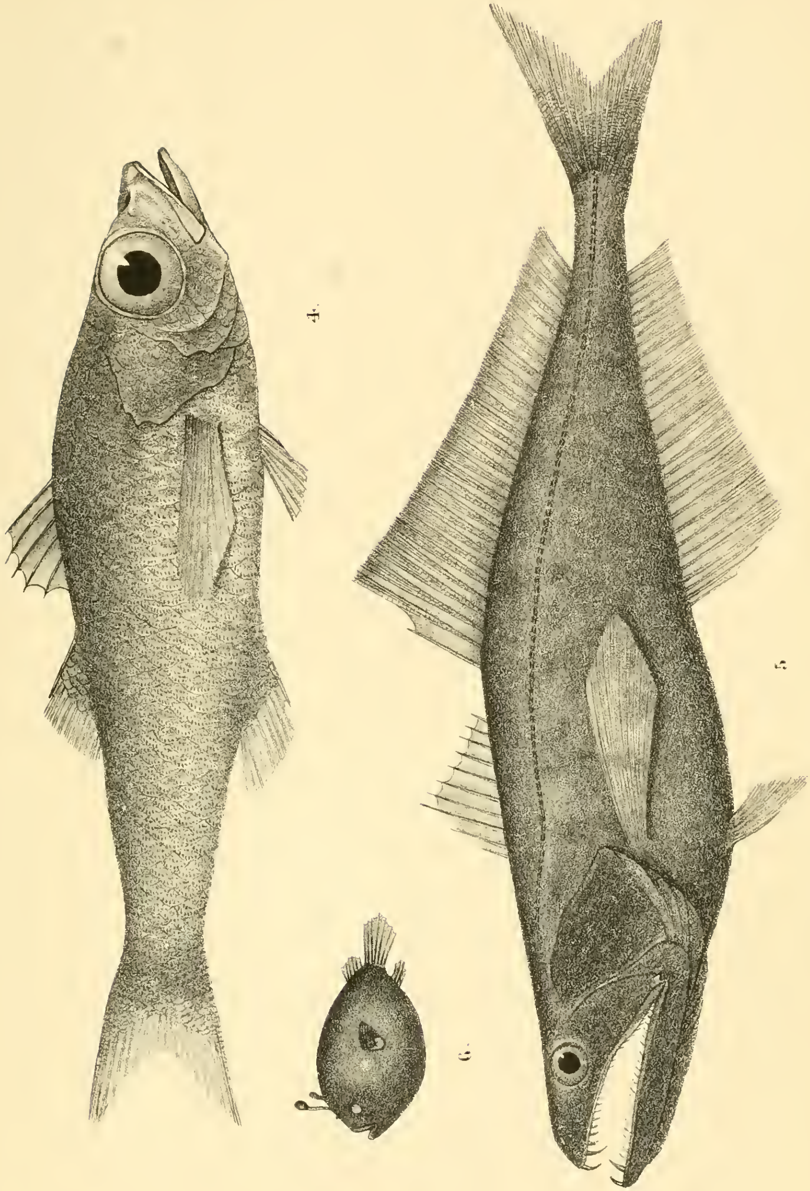

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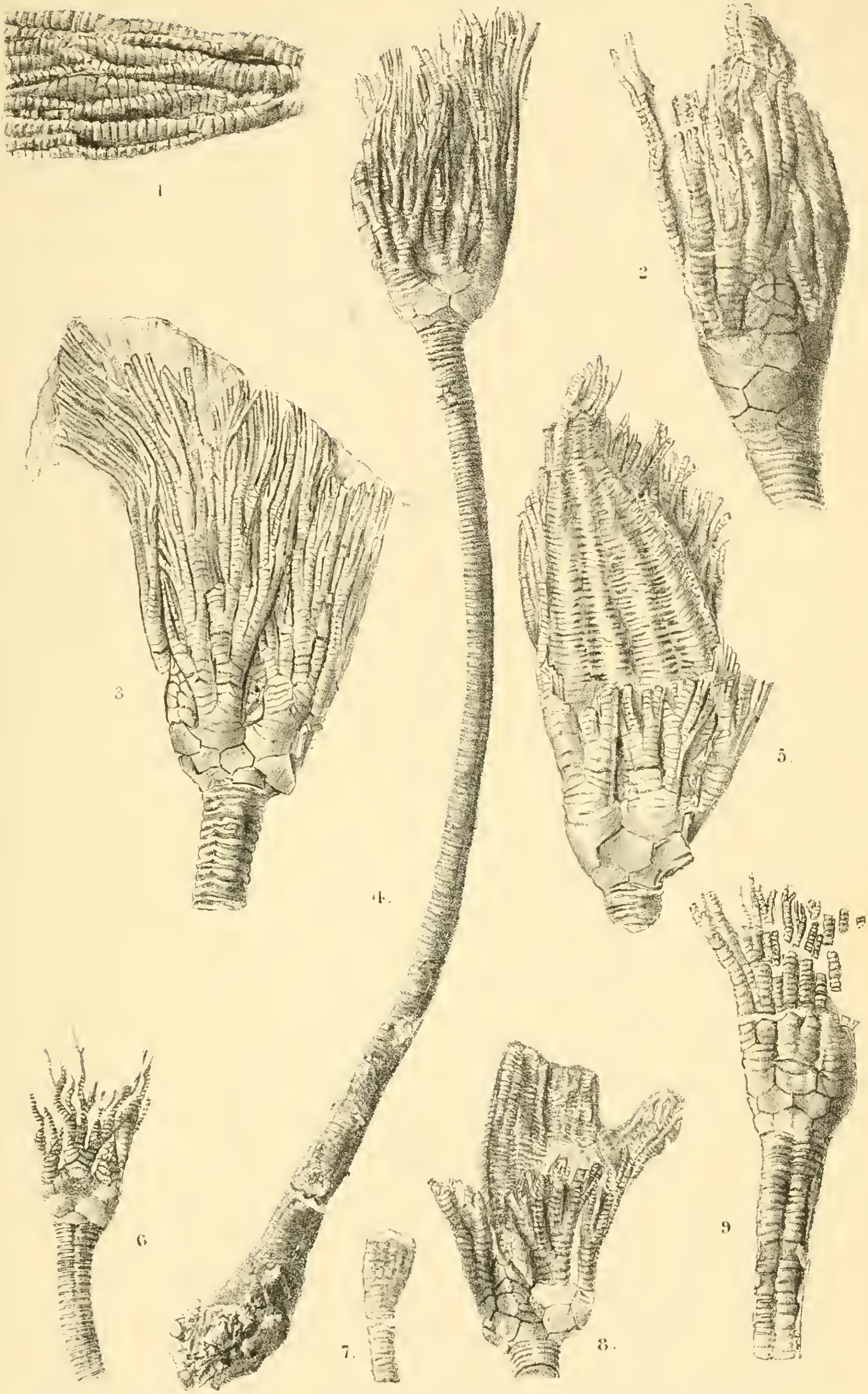

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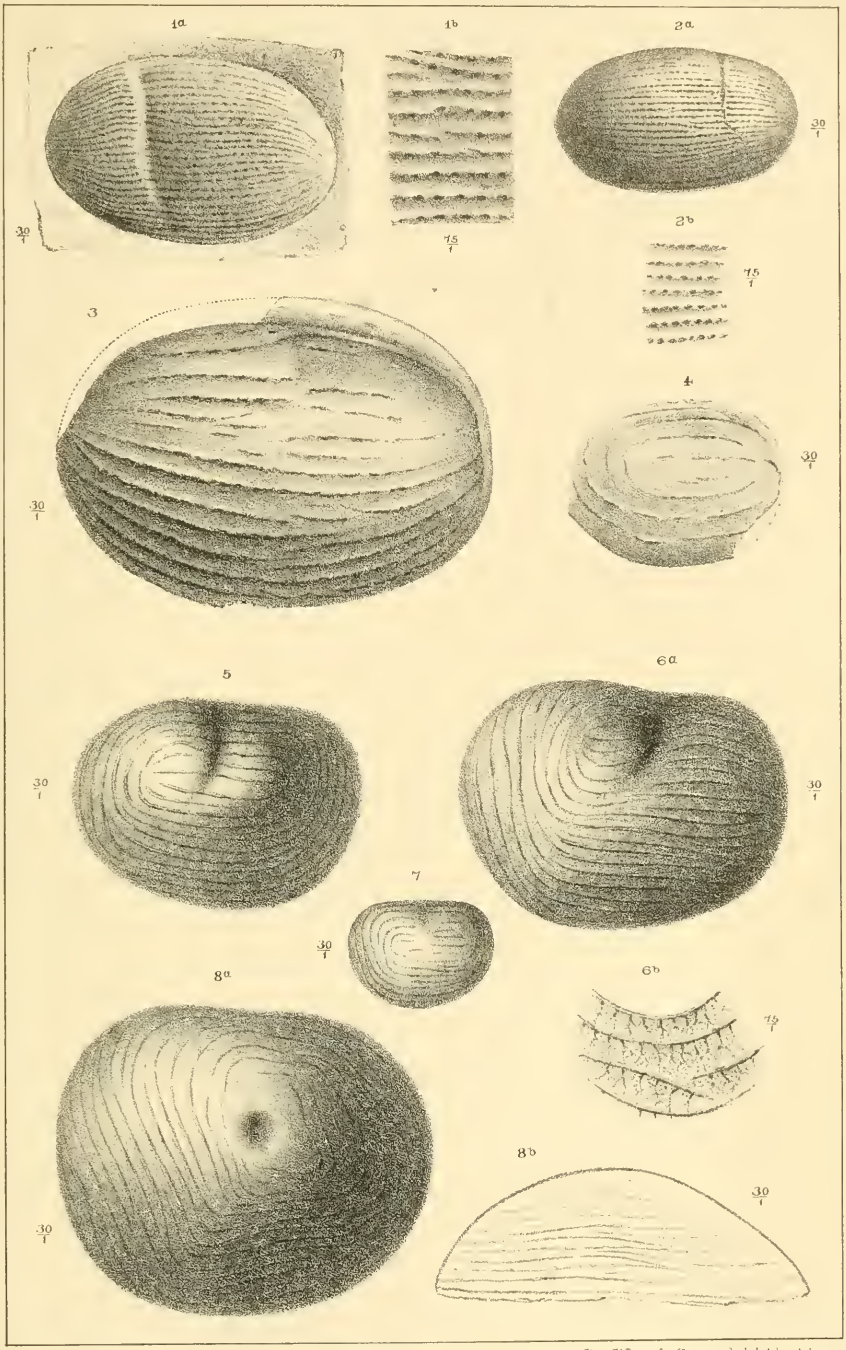

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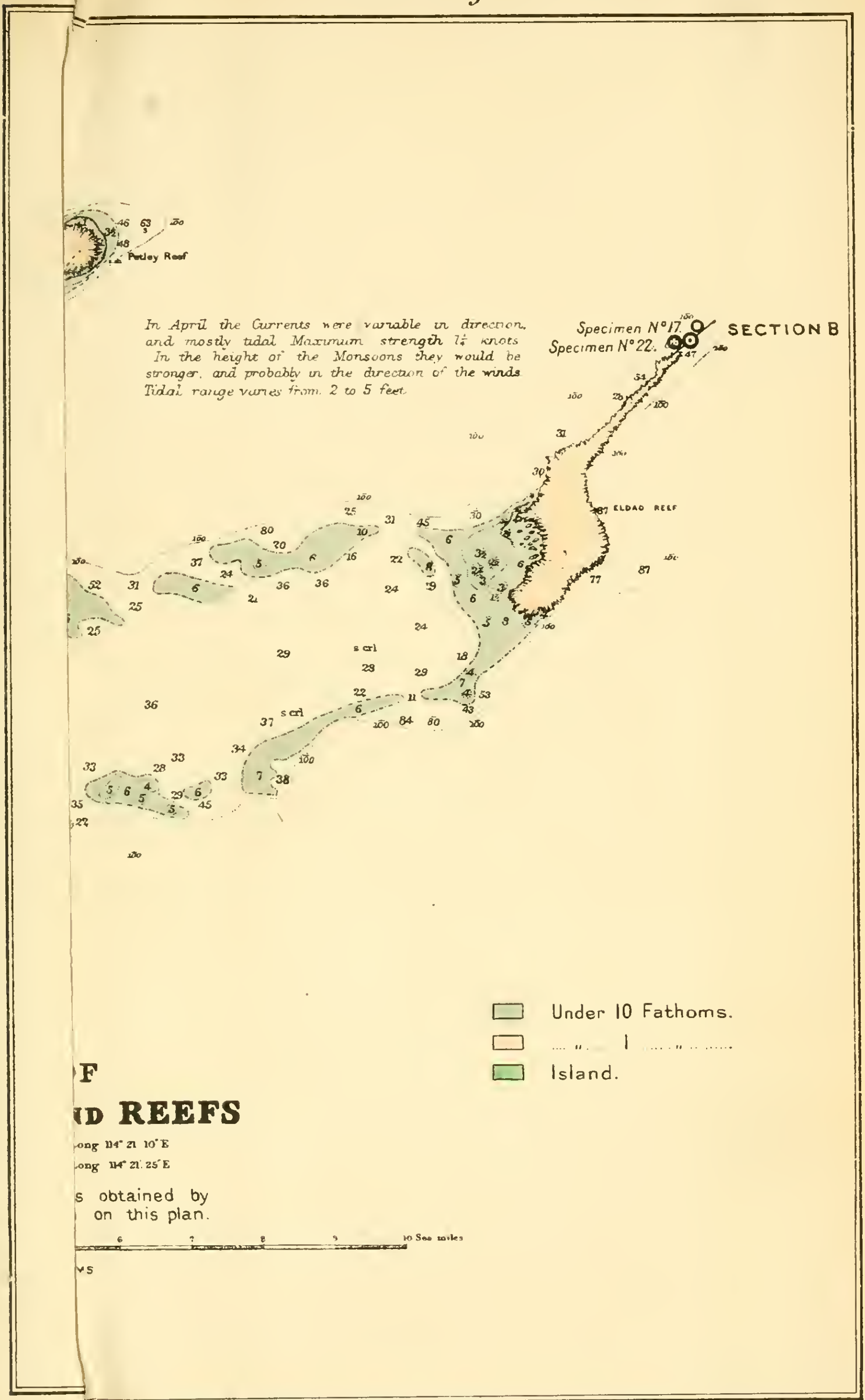

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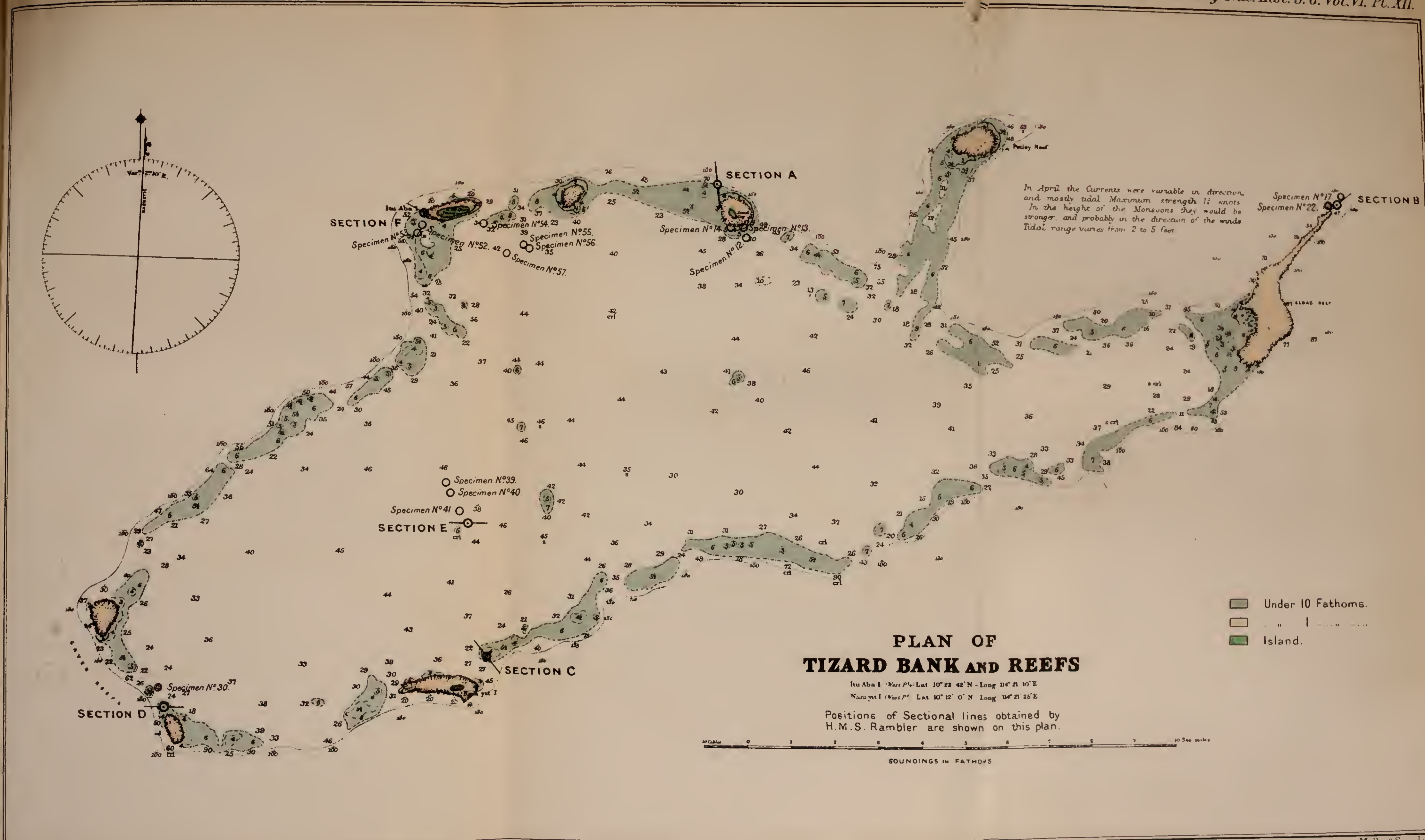

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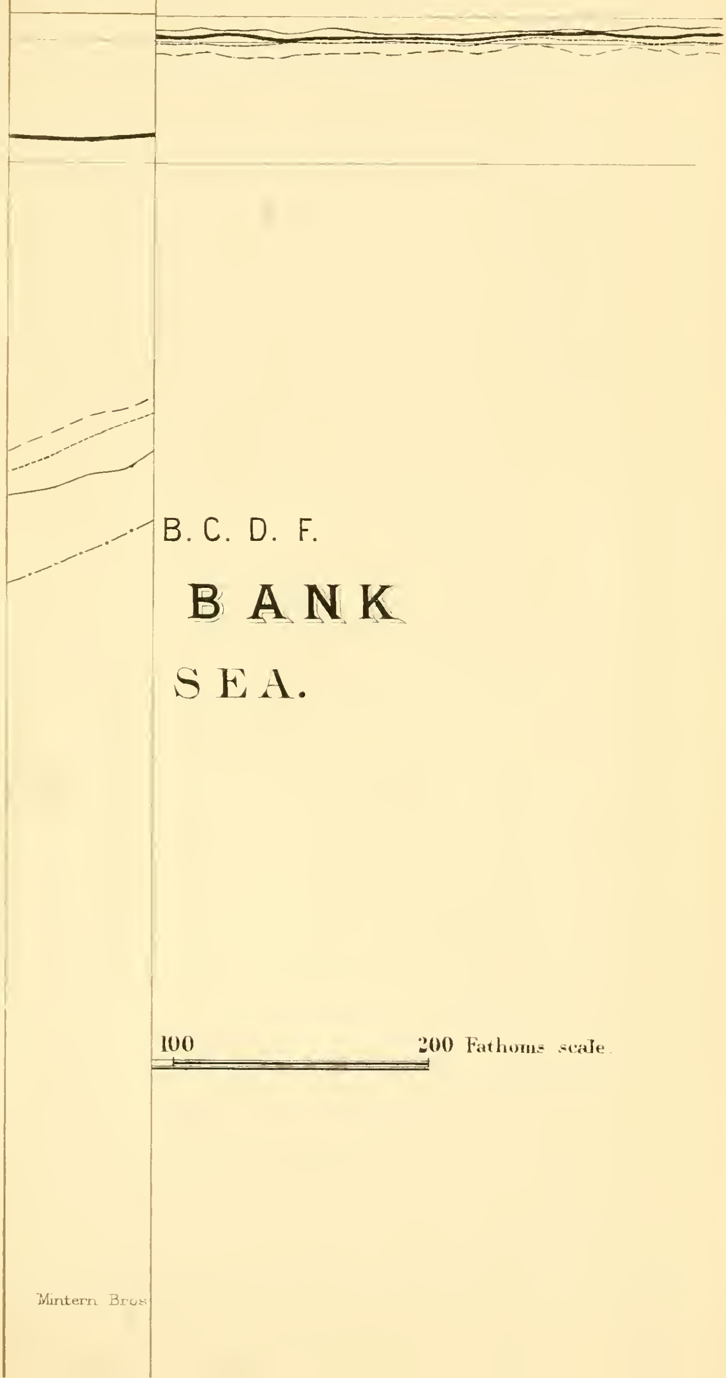
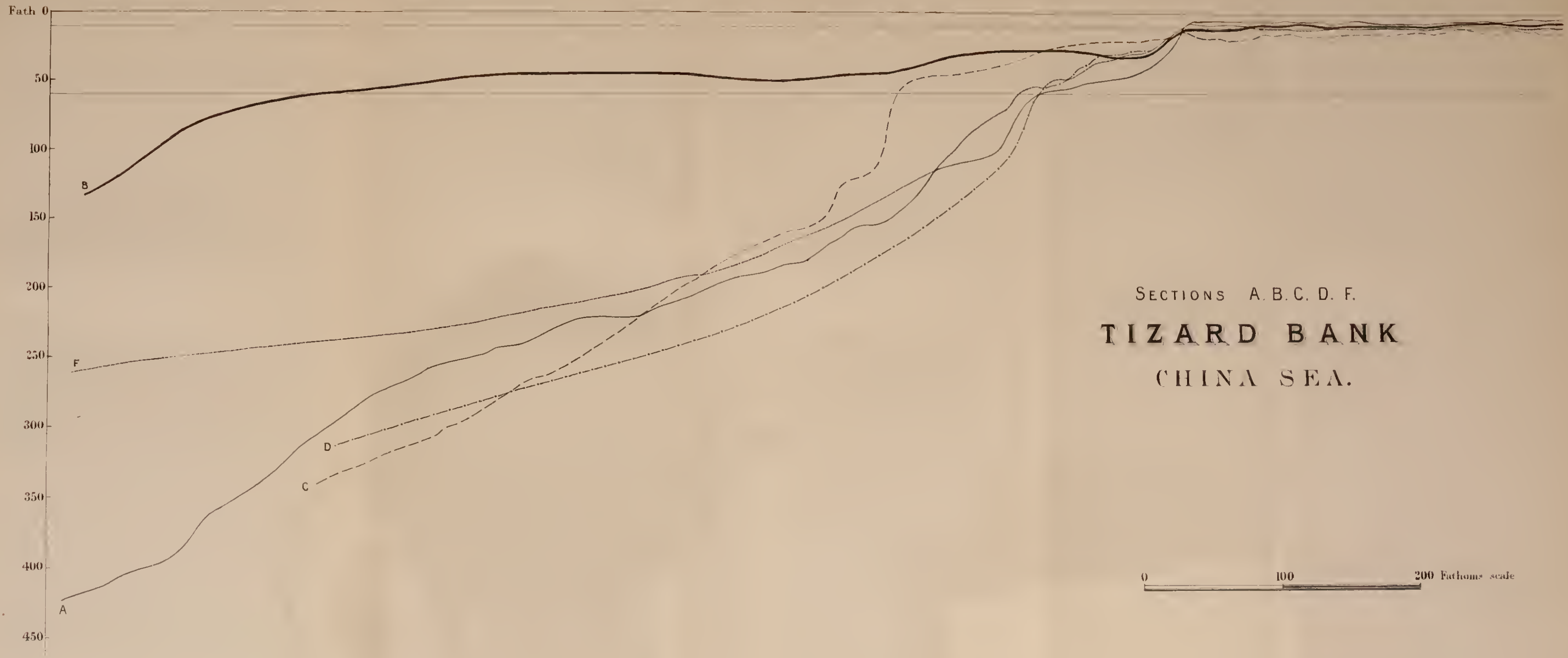
Ann. & Mag. Nat. Hist. S. 6. Vol. VI. Pl. XIII.





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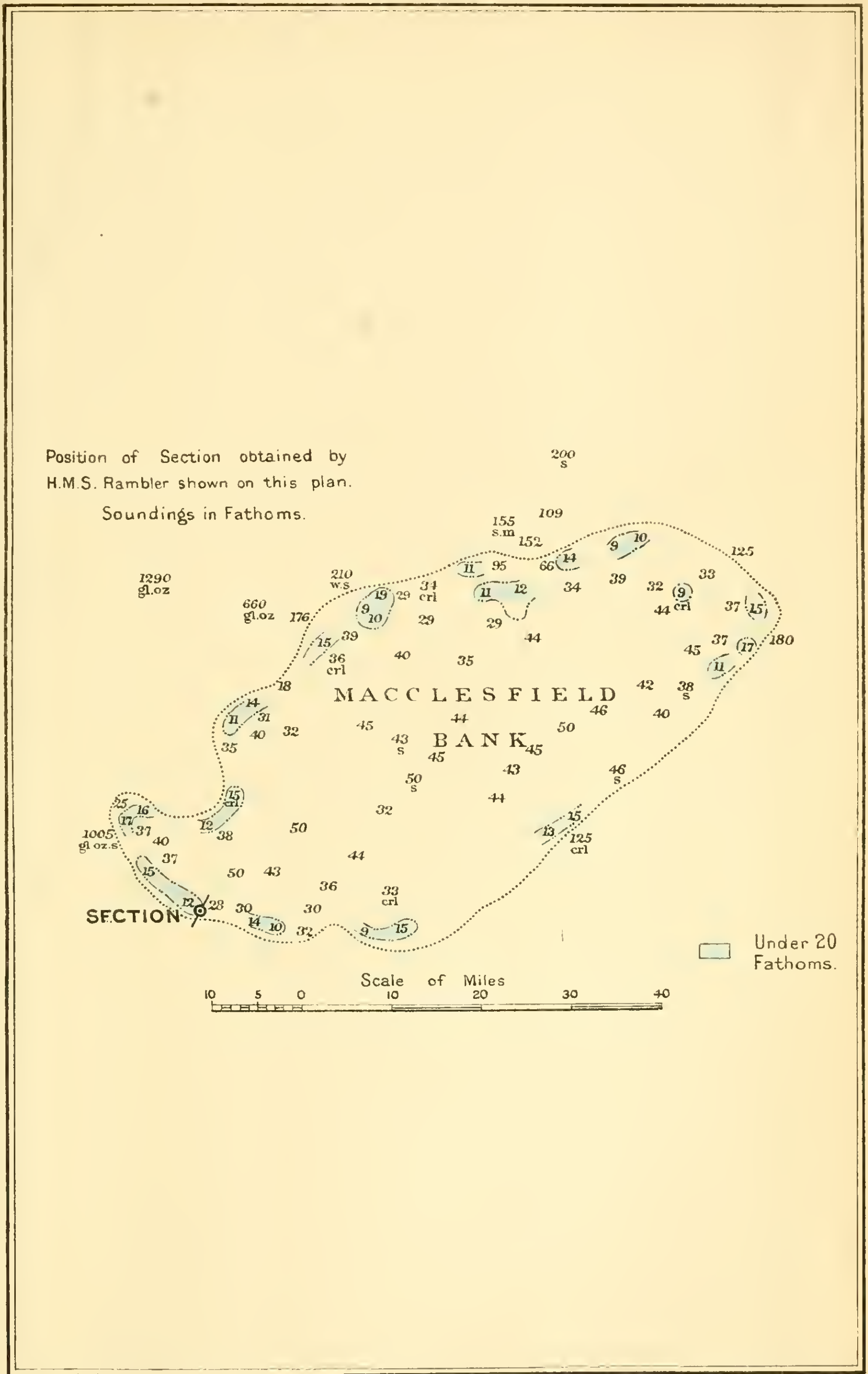

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