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LIST OF PAPERS.

EXPLANATION OF THE PLATES.

Plate	
I.–IV.	CURCULIONIDÆ.—Figures of new, rare, or interesting species of Coleoptera, and segments of same, to illustrate Mr. F. P. Pascoe's paper on these Beetles (Part IV.).
V.	ONISCIGASTER WAKEFIELDI, male and female imago, larva, and nymph, with parts of same, to illustrate Mr. R. MacLachlan's paper on this New-Zealand Ephemerid.
VI. VII.	CYCLURA VENOSA, nat. size and enlarged, with segments of same; also *Dynamene Montagui*, *D. varians*, and *Idotea pelagica*, to illustrate the Rev. T. R. R. Stebbing's paper on a new Australian Sphæromid &c.
VIII.	GONYLEPTES, five new species, and parts of same, to illustrate Mr. A. G. Butler's paper on the above genus of Harvest-Spiders.
IX.–XXIII.	HYDROIDA, new genera and species from Greenland, Scandinavia, India, Japan, New Zealand, &c., to illustrate Professor Allman's paper on this group.
XXIV.–XXVI.	ANATOMY OF CESTOIDA, illustrating Mr. F. H. Welch's paper on the family Tetrarhynchidæ.
XXVII. XXVIII.	VENATION, WINGS OF ZYGÆNIDÆ, to illustrate Mr. A. G. Butler's paper on this family of Lepidoptera.
XXIX.	NEURATION, illustrating Mr. A. G. Butler's paper on the subfamilies Antichlorinæ and Charideinæ.
XXX.	NEW MARINE SHELLS, illustrative of specimens described from the Solomon Islands &c. by Mr. Edgar A. Smith.
XXXI.	ARCTOMYS DICHROUS, a new species of Marmot from Kabul, described by Dr. J. Anderson.

CORRIGENDA ET ADDENDA.

Page 138, line 18 from top, *substitute* nine *for* "three" months.

— 343, — 15 from top, "*Amycles*" should there be *Anycles*—the former being Herrich-Schäffer's genus, whereas the latter, Walker's genus, was intended.

— 353, — 12 from bottom, "*Trianura*" ought to be *Trianeura.*

— 354, — 5 from bottom, *for* "Syntonis" *read* Syntomis.

— 419. The restricted genus *Creatonotus* of Herrich-Schäffer being superseded in the typical Arctiidæ by a group immediately following *Spilosoma* and allies, it is proposed to call the species *Sutonocrea incerta.*—A. G. Butler, Aug. 1, 1876.

— 494, line 17 from top, *for the word* "latter" *read* former.

— 494, — 18 from top, *for the word* "former" *read* latter.

— 563, — 3 from bottom, "*Pyjcara*" should be *Pykara.*

— 566, — 3 from bottom, for "*Rajahmundy*" read *Rajahmundry.*

— 570, footnote, top line, for "n. s.," read *Cuv. & Val.*

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CONTENTS.

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THE LINNEAN SOCIETY.

Contributions towards a Knowledge of the Curculionidæ.

By Francis P. Pascoe, F.L.S., late Pres. Ent. Soc.

Part IV.

(Plates I., II., III., & IV.)

[Read June 19, 1873.]

Rhinoscapha basilica. *R.* nigra, nitida, supra irregulariter granulata, interspatiis plerumque squamulis viridescentibus repletis; capite rostroque interrupte squamosis, hoc indistincte nigro-carinulato; antennis gracillimis; clava fusiformi; prothorace in medio longitudinaliter lineato, granulis subplanatis, plurimis subcontiguis, instructo; elytris striato-punctatis, punctis elongatis, interstitiis impunctatis, granulis depressis transversis obliquisque irregulariter notatis, vitta basali aliisque in lateribus et pone medium fascia oblique marginibusque glaucis, vel argenteo-viridibus, decoratis; corpore infra pedibusque viridescentibus, vage nigro-punctatis. Long. 11 lin.

Hab. Kaioa; Gilolo; Batchian; Makian; Ternate; Morty; Dorey.

If I am right in associating many varieties together, this is a most inconstant species; generally there are few or no traces of granules on the interstices of the elytra; and these are mostly bare of scales, except when the stripes and band occur; then the scales vary in colour from a nearly pure white to a rich metallic green. The slight ridge on the rostrum appears to be confined to the specimen here described; in others the rostrum is more or less grooved.

Rhinoscapha aulica. *R.* nigra, nitida, in cavitatibus squamulis aureo-viridibus (vel albis) maculata; capite rostroque vage squamosis, longitudinaliter fortiter sulcatis, sulco utrinque lineis elevatis nigris limitato; antennis nigrescentibus, tenuiter vage squamosis; clava fusiformi; prothorace intricate corrugato, aliquando fere obsolete impresso, in medio longitudinaliter canaliculato, lateribus viridi-vittato; elytris subsulcato-punctatis, punctis rotundatis, squamulis viridibus plus minusve repletis, interstitiis vix convexis, generaliter macula basali, fascia obliqua pone medium lateribusque aureo-viridibus; corpore infra pedibusque splendide aureo-viridibus. Long. 9–11 lin.

Hab. Batchian.

R. insignis, Guér., differs, *inter alia*, from this species in its shorter rostrum, the longitudinal groove not extending to between the eyes, by the median ridge of the prothorax, and the striated elytra with narrow punctures.

Rhinoscapha Staintoni. (Pl. I. fig. 1.) *R.* nigra, vix nitida, squamulis minutis albidis præcipue densissime, capite rostroque squamulis fervide aureis sat dense, tecta, illo pone oculos depresso, hoc fortiter sulcato; antennis albido-squamosis; scapo recto; funiculo articulo secundo longiore; clava attenuata, fusca, murino-pubescente; prothorace oblongo, supra sparse nigro-granulato, interspatiis fulvescenti-, lateribus albido-squamosis, in medio linea nigra elevata notato; elytris obovatis, humeris fere obsoletis, apice rotundatis, seriatim punctulatis, supra figura magna ⊥-formi nigra, punctis grossis squamulis albidis repletis, ornatis, reliquis elytrorum densissime albido-squamosis; corpore infra pedibusque dense albido-squamosis, his aureo-lavatis, parce pilosis, femoribus tibiisque opalescentibus. Long. 11 lin. (rost. incl.).

Hab. New Guinea (Saylee).

This fine species, the most isolated of the genus, I have dedicated to H. T. Stainton, Esq., F.R.S., &c. I believe but one example of it was taken by Mr. Wallace. Besides its remarkable coloration, it differs from the other members of *Rhinoscapha* in that the scrobe terminates before the eye and not beneath it.

Rhinoscapha formosa. *R.* omnino argenteo-viridi-squamosa, opalescenti-refulgens, supra plagis auratis vel argentei-roseis ornata; capite rostroque linea elevata nigra longitudinali instructis; antennis tenuatis, articulis funiculi subæqualibus, longiusculis; clava attenuata, infuscata; prothorace suboblongo, angusto, utrinque modice rotundato, supra nigro-granulato, linea elevata longitudinali vittisque duabus aurulentis notato; elytris striato-punctatis, punctis paulo elongatis, interstitiis tertio quintoque paulo magis convexis, remote nigro-punctulatis; corpore infra pedibusque punctis nigris adspersis. Long. 13 lin. (rost. incl.).

Hab. Morty.

This beautiful insect, of which, like the preceding, Mr. Wallace only obtained one specimen, is perhaps most allied to *R. Dohrnii*, Von Voll., but the sculpture of the elytra and colour are at once distinctive; the latter is difficult to describe, and is probably variable.

Rhinoscapha alma. *R.* nigra, squamulis grisescentibus, elytris niveo-variis, dense tecta; rostro utrinque linea nigra lævigata instructo; antennis gracillimis, dense squamosis, rarissime setulosis; prothorace pone apicem manifeste excavato, foveis nigris adsperso, dorso transversim subplicato, in medio linea elevata nitide nigra instructo; elytris subsulcato-punctatis, punctis vix approximatis, interstitiis convexis, granulis subtilissimis nigris, singulis squamulam elongatam gerentibus, adspersis, basi plagis irregularibus, fascia flexuosa pone medium lateribusque, plus minusve niveis, ornatis; corpore infra opalescente in medio cærulescenti-nebuloso; pedibus nigromaculatis, maculis squamulam elongatam gerentibus. Long. 11 lin. (rost. incl.).

Hab. Aru.

I have three specimens of this species, two of which are males and have the legs slightly opalescent.

Rhinoscapha opalescens. *R.* nigra, ubique squamulis opalescentibus, in elytris pallide cærulescenti-variis, dense tecta; rostro utrinque haud nigro-lineato; antennis gracillimis, dense squamosis, rarissime setulosis; prothorace irregulariter foveatis, interspatiis tuberculis parvis nitide nigris munitis, in medio linea nigra impresso; elytris subsulcato-punctatis, punctis magis approximatis, interstitiis convexis, granulis subtilissimis nigris, singulis squamulam elongatam gerentibus, adspersis, basi plaga irregulari elongata, aliis pone medium, simul sumptis fasciæformibus, lateribus, plus minusve, maculisque postice, cærulescentibus, ornatis; corpore infra pedibusque setulosis, ut in præcedente. Long. 11 lin. (rost. incl.).

Hab. Waigiou; Mysol; Dorey.

A specimen from Mysol is nearly concolorous; a pair from Dorey is less opalescent, and the blue is replaced by white. This and the preceding species are nearly allied; and putting colour aside, on which little dependence is to be placed, I think *R. alma* may be distinguished by the presence of a smooth black line running down the convexity lying between the median and outer sulcus of the rostrum (the presence of the latter is one of the generic characters of *Rhinoscapha*), and by the *raised* line on the prothorax, both wanting in the present species.

RHINOSCAPHA VERRUCOSA. (Pl. I. fig. 2.) *R.* nigra, argenteo-cervino-vel argenteo-viridi-squamosa; capite pedibusque cæruleis vel albidis, rostro in medio nigro-carinato; antennis dense cæruleo-squamosis; scapo arcuato; clava infuscata, pubescente; prothorace utrinque modice rotundato, basi apiceque fere æqualibus; supra nigro granulato, in medio linea elevata nigra; scutello oblongo; elytris sulcato-punctatis, punctis densissime squamosis, interstitiis convexis, granulis oblongis nitide nigris irregularibus maculatis; pedibus setigero-punctatis. Long. 8–10 lin. (rost. incl.).

Hab. Matabello; Goram; Bouru; Amboyna; Sula; Java.

The colour varies from an opake pale greyish white to silver-fawn and silver-greenish; but in all the elytra are beautifully spotted with glossy black irregularly formed granules. It may possibly be *Curculio amictus*, Wiedem.

RHINOSCAPHA SELLATA. (Pl. I. fig. 3.) *R.* nigra, squamulis albis, supra interruptis, omnino dense tecta; antennis minus gracillimis, dense albo-squamosis; clava attenuata, basi haud pedunculata, dimidio apicali nigro; prothorace subreticulato-tuberculato, pone apicem excavato, tuberculis plus minusve conspicuis nitide nigris; elytris striato-punctatis, punctis angustis, elongatis, interstitiis convexis, in medio pone scutellum et pone medium ad latera protensis lineis tuberculiformibus transversis, nitide nigris instructis. Long. $6\frac{1}{2}$–10 lin. (rost. incl.).

Hab. Batchian.

Of this species I have five examples, all easily distinguishable by the short raised bars across the interstices confined to a large patch behind the scutellum and which spreads out to the sides behind the middle, the hollows formed by the bars being filled in with white scales, giving the spotted appearance as seen in the Plate.

RHINOSCAPHA STOLIFERA. *R.* nigra, squamulis ochraceo-grisescentibus, albido variis, dense tecta; antennis minus gracillimis; clava ovali, basi haud pedunculata, fere nigra; prothorace irregulariter foveato, maculis nitide nigris minutis adsperso, in medio longitudinaliter sulcato; elytris striato-punctatis, punctis elongatis, interstitiis carinatis, in medio a basi usque ad paulo pone medium tum ad latera protensis, interstitiis nitide nigro flexuoso-culminatis, colore etiam saturate ochraceo; corpore infra albido-squamoso, lateribus sternorum abdominisque ochraceo-maculatis; pedibus ochraceis. Long. 11 lin. (rost. incl.).

Hab. Waigiou.

The strongly raised interstices, some of them in part having the angular ridge zigzag and glossy black, and this portion of the elytra being of a darker ochreous colour, forming, as in the preceding species, a somewhat ⊥-shaped figure, readily marks off this species from its congeners.

Rhinoscapha miliaris. *R.* nigra, squamulis griseo-opalescentibus, elytris viridulo variis, dense tecta; rostro paulo elongato, metallico-viridi-squamoso, maculis parvis nigris adsperso; antennis gracillimis, funiculo setulis paucis longis munito; clava basi subpedunculata; prothorace pone apicem excavato, irregulariter subfoveato, granulis numerosis nitide nigris inæqualibus adsperso; elytris sulcato-punctatis, punctis late impressis, interstitiis subuniseriatim granulatis, tertio, quinto septimoque manifeste magis elevatis; corpore infra pedibusque concinne opalescentibus aureoque lavatis. Long. 11 lin. (rost. incl.).

Hab. Mysol.

My only specimen of this species is at first sight not very unlike *R. Dohrnii*, Voll.; but, besides the far less brilliant coloration, the raised alternate interstices of the elytra, all of them with a single, but not very regular, row of minute and very distinct granules, and the broadly impressed puncture in the sulci will at once suffice to separate them.

Rhinoscapha carinata. *R.* nigra, supra squamulis viridulis interrupte tecta; rostro squamulis aureo-viridibus griseisque intermixtis sejunctim vestito, sulco mediano lineatim inciso; antennis modice tenuatis, sordide griseo-squamosis; clava basi pedunculata; prothorace pone apicem excavato, dorso foveato, irregulariter rude tuberculato et utrinque viridi vittato; elytris sulcato-punctatis, punctis elongatis, interstitiis nigro culminatis, tertio, quinto septimoque usque ad partem declivam carinatis, juxta suturam lineis transversis elevatis nigris instructis; corpore infra pedibusque metallico-aureo-viridibus, his squamulis fuscis variis. Long. 9 lin. (rost. incl.).

Hab. Morty.

The raised interstices of the elytra in this species are glossy black except at the sides; and between the first of these raised interstices and the suture are transverse bars, as in *R. sellata*; and the hollows are in like manner filled in with scales: in other parts of the elytra the scales are sufficiently contiguous to form patches; but, judging from the two examples of this species before me, there is the usual variability in this respect.

Brachycerus tursio. (Pl. I. fig. 10.) *B.* ovatus, niger, squamositate albida, fusco-plagiata, vestitus; rostro basi longitudinaliter excavato, vage punctato; oculis ovatis, infra acuminatis; antennis albo-squamosis; prothorace subtransverso, utrinque in medio late angulato-producto, rarissime inæqualiter punctato, vitta fusca, apicem versus gradatim dilatata, ornato; elytris globosis, impunctatis, humeris maculaque magna pone medium fuscis; abdomine nigro, segmentis utrinque macula albo-squamosa notatis; pedibus albido-squamosis. Long. 8 lin.

Hab. Damara Land.

This well-marked species belongs to Schönherr's "Stirps 1" and "Manipulus 1."

Acantholophus nasicornis. *A.* oblongus, niger, sejunctim albido-squamosus; fronte lineis duabus impressa, supra oculum spinis duabus connatis; rostro basi transversim sulcato, antice fortiter excavato, ad latera carinato, carinæ apice spina conica munito, basi triangulariter foveata; antennis elongatis, squamosis, setulis adspersis; funiculo articulo secundo quam primo fere duplo longiore, quatuor ultimis longiusculis; clava elongata; prothorace paulo convexo, leviter granulato, in medio longitudinaliter sulcato, sulco utrinque basi tuberculis duobus parvis obsito, apice utrinque tuberculo conico instructo, lateribus dorsi quadrituberculatis, tuberculis duobus anticis majoribus, antico minore, basi connatis, posticis minusculis, sed tuberculo postico longiusculo; elytris seriatim foveatis, dorso interstitiis granulatis, postice magis tuberculatis, interstitio quinto (humerali) tuberculis conicis majusculis (circa 11–12) munito, lateribus foveatis; pedibus squamosis, nigro-setosis. Long. 8 lin.

Hab. West Australia.

The scales, under a Codington, are of a pearly lustre; but to the naked eye the back has a smoky tinge varied with cinereous; the two median rows of tubercles on the prothorax are not distinctly marked off from those on the disk, except two somewhat larger tubercles on each side at the base.

Acantholophus gladiator. (Pl. II. fig. 3.) *A.* oblongus, fuscus, interrupte silaceo-squamosus; rostro antice leviter trifido-impresso, supra oculum spina valida instructo; clava modice pedunculata; prothorace supra bifariam tuberculato, tuberculo antico valde producto, securiformi, tuberculo postico parvo, inter eos tuberculis quatuor obconicis obsito, lateribus utrinque trituberculato, anteriore manifeste longiore, postico parvo; elytris trifariam tuberculatis, quatuor anticis suturalibus minoribus, cæteris elongato-spiniformibus, lateribus granulatis, albo variegatis; abdomine sparse punctato. Long. 8 lin.

Hab. West Australia.

The two large hatchet-shaped spines overhanging the head is diagnostic of this species. It is unfortunate that the name of *Acantholophus* should have been previously used by Koch for a genus of spiders*.

Acantholophus simplex. *A.* oblongus, niger, squamis rufo-brunneis in cavitatibus sat dense vestitus; fronte excavata; rostro utrinque lamina triangulari sulcato, basi bifoveato, supra oculum spinis duabus connatis, postica elongata recurva, antica parva vel dentiformi, instructo; antennis haud elongatis, dense squamosis, nigro-setulosis; funiculo articulis quatuor ultimis subovalibus; prothorace subanguste convexo, supra tuberculis granuliformibus, circa quatuordecim in seriebus irregularibus duabus ordinatis, lateribus utrinque tuberculo spiniformi armatis, basi sat fortiter sulcato; elytris oblongo-obovatis, granulis minutis subseriatim munitis, ad latera magis tuberculatis, interstitio tertio postice tuberculo minusculo obsito, apice anguste rotundatis; abdomine segmento secundo tertio paulo longiore; pedibus sat dense squamosis, setulis adspersis. Long. 6 lin.

Hab. West Australia.

The concavity in the forehead is principally formed by a fold connecting the spines above the eyes; the elytra are covered with numerous small granules, many of them almost hidden by the scales, but becoming more tuberculate at the sides.

Anascoptes.

(Amycterinæ.)

Caput inter oculos excavatum; *rostrum* capite angustius, utrinque trituberculatum; *scrobes* infra oculos currentes. *Oculi* prominuli, rotundati, fortiter granulati. *Prothorax* utrinque angulatus, basi angustus, apice productus, lobis ocularibus nullis. *Elytra* ovalia, postice subito declivia. *Femora* modice incrassata; *tibiæ* rectæ; *tarsi* articulis tribus basalibus breviter triangularibus, ultimo elongato. *Abdomen* ut in *Acantholopho*.

In some respects like *Acantholophus*, but without ocular lobes, and with prominent eyes and well-limited scrobes running beneath the eye.

Anascoptes muricatus. (Pl. II. fig. 6.) *A.* niger, opacus; capite

* 1837, ten years before Schönherr described his genus.

inter oculos profunde excavato; rostro antice subplanato; antennis ferrugineis; funiculo articulo secundo longiusculo, sequentibus rotundatis; prothorace in medio profunde canaliculato, marginibus apiceque canaliculæ tuberculis difformibus elevatis munitis, ad latera in medio tuberculo elongato, supra ad basin excavato, instructo; elytris supra tuberculis numerosis conicis, basi posticeque magis elongatis, instructis, apice explanato-rotundatis, bituberculatis; pedibus sparse setosulis. Long. 3 lin.

Hab. Swan River.

Polycreta.

(Amycterinæ.)

Caput antice subplanatum, supra oculum tuberculatum; *rostrum* capite multo angustius, subelongatum, basi sulcatum, antice bituberculatum; *scrobes* subterminales, ante oculos evanescentes. *Oculi* prominuli, rotundati, tenuiter granulati. *Scapus* elongatus. *Prothorax* basi lateribusque rotundatus, apice productus, lobis ocularibus obsoletis. *Elytra* ovata, convexa. *Femora* modice incrassata; *tibiæ* rectæ, vel paulo incurvatæ, apice crassiores; *tarsi* elongati. *Abdomen* ut in *Hyborhyncho*.

This genus seems to be most nearly allied to *Hyborhynchus*, MacLeay, jun.; but it has a narrower and longer rostrum, especially narrow in the part between the scrobes, and the eyes are prominent and finely faceted.

Polycreta metrica. (Pl. II. fig. 1.) *P.* anguste ovata, fusca, squamulis parvis, fere ubique, plerumque silaceis irrorata; capite rostroque medio albo-squamosis, hoc tuberculis duobus elongatis compressis basi obsito; antennis piceis; funiculo articulo secundo breviore, ultimis subrotundatis; clava brevi; prothorace in medio albo-vittato, lateribus disci bifariam spinosis, spina penultima exteriore maxima; elytris bifariam conico-tuberculatis, tuberculo solitario, apice spiniformi, pone humeros instructis, utrinque ad tertiam partem albo-squamosis, pone medium fascia albo-squamosa munitis; pedibus ferrugineis, longe pilosis. Long. 3–3½ lin.

Hab. Champion Bay.

Sclerorhinus tæniatus. *S.* elongatus, niger, squamulis minutis obscure umbrinis, tuberculis exceptis, dense tectus; rostro crasso, carina media brevi; oculis minusculis; clava elliptica; prothorace transverso, utrinque ampliato, granulis remotis nitidis, singulis seta minuta instructis, munito; elytris ubique prothorace vix latioribus, humeris subbidentato-productis, apice late rotundatis, ad suturam perparum productis, singulatim dorso pallide trivittato, vitta interiore basali abbreviata, irregulariter striato-punctulatis, interstitiis 2. 3. 4. tuberculis oblongis remotis, singulis seta minuta instructis, interstitio sexto granulis magis confertis munito; metasterno abdomineque lateribus griseo-squamosis, in medio longitudinaliter dense silaceo-pilosis. Long. 9 lin.

Hab. South Australia.

Allied to *S. longus*, MacLeay, jun., but differently coloured, the rostrum with a central carina, and with smaller and more numerous tubercles on the elytra, the second interstice with four, the third with nine or ten, and the fourth with two; the elytra are about twice and a half as long as the prothorax.

Sclerorhinus molestus. *S.* elongatus, niger, squamulis minutis silaceis sejunctim tectus; rostro crasso, carina media fere obsoleta, capiteque squamulis piliformibus sat dense vestitis; oculis majoribus; clava pedunculata; prothorace transverso, lateribus ampliato, in medio longitudinaliter impresso, granulis depressis subnitidis, singulis seta minuta a basi postice projecta, munito; elytris prothorace in medio vix latioribus, humeris callosis, apice sat late rotundatis, seriatim tuberculatis, tuberculis parvis, plerumque subconicis, singulis seta minuta postice instructis, seriebus secunda quartaque tuberculis singulatim circa quinque gerentibus, interstitio suturali tuberculis multo minoribus, circa 20, instructo; metasterno abdomineque in medio longitudinaliter dense pilosis. Long. 10 lin.

Hab. South Australia.

In many respects like the last, but, *inter alia*, with the elytra very differently tuberculated; the third and fifth interstices have about sixteen or seventeen tubercles on each.

Sclerorhinus marginatus. *S.* elongatus, niger, læte umbrino-squamosus, griseoque vittatus; rostro longiore, in medio linea lævi nigra ad frontem protensa; capite rostroque vittis duabus medianis, lateribus et supra oculos griseis; oculis majoribus; clava elliptica; prothorace transverso, utrinque rotundato, granulis minusculis sat remotis munito, dorso trivittato, vitta intermedia angusta; elytris prothorace triplo longioribus, confertim granulatis et tuberculatis, granulis plerumque proxime suturam obsitis, tuberculis parvis conicis, apice singulorum seta recurva instructo, sutura, vitta humerali marginibusque exterioribus griseis; metasterno abdomineque ad latera griseo-plagiatis, in medio longitudinaliter dense silaceo-pilosis; pedibus griseis, nigro irroratis; tarsis posticis linearibus. Long. 9 lin. (rost. incl.).

Hab. South Australia.

This species may be compared to *S. pilularius*; but it has a narrower rostrum, and the tubercles on the elytra are much smaller generally, more numerous, and irregularly crowded between the suture and sixth or infrahumeral interstice.

Sclerorhinus echinops. *S.* oblongo-ovatus, niger, in cavitatibus silaceo- et maculatim albo-squamosus; capite squamis elongatis, fuscis, silaceo-trilineatis, inter oculos paulo excavato; rostro antice sat fortiter excavato, in medio lævigato, basi trifoveato; antennis haud elongatis; prothorace transverso, sat confertim granulato, lobis ocularibus modice prominulis; elytris subseriatim tuberculatis, tuberculis mediocribus, basalibus depressis, posticis conicis, singulis setam basi nigram recurvam gerentibus, humeris tuberculatis, apice late rotundatis; corpore infra nigro nitido, abdomine in medio silaceo-maculato. Long. 8 lin.

Hab. West Australia.

Of all the named species known to me, I can only compare this to *S. pilularius*, MacLeay, jun.; but, *inter alia*, it is shorter, the tubercles on the elytra larger and more numerous, and those on the base much depressed.

Sclerorhinus meliceps. *S.* oblongus, fuscus, opacus; capite rostroque squamis angustis et setiformibus læte ochraceis, illo densissime, tectis, hoc in medio modice excavato, carina media obsoleta; antennis fuscis; scapo haud elongato; oculis minusculis; prothorace vix transverso, apice basi latitudine fere æquali, lobis ocularibus subprominulis, apice rufo-marginato, granulis numerosis, basi indeterminatis, singulis setam læte ochraceam gerentibus, munito; elytris subovalibus, prothorace paulo latioribus, confertim tuberculatis, tuberculis minusculis, granuliformibus, plurimis aspersis aliis subseriatim dispositis, apice nitidis et setam læte ochraceam gerentibus; abdomine in medio dense silaceo-piloso; pedibus rufescentibus, sparse pilosis; tibiis intermediis apice intus emarginatis. Long. $7\frac{1}{2}$ lin.

Hab. Queensland (Rockhampton).

This species is remarkable far the numerous small tubercles on the elytra and the notch on the intermediate tibiæ, which, however, may possibly be only a sexual character.

Talaurinus victor. *T.* oblongo-ovatus, niger, in cavitatibus squamulis vel squamositate umbrinis vel griseis munitus; capite setigero-punctato; rostro crasso, antice profunde excavato, basi biimpresso, carina exteriore ad oculum protensa; clava basi elongato-obconica; prothorace transverso, utrinque in medio subangulato, granulis majusculis sejunctim instructo; elytris prothorace latioribus, pone medium latioribus, basi truncatis, humeris dentatis, apice paulo ampliatis, ad suturam triangulariter productis, ubique granulis inæqualibus sat confertim instructis, granulis singulis setam subtilissimam gerentibus; corpore infra nitide nigro, setulis minutis adsperso; tarsis sat angustis, posticis haud elongatis. Long. 11 lin.

Hab. South Australia.

This description is made from a female; the male has the apex of the elytra mucronate, and longer posterior tarsi. This fine species has the outline of *T. rugifer*, Bois., but is very differently sculptured.

Talaurinus funereus. *T.* oblongus, niger, vix nitidus, squamulis silaceis in cavitatibus munitus; capite parce setuloso, occipite solo silaceo-squamoso; rostro brevi, punctato, capite angustiore, in medio profunde sulcato, basi bifoveato; scapo modice elongato; clava basi elongato-obconica; prothorace transverso, utrinque rotundato, granulis minusculis sat confertim munito; elytris pone medium latioribus, humeris tuberculatis, apice rotundatis, seriatim subfoveatis et granulatis, interstitiis parce tuberculatis, tuberculis posticis solis modice conicis, alteris granuliformibus; corpore infra subnitido; segmentis tribus ultimis abdominis in medio macula squamosa notatis. Long. 8½ lin.

Hab. West Australia.

The rostral fovea is formed by the approximation of the intermediate carina to the outer, which is a step towards its obliteration. On the elytra it is hard to say where the granules end and the tubercles begin; but one or two may be counted in the first row (second interstice), four or five in the second, one in the third; the fourth or humeral row has also four or five, without counting four or five tolerably stout granules near the shoulder; and the outer row has some five or six: the intermediate granules accompanying the foveæ are very small.

Talaurinus pustulatus. *T.* oblongo-ovatus, niger, obscurus, in cavitatibus asperse silaceo-squamulosus; capite parce setuloso; rostro brevi, crasso, basi bifoveato; scapo modice elongato; clava basi elongato-obconica; prothorace subtransverso, utrinque rotundato, granulis depressis majusculis munito; elytris irregulariter foveatis, et granulatis, tuberculis minusculis, breviter conicis, sat remote obsitis, humeris tuberculatis, apice rotundatis, ad suturam paulo productis; corpore infra subnitido; segmentis intermediis in medio maculatim squamosis. Long. 7½ lin.

Hab. West Australia.

In this dull black species the granules and tubercles are much flatter than usual. On the elytra it is difficult to trace any linear arrangement of the foveæ, but the tubercles are dispersed in the following manner:—four or five in the first row, eight or nine in the second, one in the third, and in the fourth or humeral row two, which are quite posterior; at the shoulder, and forming the outer row, are granules only.

TALAURINUS CARBONARIUS. *T.* ovatus, niger, opacus, squamulis filiformibus minutis nigrescentibus adspersus; capite subtiliter punctulato; rostro crasso, capite paulo angustiore, antice modice excavato, basi bifoveato; scapo sat breviusculo; clava elliptica; prothorace transverso, utrinque rotundato, granulis minusculis sat confertim munito, lobis ocularibus manifestis; elytris postice paulo latioribus, humeris vix productis, apice late rotundatis, dorso transversim foveato, interstitiis indeterminatis, paulo elevatis, granulis parvis seriatim et biseriatim ordinatis; corpore infra nigro, vix nitido. Long. 7½ lin.

Hab. West Australia.

The intermediate rostral carinæ are in this species almost entirely obliterated, so that in reality there is only a short stout carina on each side; the sculpture of the elytra is confined to small approximate granules, each bearing a pale minute seta arranged in lines, or here and there in double lines, with well-marked transverse foveæ between them.

TALAURINUS PHRYNOS. *T.* ovatus, fuscus, squamulis minutis silaceis vestitus, supra granulis numerosis, singulis setam magnam gerentibus; capite punctulato, fronte valde convexo; rostro brevi, capite paulo angustiore, antice modice excavato, carinis intermediis approximatis, basi sulco flexuoso impresso; oculis subovalibus; clava breviuscula; prothorace vix transverso, utrinque fortiter rotundato, confertim granulato, dorso utrinque vitta pallida notato; elytris leviter depressis, subcostatis, lateribus ampliato-rotundatis, humeris tuberculo parvo instructis, apicibus ad suturam dentato-productis, dorso transversim foveato-impressis, granulis minutis nitide nigris seriatim ordinatis, maculis indistinctis vittatim notatis; corpore infra nigro, subnitido; abdomine granulis minutis adsperso. Long. 9 lin.

Hab. Queensland (Rockhampton).

A broad dull-coloured species indistinctly striped or mottled with greyish; the numerous minute glossy granules on the elytra are seated on slightly raised lines, the alternate ones, of which there are three on each elytron, including one close to the suture, are more pronounced; the setæ are only large when compared with the granules from which they arise. It is probably near *T. incertus*, MacLeay, jun., which, however, is described as "oblongo-ellipticus niger cinereo-squamosus," Trans. Ent. Soc. New South Wales, i. p. 221.

Talaurinus molossus. *T.* oblongus, niger, nitidus; capite rostroque brevibus, sparse punctulatis, illo lato, hoc paulo angustiore, carinis intermediis brevibus, conjunctis, haud prominulis; scapo pone oculum haud protenso; clava parva, subelliptica; prothorace subtransverso, ampliato, utrinque fortiter rotundato, granulis majusculis sat confertim munito; elytris pone medium paulo latioribus, humeris tuberculatis, apice subrotundatis, ad suturam perparum divaricatis, seriatim tuberculatis et granulatis, squamulis minutis in cavitatibus munitis, tuberculis nonnullis oblongis, vel ad basin transversis, plurimis conicis, ad latera inæqualiter granulatis; abdomine segmentis tribus ultimis squamis maculatim notatis. Long. 9 lin.

Hab. West Australia.

A robust species, with a short scape and small antennæ, whose immediate affinities are not obvious. The tubercles on the elytra are thus disposed: the second interstice has five, mostly oblong, tubercles; the third has from fourteen to sixteen, extending from the base, where they are somewhat transverse, to the apex, the fourth three, the fifth or humeral twelve, but three or four of the posterior only are conical; the outer row has nine or ten mostly rounded tubercles or large granules; the first or sutural interstice is also rather roughly granulate.

Talaurinus melanopsis. *T.* oblongo-subovatus, niger, nitidus, supra esquamosus, granulis tuberculisque, singulis setam minutam gerentibus, confertim munitus; capite antice fortiter granulato; rostro brevissimo, crasso, modice excavato, pone apicem sulco Λ-formi impresso, basi inter carinas utrinque granulo unico notato; antennis gracilibus; prothorace transverso, lateraliter rotundato, sat confertim granulato, lobis ocularibus obsoletis; elytris ovalibus, in medio latioribus, basi subtruncatis, humeris calloso-productis, seriatim tuberculatis, regione scutellari granulatis, tuberculis conicis, versus apicem manifeste minoribus; corpore infra sparse nigro-setoso, in medio setis longitudinaliter condensatis; pedibus piceis. Long. 6 lin.

Hab. West Australia.

The angular transverse groove just behind the apex of the very short rostrum, followed by a corresponding elevation, which is formed by the union of the two inner oblique carinæ, differentiates this species from any of its section among the tuberculate species of *Talaurinus*.

Talaurinus simulator. *T.* oblongo-ovatus, niger, nitidus, supra granulis tuberculisque majusculis, squamulam minutam gerentibus, confertim munitus; capite fere lævigato; rostro crasso, fortiter excavato, basi profunde bifoveato; antennis crassioribus; prothorace minus transverso, granulis majusculis subdepressis munito, lobis ocularibus manifestis; elytris pone medium latioribus, basi arcuatis, humeris vix productis, tuberculis majusculis usque ad apicem instructis, lateribus in cavitatibus albido-squamosis; corpore infra sparse punctulato, haud setoso. Long. 8 lin.

Hab. West Australia.

The principal differences between this and the last species are the larger size of the tubercles, more ovate outline, stouter antennæ, the presence of ocular lobes, and the incurved base of the elytra; the sculpture of the rostrum, moreover, is essentially different, and resembles that of *T. tuberculatus*; but the rostrum itself is much thicker and shorter, and the head is concave in front.

Talaurinus Macleayi. *T.* subangustatus, niger, squamis supra cineraceis silaceisque vittatim, lateribus albis, vestitus; capite rostroque setigero-punctatis, hoc brevi, capite vix angustiore, fortiter trisulcato, carinis intermediis subparallelis; funiculo articulis quatuor ultimis subrotundatis; prothorace subtransverso, utrinque ampliato-rotundato, granulis sat confertim munito, sed in medio pone apicem longitudinaliter interrupto; elytris prothorace haud latioribus, (♀) paulo angustioribus, humeris haud productis, apice late rotundatis, seriatim irregulariter foveatis, lateribus inæqualiter granulatis, supra tuberculis majusculis conicis in seriebus tribus ordinatis; corpore infra pedibusque albo-squamosis maculis nigris irroratis; abdomine nudo, maculis albo-squamosis notato, segmento ultimo, in utroque sexu, medio nigro-velutino. Long. 7 lin.

Hab. King George's Sound.

A very distinct species, which, but for its strongly convex forehead, I should have referred to *Amycterus*; in the first row the tubercles, two or three in number, correspond to gaps in the second row, which has six or seven tubercles, whilst the outer row has eight. I dedicate this species to William MacLeay, jun., Esq., who has added so much to our knowledge of this group.

Talaurinus encaustus. *T.* ovatus, niger, squamulis minutis, supra silaceis albisque variegatus, lateribus abdomineque albis nigro-irroratis; rostro capite haud angustiore, fortiter trisulcato, carinis intermediis divaricatis, capiteque setigero-punctatis, vix squamosis; funiculo articulis quatuor ultimis obovatis; prothorace transverso, utrinque rotundato, granulis sat confertim munito, sed in medio pone apicem longitudinaliter interrupto, lobis ocularibus leviter prominulis, dorso utrinque subvittatim plagiato; elytris brevibus, convexis, lateribus rotundatis, in medio prothorace manifeste latioribus, tuberculis conicis minusculis numerosis, granulisque intermixtis, instructis, supra irregulariter albido-plagiatis, apice sat late rotundatis; tarsis intermediis posticisque angustis. Long. 7 lin. (rost. incl.).

Hab. King George's Sound.

The head and prothorax in this species are not unlike those of the preceding; but the short convex elytra with their numerous tubercles are essentially different.

Talaurinus tenuipes. (Pl. II. fig. 2.) *T.* niger, opacus, lateribus aliquando abdomineque niveo-maculatis; rostro capite angustiore, basi antice in medio bifoveato; fronte fere obsolete granulata; funiculo articulis quatuor ultimis rotundatis; clava basi oblongo-obconica; prothorace transverso, antice dilatato, ante medium latiore, tum ad basin gradatim angustiore, basi ipse quam apice multo angustiore, granulis elevatis subconicis sejunctim munito; elytris ovato-cordatis, inæqualiter granulatis, singulis tuberculis conicis in seriebus duabus ordinatis, tuberculo humerali bifido, apicem versus minus granulatis; pedibus elongatis, gracilibus; tarsis, præsertim posticis, linearibus, longiusculis. Long. 4–5 lin.

Hab. Swan River (Albany).

The description is made from an individual nearly deprived of scales, but having a shorter and more characteristic prothorax than another individual, which has small silaceous scales on the upper parts and the sides dotted with pure white spots; the femora and tibiæ also are clothed with white scales. This species is allied to *T. hystricosus.* So far as the linear tarsi are concerned, there are intermediate forms which take us back to the very short tarsi of *T. rugiceps*, MacLeay, jun.

Talaurinus tessellatus. (Pl II fig. 11.) *T.* oblongo-ovalis, niger, variegatim albido- silaceoque sejunctim squamosus; rostro antice parum excavato, capite paulo angustiore, cum capite fuscis, vitta grisea supra oculum alteraque in medio, ad apicem rostri divisa, ornatis; funiculo articulis quatuor ultimis subtriangularibus; clava basi elongato-obconica; prothorace longitudine vix latiore, lateribus ampliatis, granulis parvis asperso, fusco, dorso vittis tribus albidis ornato; elytris postice gradatim latioribus, apice subtruncatis, subseriatim granulatis, interstitiis fortiter foveato-impressis, albidis, silaceo-variegatis, sparse fusco tessellato-maculatis; corpore infra nitide nigro; abdomine segmento singulo trimaculatim silaceo-squamoso; mesosterno prominulo; pedibus nigro-maculatis. Long. 7 lin.

Hab. Western Australia (Champion Bay).

A species, like many others, lying between *Talaurinus* and *Sclerorhinus*; it may to a certain extent be compared with *T. Manglesii.*

Talaurinus geniculatus. *T.* oblongo-ovalis, niger, squamis griseis silaceisque variegatus; capite granulato; rostro brevi, antice parum excavato, triangulariter impresso, triangulo utrinque albo-marginato; prothorace modice transverso, apice quam basi angustiore, remote granulato, griseo, supra vittis duabus silaceis ornato; elytris breviter ovatis, basi paulo depressis, humeris tuberculatis, tenuiter striato-punctatis, interstitiis elevato-granulatis, anterius granulis minoribus depressis, posterius et lateraliter majoribus conicis, dorso griseis, sub-vittatim silaceo-variegatis, lateribus albis; pedibus albido-squamosis, femoribus apice nigris. Long. 8 lin.

Hab. West Australia.

Allied to *T. Manglesii*, Boh., but differently coloured, with shorter more depressed elytra, smaller granules at the base, and much fewer posteriorly.

Talaurinus lemmus. *T.* ovatus, niger, plagiatim griseo-squamosus; rostro brevi, in medio fortiter anguste sulcato, sulco basi bifurcato; clava antennarum funiculo vix crassiore, basi elongato-obconica; prothorace transverso, utrinque rotundato, basi quam apice parum angustiore, supra sparse granulato, vittis tribus griseis ornato; elytris subcordatis, humeris dentato-productis, seriatim profunde foveatis, transversim parce granulatis, apicibus paulo divaricatis, supra plagis griseis notatis, lateribus sejunctim albido-squamosis; corpore infra nitide nigro. Long. 4 lin.

Hab. Western Australia.

In appearance like *T. spinosus*, MacLeay, jun., but the elytra rather granulate than tuberculate, and a totally different rostrum.

Talaurinus pupa. *T.* ovatus, niger, fere esquamosus, capite rostroque granulatis, hoc magis rugoso, in medio paulo, apice fortiter excavato, fronte sulco V-formi impresso; antennis nitide nigris, clava latiore; prothorace transverso, utrinque rotundato, basi quam apice parum latiore, supra sat confertim fortiter granulato, lateribus tuberculatis; elytris subcordatis, humeris dentato-productis, seriatim conico-tuberculatis, sed regione suturali granulis parvis instructis, lateribus albido-maculatis; corpore infra nitide nigro. Long 4 lin.

Hab. West Australia.

Allied to the preceding, but nearly without scales above, and the elytra tuberculate. In two females, which are considerably broader than the males, there is an indistinct whitish stripe on each side of the prothorax.

Talaurinus cariosus. *T.* elongato-ovatus, squamulis minutis parce adspersus; rostro longiore, in medio valde excavato, basi subtiliter transversim sulcato; funiculo articulis subpyriformibus; clava basi oblongo-obconica; prothorace longiore quam latiore, subcylindrico, antice in medio profunde longitudinaliter, ad latera transversim et pone medium irregulariter transversim sulcato, sulcis minoribus basin versus longitudinaliter impresso; elytris ovalibus, prothorace ubique paulo latioribus, nodulosis, cavitatibus foveiformibus, humeris haud prominulis; corpore infra tenuiter remote punctulato. Long. 5–6 lin.

Hab. West Australia.

Mr. MacLeay would probably arrange this species in his fourth section "Foveati;" the elytra, however, are neither granulate or tuberculate, and are without a trace of setæ.

Talaurinus capito. (Pl. II. fig. 7.) *T.* fusco-niger, opacus, sparse setosus; capite magno; rostro brevi, ad apicem capite latiore, antice vix excavato, linea impressa spatia duo ovata in medio includente; oculis parvis; antennis validis; funiculo articulis duobus basalibus longiusculis, cæteris subobconicis, ultimo longiore; clava basi oblongo-obconica; prothorace latitudine vix longiore, basi quam apice angustiore, in medio utrinque subangulato, ubique confertim granulato; elytris obovatis, seriatim foveatis, interstitiis transversim conferte granulatis, apice rotundatis; corpore infra setis numerosis appressis munito; tarsis modice dilatatis. Long. 9 lin. (rost. incl.).

Hab. Champion Bay.

Remarkable for the large size of the head, and the regularity of the sculpture; *T. angustatus*, MacLeay, jun., has a similarly marked rostrum.

Talaurinus lævicollis. (Pl. II. fig. 8.) *T.* ovatus, niger, sub nitidus, esquamosus; capite rostroque disperse subtiliter punctatis, hoc longiore, ad apicem latiore, in medio oblique bicarinato; antennis setosis; funiculo articulis quatuor ultimis valde transversis; clava breviter elliptica; prothorace transverso, utrinque rotundato, supra lævigato, subtilissime remote punctulato, lateribus obsolete granulato; elytris ovato-cordatis, basi prothorace in medio latioribus, profunde et grosse foveatis, foveis magnis, inæqualibus, apice parum productis; corpore infra nigro, impunctato, segmentis singulis in medio macula pallide ochracea ornatis. Long. 7 lin.

Hab. Victoria.

This species has no relationship to any of the three species of the *Foveati* group described by Mr. MacLeay, jun. It seems to be the only species of Amycterinæ with a smooth prothorax. The rostrum is marked in a manner not unlike *T. Mastersii*, MacLeay, jun.

Molochtus.

Rostrum crassum, antice transversim arcuato-excavatum, basi sulcatum. *Prothorax* angulis posticis obliquis, ad elytra haud arcte applicatus; *tarsi* articulis omnibus dilatatis. *Cætera* ut in *Talaurino*.

The only exponent of this genus is an insect not very unlike *Cubicorhynchus maximus*, MacLeay, jun.; but its affinity is apparently more with *Talaurinus*, the sculpture of its rostrum being a somewhat extreme modification of the typical characters, but having the tarsal joints unusually dilated. The granules on the prothorax are fitted into one another, somewhat like the scales on a fish.

Molochtus gagates. (Pl. II. fig. 9.) *M.* oblongus, subplanatus, niger, nitidissimus; fronte valde convexa, opaca, subtiliter punctata; rostro utrinque supra scrobes fortiter punctato, lamina triangulari profunde excavato; scapo modice elongato; funiculo articulis duobus basalibus obconicis, cæteris oblongo-moniliformibus; clava longe pedunculata; prothorace transverso, antice sulcato, supra confertissime granulato, postice utrinque dente parvo instructo; elytris transverse foveatis, tuberculis conicis confertim instructis, humeris rotundatis dente minore armatis; corpore infra tenuiter punctato. Long. 9–11 lin.

Hab. West Australia.

Cubicorhynchus cichlodes. *C.* ovatus, niger, interrupte silaceo-squamosus; rostro latissimo, late excavato, in medio canaliculato; fronte rostroque vittis duobus silaceis ornatis; funiculo articulis quatuor ultimis breviter obconicis; oculis longe ovatis; prothorace transverso, sat remote nitide granulato, supra albido-trivittato; elytris pone medium latioribus, transversim subcorrugatis, seriatim granulatis, dorso utrinque vitta albida decorato; corpore infra nitide nigro, segmentis singulis abdominis in medio silaceo-notatis. Long. 4–4½ lin.

Hab. West Australia.

A well-marked species, somewhat resembling *Talaurinus cricetus*, but which, except for the spine or tooth over its eye, might have been referred to *Sclerorhinus*. Another species, *Acantholophus scotobioides*, Hope's MS., is probably, according to the short description of Mr. Waterhouse, the male of *C. Bohemani* *

* In this species and one or two others not described, the anterior coxæ are not contiguous; but as they are so in *C. calcaratus*, MacLeay, jun., which cannot

(*C. angularis*, MacLeay, jun.). The *C. scotobioides* of some collections (not of Hope) may be distinguished by the following characters :—

Cubicorhynchus sterilis. *C. moroso* assimilis, sed antennis gracilioribus, funiculo articulis subpyriformibus; prothorace subtiliter remote granuloso; elytris interstitiis fere obsolete granulatis, tarsis minus dilatatis. Long. 5–6 lin.

Hab. Victoria.

Chriotyphus.

Rostrum angustius, basi profunde transversim sulcatum, in medio anguste canaliculatum. *Oculi* majusculi, ovati, tenuiter granulati, prothoraci contigui. *Cætera* ut in *Talaurino*.

In *Talaurinus* the eye is small, round, and away from the prothorax; and the sculpture of the rostrum, which is rather deep, especially in proportion to its breadth, cannot be considered a modification of that of *Talaurinus*. The species described below is remarkable for its pale ochreous-grey colour, with a few patches of brown, and for its prominent conical shoulders.

Chriotyphus acromialis. (Pl. II. fig. 10.) *C.* oblongo-ovatus, niger, sat dense pallide grisescenti-squamosus fusco-plagiatus; capite rostroque supra grisescentibus, lateribus nigris; antennis squamosis, modice elongatis; funiculo articulis duobus basalibus obconicis, cæteris subobconicis; clava anguste elongata; prothorace apice quam basi fere duplo angustiore, utrinque fortiter rotundato, pone apicem transversim impresso, dorso granulis diversis nitide nigris bivittatim obsito, lateribus etiam granulatis, interspatiis subaureo-squamosis; elytris seriatim foveatis, interstitiis, regione suturali excepta, irregulariter conico-tuberculatis, apicibus paulo productis; corpore infra nitide nigro, sternis medioque abdominis griseo-squamosis. Long. 6 lin.

Hab. Western Australia (Champion Bay).

Alexirhea.

(Amycterinæ.)

Caput transversum, antice convexum; *rostrum* crassiusculum, sed

be separated from them, the character in this case is not of generic value. I give *C. angularis* as the male of *C. Bohemani* on the authority of Mr. Du Boulay, who takes it abundantly at Champion Bay. No species was described when Lacordaire differentiated the genus; it remains, therefore, without a type.

capite multo angustius, basi sulcatum, bituberculatum. *Scrobes* arcuatæ, ad oculos haud protensæ. *Oculi* ovati, tenuiter granulati. *Scapus* breviusculus (in *A. notata* longior); *funiculus* articulis duobus basalibus breviter obconicis, cæteris transversis; *clava* breviter ovata. *Prothorax* subtransversus, apice multo angustior, basi utrinque obliquus, ad elytra haud arcte applicatus, lobis ocularibus paulo prominulis. *Elytra* elongato-cordata, apicibus productis. *Pedes* breviusculi; *tarsi* articulis tribus basalibus angulis anticis productis, subtus hispidis.

In the bituberculate base of the rostrum this genus resembles *Oditesus*; but the scape, although rather short, is that of the more typical Amycterinæ. A line of granules at the sides of the prothorax gives it the appearance of being serrated. The scutellum is not always apparent, owing to the elevation of the elytra at its sides. The coloration of *A. notata* is somewhat complicated, and is apparently rather variable.

Alexirhea notata. (Pl. II. fig. 4.) *A.* oblongo-ovata, nigra, squamis piliformibus cervinis fusco-variegata, setisque nigris adspersa; rostro rude punctato, in medio anguste canaliculato, basi tuberculis duobus conicis divaricatis munito; capite subtiliter umbrino-squamoso; prothorace inæquali, latitudine paulo breviore, subseriatim granulato, utrinque, apice excepto, parallelo, pone apicem et basi longitudinaliter impresso, dorso fusco, medio et vitta laterali albo; elytris sulcato-punctatis, interstitiis alternis convexis, vel costatis, singulis postice nodulis duobus, interiore majore, munitis, basi truncatis, dorso maculis irregularibus fuscis bene limitatis ornato; corpore infra fusco, pilis elongatis remotis vestito; pedibus albo-squamosis, setis nigris adspersis. Long. $5\frac{1}{2}$ lin.

Hab. Western Australia.

Alexirhea aurita. *A.* oblongo-ovata, nigra, opaca, subtiliter vage griseo-squamulosa; rostro breviusculo, basi profunde excavato-sulcato; scapo brevi; prothorace longitudine latitudini æquali, utrinque rotundato, tuberculis validis confertim munito, in medio longitudinaliter canaliculato, pone apicem transversim sulcato; elytris subseriatim fortiter foveatis, interstitiis elevatis, tuberculatis, tuberculis minusculis, postice singulatim nodulis duobus, interiore majore, munitis, sutura squamulis subsilaceis adspersis, basi arcuatis, humeris projectis, apice rotundatis, sutura tuberculato-productis; corpore infra in medio longitudinaliter dense fusco-setuloso; abdomine utrinque ferrugineo-maculato; pedibus albo-squamosis, setulis adspersis. Long. 5 lin.

Hab. West Australia.

Besides the colour, which, however, varies much in intensity, the form of the prothorax, and of the elytra at the base, will at once differentiate this species from the last.

ALEXIRHEA FALSIFICA. *A.* oblongo-ovata, nigra, opaca, humeris (in unico spec.) griseo-squamosis; scapo breviusculo; prothorace ut in præcedente, sed minus rotundato, canalicula vittaque utrinque griseo-squamosis; elytris subseriatim fortiter foveatis, interstitiis elevatis, irregulariter tuberculatis, cornibus duobus ad suturam supra apicem obsitis, et apice ipso similibus, humeris vix productis, corpore infra nigro-setosulo; pedibus albo-squamosis, setulis adspersis. Long. 5 lin.

Hab. Western Australia (Champion Bay).

The two horn-like projections (contiguous, and therefore apparently one) on the suture above the apex of the elytra are peculiar to this species.

The following table will give an idea of the principal characters of the genera of the long-scaped Amycterinæ; *Alexirhea*, however, might perhaps have been better placed with the short-scaped genera ("Euomides" of Lacordaire).

Rostrum (or head) crested (either with tubercles or spines).
  With ocular lobes............ *Acantholophus*, Schön.
  Without ocular lobes.
    Rostrum broad.
      Forehead flat, a transverse suture separating it from the rostrum .... *Cubicorhynchus*, Lac.
      Forehead convex and rugose. *Hyborhynchus*, MacLeay, jun.
    Rostrum narrow.
      Eyes coarsely faceted .... *Anascoptes*, n. g.
      Eyes finely faceted ...... *Polycreta*, n. g.
Rostrum not crested.
  Male with anal forceps ...... *Psalidura*, MacLeay.
  Male without anal forceps.
    Scape extending beyond the eye.
      Base of the prothorax closely applied to the elytra.
        Head and rostrum concave. *Amycterus*, Schön.
        Head convex.
          Rostrum broad, with two oblique ridges. *Talaurinus*, MacLeay, jun.

Rostrum broad, with a straight edge on each side.
Sclerorhinus, MacLeay, jun.
Rostrum narrow .... *Chriotyphus*, n. g.
Base of the prothorax not closely applied to the elytra.
Molochtus, n. g.
Scape not extending to the posterior border of the eye.
Alexirhea, n. g.

MYOTROTUS.

Caput antice convexum, integrum; *rostrum* crassum, versus apicem triangulariter excavatum; *scrobes* arcuatæ, ab oculos distantes, postice bene limitatæ. *Scapus* brevis, gradatim incrassatus; *funiculus* validus. *Oculi* tenuiter granulati. *Prothorax* transversus, lobis ocularibus prominulis, oculos fere obtegentibus. *Elytra* ovata, basi incurvata. *Tarsi* breves, sublineares, articulis tribus basalibus angulis terminalibus spinosis, ciliatis. *Abdomen* segmentis tribus intermediis subæqualibus.

It is not without hesitation that I place this genus among the short-scaped forms of Amycterinæ; but its large ocular lobes nearly covering the eyes in repose, and a certain resemblance in its contour, induce me to think that it is nearer to *Amorphorhinus* than to any other genus, although some of the *Talaurini* are not very dissimilar. The abdomen in the following species is of a remarkably square form, the last segment being as large as the three preceding together; it is also thickly clothed with golden-brown spine-like hairs.

MYOTROTUS OBTUSUS. (Pl. II. fig. 5.) *M.* subovatus, paulo planatus, squamositate obscure umbrina tectus, setis nigris erecte adspersus; capite rostroque dense squamosis, hoc basi utrinque modice excavato; antennis dense squamosis; funiculo articulis duobus basalibus breviusculis, cæteris valde transversis; clava breviter elliptica; prothorace ad latera paulo ampliato, granulis depressis irregulariter adsperso; elytris postice gradatim latioribus, ad apicem declivibus, apice ipso late rotundato, dorso, regione suturali excepta, inæqualiter subtiliter granulatis; corpore infra pedibusque, unguiculis solis exceptis, dense griseo-squamosis. Long. 5 lin.

Hab. Queensland (Rockhampton).

CATACHÆNUS SCINTILLANS. *C.* ovatus, supra, capite, rostro pedibusque squamis margaritaceo-viridibus, in certa luce splendide aureo-viridibus, infra læte cæruleis sejunctim vestitus; antennis nigris; prothorace oblongo; elytris prothorace multo latioribus, substriato-punctatis, interstitiis planatis. Long. 4 lin.

Hab. Philippine Islands.

Besides the difference of colour, this species has a narrower prothorax, and the front between the eyes not depressed as in *C. circulus.*

Eugnathus bracteatus. *E.* angustus, ovatus, niger, supra capite rostroque squamis concoloribus, aureo-viridibus intermixtis, vestitus; capite inter oculos rostroque sat fortiter excavatis; antennis nigris; scapo paulo arcuato; funiculo articulo primo valido; prothorace subtransverso, utrinque manifeste rotundato; scutello parvo; elytris substriato-punctatis; corpore infra pedibusque squamis cæruleo-viridibus tectis. Long. $2\frac{1}{2}$ lin.

Hab. Tsusima.

A narrow species, with sparkling golden-green scales, dotted about among others of a deep black. Tsusima is an island in the Corean Channel, where this species was found by Mr. Arthur Adams, R.N.

Eugnathus chloroticus. *E.* ovatus, niger, squamis pallide aureo-viridibus sejunctim, infra pedibusque magis dense, vestitus; antennis nigris; scapo recto; funiculo articulo primo ampliato; prothorace transverso, utrinque parum rotundato; scutello vix conspicuo; elytris latiusculis, striato-punctatis, apicibus acuminatis, paulo divaricatis. Long. 3 lin.

Hab. Formosa; North China.

There is an admixture of brownish scales on the elytra, varying in extent in my two specimens, but very slight indeed in one of them.

Orthorhinus palmaris. (Pl. I. fig. 7.) *O.* cylindricus, niger, squamis concoloribus plerumque vestitus; rostro, apice excepto, rugoso-punctato; funiculo articulis secundo tertio quartoque conjunctim (♂) primo haud longioribus, (♀) brevioribus; prothorace sat confertim grosse granulato, interspatiis subtiliter vage squamoso, disco utrinque albo-subvittato; elytris sulcato-punctatis, interstitiis, præsertim alternis, fortiter elevatis et uniseriatim granulatis, squamis subsilaceis, vel subalbidis, fascias duas arcuatas formantibus, unam ante, alteram pone medium sitam; corpore infra sat vage brunnescenti-squamoso; tarsis omnino subalbidis, anticis in maribus vald e dilatatis et nigro-fimbriatis. Long. 8 lin.

Hab. Ceram.

Orthorhinus arrogans. *O.* oblongo-ovalis, niger, squamis con coloribus plerumque vestitus; rostro rugoso-punctato; funiculo articulo secundo quam primo (♂) paulo, (♀) dimidio breviore; prothorace sat confertim grosse granulato, interspatiis subtiliter squamoso, lateribus plaga subobliqua ornato; elytris sulcato-punctatis, punctis approximatis, interstitiis convexis, magis remote granulatis, fascia media arcuata maculisque posticis albis ornatis; tarsis anticis minus dilatatis. Long. 6–8 lin.

Hab. Ceram; Amboyna; Bouru.

At the first glance these two species have much the same appearance; but their contour will at once distinguish them. The markings are somewhat variable; in one of my specimens of the species before us the posterior spots are absent.

Cenchrena.

(Erirhininæ.)

Rostrum cylindricum, arcuatum; *scrobes* antemedianæ, rectæ. *Scapus* oculum haud attingens; *funiculus* 7-articulatus; *clava* adnata. *Oculi* angusti, subfortiter granulati. *Prothorax* paulo transversus, apice tubulatus, basi bisinuatus; *lobis* ocularibus haud prominulis, vel obsoletis. *Scutellum* nullum. *Elytra* oblonga, prothorace latiora, basi reflexo-marginata. *Pedes* validi; *femora* incrassata, mutica; *tibiæ* intus bisinuatæ, apice calcaratæ; *tarsi* triarticulati, articulo ultimo ampliato-rotundato; *coxæ* anticæ contiguæ. *Abdomen* segmentis duobus basalibus ampliatis. *Corpus* oblongum.

Among the few genera of Erirhininæ with three-jointed tarsi, this genus may be known by its straight scrobes, a funicle of seven joints, and the absence of a scutellum. The three species described below are densely scaly, except their antennæ and tip of the rostrum, and have erect curiously hooked bristles sparingly scattered on the upper surface.

Cenchrena fasciata. (Pl. III. fig. 9.) *C.* supra griseo-squamosa, fuscescenti-nebulosa; rostro prothoraci longitudine æquali; antennis subtestaceis; prothorace crebre punctato; elytris fortiter sulcato-punctatis, interstitiis, præsertim alternis, elevatis, paulo pone medium fascia lata brunnea ornatis; abdomine infra in medio argenteo-squamoso. Long. $1\frac{1}{2}$ lin.

Hab. Aru; Waigiou.

Cenchrena pœcila. *C.* supra cervino-brunneo-squamosa, elytris niveo-maculatis; rostro prothorace paulo longiore, squamis concoloribus leviter induto; antennis subtestaceis; prothorace crebre punctato; elytris sulcato-foveatis, interstitiis elevatis, macula humerali alterisque paucis adspersis; corpore infra griseo-squamoso. Long. $1\frac{1}{4}$–$1\frac{1}{2}$ lin.

Hab. Batchian.

Cenchrena suturalis. *C.* supra fuscescenti-squamosa, elytris dimidio basali sutura albis; rostro prothorace manifeste longiore, ferrugineo, apice excepto, dense squamoso; antennis subtestaceis; prothorace crebre punctato; elytris sulcato-foveatis, interstitiis elevatis, regione humerali et pone medium pallidioribus. Long. $1\frac{1}{2}$ lin.

Hab. Sula.

Thechia.

(Erirhininæ.)

Rostrum cylindricum, arcuatum; *scrobes* medianæ, rectæ. *Scapus* oculum vix attingens; *funiculus* 7-articulatus; *clava* adnata. *Oculi* rotundati, grosse granulati. *Prothorax* transversus, apice parum productus, lobis ocularibus nullis. *Scutellum* distinctum. *Elytra* suboblonga, prothorace paulo latiora. *Pedes* breviusculi; *femora* incrassata, mutica; *tibiæ* intus bisinuatæ, apice haud calcaratæ; *tarsi* triarticulati; *coxæ* anticæ contiguæ. *Abdomen* segmento secundo ampliato.

Allied to the last genus, but very distinct from it on account of its scutellum, and the tibiæ without the uncus or spur at the apex. Judging from my specimen, it is probable that the insect in a fresh state is tolerably closely covered with scales.

Thechia pygmæa. *T.* subcylindrica, brunneo-rufa, squamis pallide griseis vestita; rostro prothorace paulo longiore, basi fronteque capitis sejunctim squamosis; antennis pallidioribus; funiculo articulo primo elongato, reliquis brevibus; clava ampla, ovata; prothorace latitudine longitudini æquali, apice constricto, antice paulo angustiore, utrinque modice rotundato; elytris prothorace paulo latioribus, parallelis, apicem versus gradatim rotundatis, striato-punctatis, interstitiis modice convexis; tibiis anticis intus late mucronatis. Long. 1 lin.

Hab. Champion Bay.

Tithene.

(Erirhininæ.)

Caput parvum, exsertum; *rostrum* elongatum, tenue, arcuatum, basi angustius; *scrobes* præmedianæ, rectæ. *Scapus* oculum attingens; *funiculus* septemarticulatus, articulis duobus basalibus elongatis, cæteris breviter obconicis; *clava* distincta. *Oculi* mediocres, tenuiter granulati. *Prothorax* apice angustus, lateribus ampliato-rotundatus, basi truncatus. *Elytra* subcordiformia, prothorace vix latiora. *Pedes* antici majores; *femora* incrassata, infra dentata; *tibiæ* subrectæ, apice haud uncinatæ; *tarsi* articulo tertio lobis angustis, divaricatis, quarto elongato; *unguiculi* divergentes; *pectus* elongatum, ampliatum; *coxæ* anticæ globosæ, sejunctæ. *Abdomen* segmento secundo ampliato.

A curious genus, for which at present I am unable to suggest any affinity; provisionally it may be placed after *Meriphus*.

TITHENE MICROCEPHALA. (Pl. III. fig. 13.) *T.* nigra, subnitida, capite pone oculos macula fulva ornato, rostro capite quintuplo longiore, supra tricarinato, carinis apicem versus serratis; antennis ochraceis, scapo clavaque infuscatis; funiculo articulo primo secundo longiore; prothorace longitudine latitudini æquali, tenuiter confertim punctulato; elytris striato-punctatis, punctis approximatis, interstitiis confertim punctulatis; tibiis anticis intus longe pilosis. Long. $2\frac{1}{2}$ lin.

Hab. Sarawak.

METRIOXENA SUBVITTATA. *M.* pallide brunnea, elytris vitta testacea arcuata ab humero fere usque ad apicem signatis; rostro minus tenuato, opaco, manifeste punctato, basi supra oculum utrinque producto; antennis fulvis; prothorace minus leviter punctato, quinquecarinato, marginibus irregulariter erosis; elytris striato-punctatis, interstitiis quinto et octavo elevatis; corpore infra ferrugineo-testaceo, subtiliter punctulato. Long. $1\frac{1}{3}$ lin.

Hab. Macassar.

The upper part of the rostrum at the base is bifurcated, and forms a well-marked ridge above each eye. In my specimens of this species and its only congener, *M. sericollis* (*antè*, vol. x. p. 442), the abdomen has six segments; but this may possibly be sexual. It was a mistake to compare the genus to *Apion*; the contour at least is not unlike *Oxycorynus*.

BELUS WALLACEI. *B.* elongatus, chalybeatus; antennis piceis; rostro nigro; capite tenuiter punctulato; prothorace subconico, subtiliter vage punctulato, in medio haud canaliculato, lobo scutellari bifido; scutello valde transverso; elytris postice gradatim latioribus, subseriatim punctatis, punctis in regione suturali majoribus, apice paulo productis nigro-funiculatis, singulis postice maculis duabus, e squamulis niveis condensatis, ornatis; corpore infra nitidissime viridi-metallico, lateribus albo-maculatis; femoribus tibiisque, anticis exceptis, nitide rufo-ferrugineis. Long. 6 lin.

Hab. Aru.

Belus is one of the few genera of Coleoptera common and confined to the Papuan group and Australia. From the former we are indebted to Mr. Wallace for the two species here described, the only ones known at present; whilst Australia has about thirty-six.

Belus inornatus. *B.* angustior, obscure nigro-fuscus, elytris purpurascentibus, pilis griseis vage vestitus; capite parce rostro obsolete punctulato; antennis ferrugineis; prothorace transverso, in medio subcanaliculato, supra rugoso-punctulato; scutello valde transverso; elytris postice minus gradatim latioribus, rude confertim punctulatis, apicibus mucronatis; corpore infra nitide nigro; femoribus ferrugineis, vel rufo-ferrugineis. Long. 4–5 lin.

Hab. Mysol; Morty.

This and the preceding are very distinct species; in my specimens both have the anterior femora bidentate beneath; but this is not a specific character; I am not even sure that it is a sexual one, although hitherto it has been used for the differentiation of species.

Euops cœlestina. *E.* brevis, nitidissime cærulea, violaceo resplendens; antennis rufo-fuscis, clava elongata, nigra; rostro breviusculo; capite prothoraceque impunctatis, hoc in medio transversim impresso; scutello subquadrato, viridi-nitente; elytris subsulcato-punctatis, punctis mediocribus, sutura nigra; pygidio pedibusque nigro-cyaneis, illo sat sparse punctato. Long. $1\frac{3}{4}$ lin.

Hab. New Guinea (Dorey).

The anterior tibiæ longer, curved, and sometimes running into a falcate process at the apex; in the females the anterior tibiæ are stouter, bulging out a little between the base and the middle, and having one or two spurs at the apex; but there are some exceptions. M. Jekel, in 'Insecta Saundersiana,' divides the genus into three groups, depending principally on the form of the body.

Euops violacea. *E.* brevis, nitidissime cæruleo-violacea; antennis rufo-fuscis, minus elongatis; rostro breviusculo; capite et prothorace subtilissime transversim corrugatis, punctis minutis adspersis; scutello subquadrato; elytris sulcato-punctatis, punctis majusculis, subapproximatis, sutura nigra; pygidio cyaneo, punctis distinctis parvis adsperso; pedibus cyaneo-fuscis. Long. $1\frac{3}{4}$ lin.

Hab. Ceram.

Euops plicata. *E.* brevis, nitidissime cæruleo-viridis, violaceo resplendens; antennis fuscis; capite sat rude punctato; rostro breviusculo; prothorace transversim fortiter reticulatim crebre corrugato; scutello brevi, subquadrato; elytris fortiter sulcato-punctatis, interstitiis subcostatis, sparse impresso-punctatis, sutura nigra; pygidio viridi sat sparse punctato; corpore infra femoribusque nitide viridibus; tibiis tarsisque viridi-fuscis. Long. $1\frac{3}{4}$ lin.

Hab. Macassar.

Euops trigemmata. *E.* brevis, nitide nigrescens, elytris violaceis; antennis fulvis, clava griseo-tomentosa; capite rostroque chalybeatis, illo breviusculo; prothorace lævigato, impunctato; scutello subquadrato, aureo-viridi; elytris subsulcato-punctatis, punctis haud approximatis, interstitiis latis, subplanatis, sutura nigra, humeris aureo-viridibus; pygidio atro, sat sparse punctato; corpore infra atro; pedibus rufo-castaneis, femoribus viridi-lavatis. Long. $1\frac{1}{2}$ lin.

Hab. Batchian; Dorey.

Euops ærosa. *E.* brevis, viridi-fusca, nitida, elytris chalybeatis; capite rostroque aureo-viridibus, illo rarius punctato; antennis piceis; prothorace corrugato, basi minus impresso, lateribus foveato et aureo- vel æreo-micante; scutello transversim subquadrato; elytris sat fortiter sulcato-punctatis, punctis approximatis, interstitiis subcostatis, sparse subtiliter punctulatis, basi humerisque aureo-viridibus, sutura nigra; pygidio, corpore infra femoribusque aureo-viridibus; tibiis tarsisque nitide castaneis. Long. $1\frac{1}{2}$ lin.

Hab. Batchian; Sarawak; Sula.

The sculpture is like *E. plicata*, but it is more marked, especially on the prothorax.

Euops clavigera. *E.* brevis, nitide nigra; capite pone oculos fortiter punctato; rostro breviusculo; antennis fuscis; clava valde ampliata, articulis sex præcedentibus conjunctim longiore; oculis vix contiguis; prothorace subtiliter raro punctato, in medio vitta nitidissime aurea ornato; scutello subquadrato, aureo-viridi; elytris subsulcato-punctatis, punctis minusculis, distantibus, interstitiis latis, vix convexis, humeris læte aureo-viridibus; pygidio sat sparse punctato; corpore infra pedibusque fusco-nigris. Long. $1\frac{1}{2}$ lin.

Hab. Queensland.

This species is like the two preceding in having three bright green spots on the shoulders and scutellum respectively; the remarkable size of the club is at once diagnostic.

Euops eucalypti. *E.* subbrevis, nitide nigra, capite prothoraceque nigro-æneis, sat sparse punctatis; rostro breviusculo; antennis castaneis, clava ampla, quasi 4-articulata; oculis haud contiguis; prothorace utrinque ampliato-rotundato; scutello subquadrato, impunctato; elytris sulcato-punctatis, punctis majusculis approximatis, interstitiis convexis; pygidio confertim punctato; pedibus anticis elongatis; femoribus anticis ampliatis; tibiis anticis modice elongatis.

Hab. Queensland (Gayndah).

The anterior legs are as long and their femora as large as in *E. divisa*, represented on Plate III. fig. 6. It is found, Mr. Masters writes, on young gum trees (*Eucalyptus*), probably on the foliage.

Euops amethystina. *E.* angusta, supra nitide violacea, subtus, rostro femoribusque aureo-viridibus, antennis, tibiis tarsisque fusco-purpureis vel viridibus; rostro brevi; clava antennarum ampliata; capite prothoraceque tenuiter sparse punctatis, scutello subquadrato, nigro; elytris subsulcato-punctatis, punctis magnis, approximatis, interstitiis uniseriatim subtilissime sparse punctulatis, sutura, basi excepta, nigra; pygidio violaceo; tibiis anticis elongatis. Long. 2 lin.

Hab. Singapore.

Euops divisa. (Pl. III. fig. 6.) *E.* subangusta, omnino nitide flavescens, parte dimidia elytrorum nigrescente excepta; rostro longiore, apice infuscato; antennis longiusculis; clava saturatiore, articulo ultimo elongato; capite prothoraceque impunctatis; scutello subquadrato; elytris sulcato-punctatis, punctis foveiformibus, approximatis, interstitiis convexis; pygidio leviter punctulato; pedibus anticis elongatis; femoribus anticis (♂) valde ampliatis, tuberculis duobus vel tribus aliquando instructis. Long. 2 lin.

Hab. Dorey; Saylee; Batchian; Mysol.

Euops Jekelii. *E.* cyanea, nitida, elytris purpurascentibus; capite pone oculos elongato, conico, rarissime subtiliter punctulato; rostro (♂) plus minusve elongato, arcuato, ultra medium gradatim latiore, aliquando prothorace manifeste longiore; antennis longiusculis; prothorace subtiliter punctulato, utrinque pone oculos (♂) spina recta vel arcuata armato; elytris subsulcato-punctatis, punctis parvis, distantibus, interstitiis latis, parum convexis, humeris aureo-viridibus, dente minuto pone angulum instructis; pygidio nigro, sparse punctato; corpore infra chalybeo-nigro; pedibus purpureis vel chalybeatis; coxis anticis aureo-viridibus. Long. $3\frac{1}{4}$ lin.

Hab. Aru; Dorey; Salwatty; Waigiou; Amboyna.

A remarkable species which perhaps might be considered the type of a distinct genus. I have the pleasure of dedicating it to M. Jekel.

Imachra.

(Anthonominæ.)

Rostrum validum, vix arcuatum, basi compressum; *scrobes* medianæ, obliquæ vel subtransversæ. *Oculi* perampli, rotundati, supra contigui, tota latera capitis occupantes. *Scapus* oculum impingens; *funiculus* 7-articulatus, articulo primo amplo, reliquis parvis, gradatim brevioribus; *clava* elongata. *Prothorax* conicus, apice truncatus. *Scutellum* distinctum. *Elytra* ampla, humeris obliquis. *Pectus* leviter excavatum. *Pedes* postici majores; *femora* crassa, mutica; *tibiæ* fere rectæ; *tarsi* normales; *unguiculi* appendiculati. *Abdomen* segmentis tribus intermediis æqualibus, lateribus valde arcuatis.

Probably a saltatorial genus like *Orchestes*, to which it is obviously allied; the stout rostrum, however, with the nearly transverse scrobes and large eyes, occupying most of the head, are trenchantly diagnostic characters.

Imachra ruficollis. *I.* late ovata, supra sparse griseo-pilosa; rostro rufescente, basi excepta infuscata; antennis fulvis, clava funiculo longitudine æquali; prothorace rufo, sat crebre punctulato; scutello elytrisque nigris, his prothorace fere duplo latioribus, striato-punctatis, interstitiis subplanatis; corpore infra nigrescente, segmentis tribus ultimis abdominis exceptis, his pedibusque rufescentibus. Long. $1\frac{1}{4}$ lin.

Hab. Sarawak.

Themeropis.

(Prionomerinæ.)

Caput elongatum; *rostrum* subcylindricum; *scrobes* obliquæ. *Oculi* perampli, fortiter granulati, supra contigui. *Scapus* gracilis, flexuosus; *funiculus* 7-articulatus, articulo primo elongato, cæteris brevissimis; *clava* magna, laxe articulata. *Prothorax* conicus. *Elytra* ampla, subquadrangularia, epipleuris distinctis. *Femora* antica elongata, validissima, dente magno, antice crenulato, infra armata; *tibiæ* anticæ fortiter arcuatæ, versus apicem crassiores; *femora* postica minuscula, infra dentata; *tibiæ* omnes calcaratæ. *Abdomen* segmentis tribus intermediis longitudine æqualibus.

The abruptly descending side of the elytra or epipleura is marked off from the dorsum by a sharp ridge clothed with coarse brownish hairs, which are carried on to the sides of the prothorax, forming a continuous fringe; nothing so marked occurs in any other Prionomerin known to me. It is one of Mr. Bates's discoveries.

Themeropis fimbriata. (Pl. III. fig. 7.) *T.* umbrina, sparse griseo-pilosa; rostro subnitido, minus piloso; antennis flavidis; funiculo articulo ultimo clavaque, articulo ultimo excepto, infuscatis; prothorace crebre punctato; scutello subrotundato; elytris postice latioribus, lineatim sulcato-punctatis, singulis in medio tuberculo validissimo conico, lateraliter compresso, instructis; tibiis tarsisque posticis et intermediis testaceis. Long. 2 lin.

Hab. Amazons.

Ochyromera.

(Prionomerinæ.)

Rostrum elongatum, arcuatum, apicem versus dilatatum; *scrobes* præmedianæ, infra marginem inferiorem oculorum currentes. *Antennæ* graciles; *funiculus* 7-articulatus, articulo primo ampliato, secundo longiusculo; *clava* distincta, magna. *Oculi* subrotundati, fortiter granulati vel subtenuiter granulati (*O. rufescens*). *Prothorax* transversus, basi parum bisinuatus. *Scutellum* mediocris. *Elytra* prothorace manifeste latiora, subcordiformia vel subovata. *Coxæ* anticæ contiguæ, intermediæ approximatæ. *Femora* antica valida, dente integro magno infra armata; *tibiæ* anticæ fortiter arcuatæ; *femora* intermedia et postica minora, infra fortiter dentata; *tibiæ* omnes calcaratæ. *Abdomen* segmentis tribus intermediis subæqualibus.

It may perhaps be thought necessary hereafter to separate generically the two rather isolated species described below. The members of the Prionomerinæ are probably numerous, but individually very scarce both in South America and the Malasian region, where alone they have been hitherto found.

Ochyromera dissimilis. (Pl. III. fig. 3. 5) *O.* fusco-nigra, rostro basi subtiliter lineatim punctato; oculis rotundatis, fortiter granulatis, antennis infuscatis; clava sublaxe articulata; prothorace confertim impresso-punctato; elytris elongato-cordiformibus, striato-punctatis, interstitiis planatis, impunctatis; corpore infra fusco-castaneo, griseo-piloso; tarsis subpiceis. Long. $2\frac{1}{4}$ lin.

Hab. Sarawak.

The upper surface of this species has a somewhat varnished appearance, due to very minute silvery hair-like scales only visible under the microscope.

Ochyromera rufescens. *O.* supra pedibusque rufo-fulva, tenuiter griseo-pilosa, setulis intermixtis; rostro subferrugineo, basi striato; antennis testaceis; oculis rotundatis, subfortiter granulatis; prothorace apice subtubulato, utrinque rotundato, punctis sparsis pilis fere obtectis; elytris breviter subovatis, sulcato-punctatis, apice late rotundatis; corpore infra rufo-castaneo, tenuiter griseo-piloso; tibiis anticis apicem versus incrassatis. Long. 2 lin.

Hab. Singapore.

Synnada.

(Prionomerinæ.)

Rostrum tenuatum, arcuatum, basi haud incrassatum, apice dilatatum; *scrobes* submedianæ, infra oculos currentes. *Oculi* prominuli, rotundati, fortiter granulati. *Scapus* gracilis, oculum attingens; *funiculus* 6-articulatus, articulo primo ampliato, tribus sequentibus gradatim brevioribus, duobus ultimis rotundatis; *clava* distincta, ovata. *Prothorax* transversus, basi angustatus, truncatus. *Elytra* prothorace manifeste latiora, subovata, humeris callosa. *Tibiæ* apice muticæ. *Cætera* ut in *Ochyromera.*

Notwithstanding the six-jointed antennæ, this genus is more nearly allied to *Ochyromera* (*rufescens*) than to either of the three other incongruous genera having the same number of joints. The scales on the species described below are so small and at such distances apart as to exercise little effect on the colour.

Synnada curruculа. *S.* fulvo-testacea, squamulis minutis subargenteis sejunctim vestita; rostro prothorace fere triplo longiore, apice paulo dilatato, basi lineatim striato; antennis pallide fulvis, clava infuscata; prothorace valde transverso, utrinque rotundato, punctis sparsis squamulis piliformibus obtecto; elytris breviter subovatis, apice rotundatis, sulcato-punctatis, punctis approximatis, interstitiis convexis, sparse setulosis; tibiis anticis intus setis sex nigris fimbriatis. Long. $1\frac{1}{3}$ line.

Hab. Macassar.

The Table below comprises all the genera of the Prionomerinæ at present known having the anterior femora furnished with a large triangular tooth. *Piazorhinus*, the only genus which offers an exception to this character, was merely compared, and only as to habit, by Schönherr with *Rhynchites*. It is founded on a North-American species unknown to me (*P. scutellaris*, Say).

Funicle 7-jointed.
  Tooth of the anterior femora crenate externally.
    Club of the antennæ loosely jointed.
      Eyes round, close to the prothorax . . *Ectyrsus*, Pasc.
      Eyes oblong, remote from the prothorax. *Themeropis*, n. g.
    Club of the antennæ closely jointed.
      Elytra flattish . . . . *Camptochirus*, Lac.
      Elytra convex . . . . *Prionomerus*, Schön.
  Tooth of the anterior femora entire . . . . . . *Ochyromera*, n. g.
Funicle 6-jointed.
  Prothorax broadest at the base.
    Scape attaining the eye . . . . *Zeiona*, Pasc.
    Scape not attaining the eye . . . . *Omphasus*, Pasc.
  Prothorax contracted at the base.
    Rostrum long, slender . . . . *Synnada*, n. g.
    Rostrum short, robust . . . . *Nychiomma*, Pasc.

Zephiantha.

(Tychiinæ.)

Rostrum cylindricum, arcuatum; *scrobes* postmedianæ. *Oculi* rotundati, fortiter granulati, supra approximati. *Scapus* apice curvatus; *funiculus* 6-articulatus, articulo primo ampliato, cæteris a secundo gradatim latioribus; *clava* ovata. *Prothorax* transversus, apice truncatus, basi subbisinuatus. *Scutellum* triangulare. *Elytra* ampla, prothorace multo latiora, pygidium obtegentia. *Femora* crassa, infra dentata; *tibiæ* fere rectæ, apice calcaratæ; *unguiculi* appendiculati. *Abdomen* segmentis tribus intermediis subæqualibus.

I place this genus near *Elleschus* and *Lignyodes*, although the abdominal segments are not very obviously curved at the sides. *Endeus*, a West-African genus which I have not seen, has also a six-jointed funiculus, but the elytra are parallel at the sides and scarcely broader than the prothorax.

Zephiantha pubipennis. *Z.* fulvo-rufa, scutello elytrisque nigrescentibus, pube grisea, setulisque interjectis, sat dense vestitis; rostro capiteque vix pubescentibus, illo prothorace sesquilongiore; antennis rufescentibus; prothorace minusculo, subtiliter pubescente, punctis raris fere obsoletis impresso; elytris modice convexis, lateribus rotundatis, basi prothoracis duplo latioribus, lineatim sulcato-punctatis, punctis approximatis, interstitiis planatis, uniseriatim punctulatis: corpore infra rufo-testaceo, subtiliter pubescente. Long. $1\frac{1}{3}$ lin.

Hab. Sumatra.

Perrhæbius.

(Cryptorhynchinæ.)

Rostrum mediocre, apice paulo dilatatum; *scrobes* obliquæ. *Oculi* ovati, grosse granulati. *Scapus* breviusculus; *funiculus* articulis duobus basalibus brevibus, primo parum ampliato; *clava* subglobosa. *Prothorax* subtransversus, antice angustus, basi bisinuatus, lobis ocularibus prominulis. *Elytra* oblonga, supra subdepressa, prothorace latiora. *Pedes* breviusculi; *femora* valida, sublinearia, infra dente parvo instructa; *tibiæ* compressæ, basin versus angulatæ; *tarsi* normales. *Rima* pectoralis incompleta; pectus antice profunde emarginatum. *Abdomen* segmentis duobus basalibus ampliatis.

This genus differs from *Colobodes* in its stouter rostrum, the shortness of the basal joints of the funiculus, the sublinear femora, the angular tibiæ, &c. When the femora are linear or sublinear, the tooth beneath, if present, will be small and abruptly connected to the femur; if the femora are thickened, fusiform, or clavate, the tooth will more or less gradually merge into the femur: the difference will be understood on referring to Pl. I. fig. 5, *a*, and fig. 9, *a* (*Odosyllis congesta* and *Berosiris picticollis*).

Perrhæbius ephippiger. (Pl. I. fig. 6.) *P.* oblongus, niger, squamis grisescentibus umbrinisque dense tectus, nonnullis elongatis erectis adspersus; capite inter oculos profunde foveato; rostro prothorace breviore, apice excepto, dense squamoso; prothorace ante medium transversim quadrituberculato-fasciculato, in medio longitudinaliter subsulcato, dorso pallide trivittato; scutello elevato; elytris sulcatis, interstitiis alternis magis elevatis et subnodoso-fasciculatis, fasciculis nonnullis nigris, in medio macula magna communi umbrina ornatis; corpore infra pedibusque roseo-griseis, his squamis erectis adspersis. Long. $4\frac{1}{2}$ lin.

Hab. Dorey; Aru; Macassar; Morty.

Pachyonyx araneosus. *P.* oblongus, piceus, ubique pube depressa grisea vestitus; antennis læte ferrugineis; clava tomentosa, quam funiculo manifeste longiore; prothorace conico, antice quadrituberculato, tuberculis dense pilosis; elytris sulcato-punctatis, apicibus late angulatis, supra tuberculis parvis, singulis circa septem, dense pubescentibus obsitis. Long. 4 lin.

Hab. Cochin-China.

Differs from the Natal species, its only congener, in the large size of the club of the antennæ, and the equal distribution of the pubescence; this to the naked eye has a cobweb-like texture and colour.

OCLADIUS BARANI. *O.* ovatus, niger, subnitidus, elytris maculis nonnullis (singulis circa quinque) ochraceis, e squamis piliformibus condensatis formatis; rostro utrinque rude bilineatim punctato; antennis ochraceis; prothorace fortiter, præsertim lateraliter, sulcato-foveato; elytris seriatim punctatis, punctis oblongis, distantibus, singulis setulam gerentibus; corpore infra squamositate ferruginea vestito; femoribus tibiisque fortiter sulcatis. Long. 2 lin.

Hab. Syria.

This very distinct species of a South-African genus, which has had, hitherto, only one representative in the European fauna (including the countries bordering the Mediterranean), is named in memory of Gabriel de Baran, a most acute entomologist, and my companion in many pleasant excursions in the south of France.

ZENEUDES.

(Cryptorhynchinæ.)

Rostrum validum, arcuatum, antice depressum; *scrobes* submedianæ, pone rostrum cito currentes. *Antennæ* breves; *scapus* crassiusculus, ab oculum distans; *funiculus* articulis duobus basalibus brevibus, secundo ampliato, cæteris valde transversis, ultimo clavæ latitudine æquali; *clava* obsolete articulata, subovata, pubescens. *Oculi* laterales, tenuiter granulati. *Prothorax* amplus, apice productus, basi bisinuatus, lobis ocularibus obsoletis. *Elytra* subcylindrica, prothorace haud latiora. *Pedes* breviusculi; *femora* valida, mutica; *tibiæ* sulcatæ, rectæ, intus bisinuatæ; *tarsi* normales; *unguiculi* divergentes. *Rima* pectoralis pone coxas anticas terminata; *mesosternum* cordiforme, antice semicirculariter excavato. *Abdomen* segmento secundo amplo.

A remarkable genus, closely resembling and, in fact, allied to the

Chilian *Empleurus dentipes*; but from the form of the mesosternum it should be placed next to the New-Zealand *Oreda*, Wh. This is another example showing that Lacordaire's subtribes do not always form natural groups. The mesosternum, however, is constructed differently from that of *Oreda*; in the latter it is projected forward, hiding the point of the rostrum in repose, while in *Zeneudes* it is sloped backwards, with a sort of wing on each side towards the coxæ and the apex of the canal, therefore, open and indefinitely limited. One of the most marked characters of the genus is that the scape only extends about halfway to the eye from the point of its insertion; another remarkable character is that the second joint of the funicle is larger than the first. The insect is one of Mr. Masters's recent discoveries, and is found on decaying bottle-trees (*Sterculia rupestris*).

Zeneudes sterculiæ. *Z.* oblongus, subcylindricus, fuscus, squamis concoloribus ochraceisque maculatim sejunctim vestitus; rostro capite duplo longiore, nitidissime nigro, basi subgibboso et utrinque sulcato; antennis piceis, rarissime setulosis, clava excepta; prothorace longitudine latitudini æquali, pone apicem valde constricto, lateribus rotundato, disco carinulato; scutello minuto; elytris striato-punctatis, interstitiis latis convexis, apice rotundatis; femoribus tibiisque sparse squamosis. Long. 4–5 lin.

Hab. Queensland (Gayndah).

Cyamobolus bicinctus. *C.* ovalis, niger, squamulis silaceis valde adspersus, lineis dense albido-squamosis ornatus; rostro dimidio apicali nitidissimo; antennis ferrugineis, funiculo articulo secundo quam primo quadruplo longiore; prothorace inæqualiter sat vage punctato, dorso antice versus latera lineis duabus notato; scutello rotundato; elytris substriato-punctatis, punctis profundis oblongis, interstitiis subangustis, remote punctulatis, fascia basali alteraque pone medium suturaque versus apicem dense albido-squamosis; corpore infra pedibusque squamis albidis adspersis. Long. 6 lin.

Hab. Malacca.

Compared with *C. Sturmii*, Boh., this species is less rugosely punctured, the striæ on the elytra nearly obsolete, and the disposition of the white lines different.

Cyamobolus subsellatus. (Pl. I. fig. 12.) *C.* ovalis, niger, albo varius; rostro crassiore, basi rugoso-punctato, apice vix nitido; antennis piceis, funiculo articulo secundo quam primo triplo longiore; prothorace subampliato, inæqualiter tenuiter punctato, punctis albo-squamosis, interspatiis lævigatis; scutello dense silaceo; elytris striato-punctatis, punctis oblongis, approximatis, interstitiis paulo convexis, squamis concoloribus adspersis, macula majuscula communi basali, fascia pone medium suturaque versus apicem dense ochraceo-squamosis; corpore infra pedibusque squamis ochraceis adspersis femoribus posticis supra linea ochracea, e squamis condensatis formata, munitis. Long. 6 lin.

Hab. Saylee.

The prothorax has a somewhat smooth appearance, only interrupted by the punctures.

CYAMOBOLUS DUPLICATUS. *C.* ovalis, niger, albo varius; rostro tenuiore, basi excepto, nitido; antennis ferrugineis, funiculo articulo secundo quam primo vix sesquilongiore; prothorace conico, punctis majoribus minoribusque intermixtis sat confertim impresso; elytris striato-punctatis, punctis ovalibus, approximatis, interstitiis latis, rugosis, irregulariter punctatis, pone humeros macula magna rotundata, et a medio lineis duabus, postice conjunctis, dense ochraceo-squamosis; rima pectorali magis elongata; pedibus ochraceo-squamosis. Long. 6 lin.

Hab. Saylee.

The greater length of the pectoral canal extending to between the intermediate coxæ must be regarded as exceptional; all the species of *Cyamobolus* have pale ochreous tarsi, and the scales are apparently more numerous under the femora, and, occasionally, also above, especially of the posterior pair. *C. Marci*, Boh., does not belong to this genus. The three species described above have longer legs, and particularly as regards the anterior pair, than either *C. Dehaanii* or *C. Sturmii*; the sexes, as Lacordaire observes, are pretty nearly alike.

CYDOSTETHUS.

(Cryptorhynchinæ.)

Rostrum fere rectum; *scrobes* præmedianæ. *Oculi* majusculi, rotundati, antice approximati. *Elytra* basi prothorace haud latiora. *Femora* crassa, infra dentata; *tibiæ* subarcuatæ, squamis decumbentibus. *Rima* pectoralis pone coxas anticas terminata; *mesosternum* fornicatum. *Cætera* ut in *Cyamobolo*.

The affinity is perhaps not so much to *Cyamobolus* as the habit and coloration would lead one to suppose. The character of the mesosternum (*en gouttière*) should place *Cyamobolus* near the *Cryptorhynchus* allies; but Lacordaire makes it an exception, and puts it next to *Euthyrhinus*, with which *Cydostethus* appears to have more affinity. The ocular lobes leave the eyes nearly free in repose.

CYDOSTETHUS SOLUTUS. (Pl. I. fig. 11.) *C.* ovalis, niger, supra squamis concoloribus albisque signatus tectus; rostro castaneo, capite duplo longiore, tenuiter, apice magis punctulato; antennis subpiceis; funiculo articulis duobus basalibus longioribus, secundo quam primo longiore; clava magna elongato-obovata; prothorace subtiliter granulato, in medio linea alba ornato; elytris striato-punctatis, prope suturam, præcipue dimidio basali, fortiter granulatis, margine basali, macula obliqua ante medium et postice linea maculari, aliquando maculis duabus, albis ornatis; corpore infra densissime albo-squamuloso; pedibus sparse squamosis, tarsis albo-pilosis. Long. 5 lin.
Hab. Ceram.

CYDOSTETHUS LINEOLATUS. *C.* ovalis, fuscus, squamis concoloribus, griseis irroratus, griseoque signatus tectus; rostro castaneo, punctis elongatis majusculis minus adsperso; antennis subpiceis, funiculo articulis duobus basalibus brevioribus; prothorace lineis tribus ornato, minus subtiliter granulato; elytris striato-punctatis, striis griseis, dimidio basali versus suturam fortiter granulato, margine basali, maculisque (vel lineis) duabus griseis ornatis; corpore infra femoribusque basi densissime albo-squamulosis; tarsis albo-pilosis. Long. 5 lin.
Hab. Amboyna; Tondano.

The white markings in both these species are variable.

SYROTELUS.

(Cryptorhynchinæ.)

Elytra ad latera haud carinata. *Mesosternum* fornicatum. *Femora* basi attenuata, infra dente parvo armata. *Cætera* ut in *Rhynchode*.

Cyamobolus Falleni, Boh., is the type of this genus, which Lacordaire has referred to *Rhynchodes*, Wh., chiefly on account of the pointed apex of the elytra. The characters given above do not, however, in my opinion, permit their association.

CECHANIA.

(Cryptorhynchinæ.)

Rostrum rectum, cylindricum; *scrobes* præmedianæ, obliquæ. *Scapus* brevis, oculum attingens; *funiculus* elongatus, articulis ultimis transversis; *clava* majuscula, distincta. *Oculi* minusculi, leviter granulati. *Prothorax* transversus, apice tubulatus, lobis ocularibus obsoletis. *Elytra* subcordiformia, basi prothorace haud latiora, apice acuminata. *Pedes* breves; *femora* valida, sublinearia, infra dentata; *tibiæ* breves, rectæ; *tarsi* articulo tertio late bilobo. *Rima* pectoralis inter coxas intermedias protensa, apice cavernosa. *Abdomen* segmentis duobus basalibus valde ampliatis. *Processus* intercoxalis latissimus.

Euthyrhinus, which this genus resembles in its habit and straight rostrum, is at once differentiated by its pectoral canal terminating before the intermediate coxæ, and the scape not nearly reaching the eyes.

CECHANIA EREMITA. *C.* sat late ovalis, nigra, fusco-maculatim albido-squamosa; capite prothoraceque sejunctim squamosis; rostro antennisque piceo-ferrugineis, funiculo articulo basali quam secundo fere duplo longiore; elytris sulcato-punctatis, sulcis inter puncta nitidis; corpore infra pedibusque ferrugineis, sejunctim albido-squamosis. Long. 2 lin.

Hab. Japan (Nagasaki).

ÆCHMURA.

(Cryptorhynchinæ.)

Rostrum breviusculum, paulo arcuatum; *scrobes* medianæ. *Funiculus* brevis; *clava* valida, ovata, distincta. *Oculi* mediocres, leviter granulati. *Prothorax* transversus, apice tubulatus, lobis ocularibus obsoletis. *Elytra* subcordiformia, prothorace basi haud latiora, apice acuminata. *Femora* crassa, infra canaliculata et dente mediocri instructa; *tibiæ* sulcatæ; *tarsi* normales. *Rima* pectoralis inter coxas anticas terminata. *Abdomen* segmentis duobus basalibus valde ampliatis. *Processus* intercoxalis latissimus.

Another *Euthyrhinus* form, but very distinct, if only on account of its canaliculate femora. In the species here described the metasternum is a little concave and slightly ridged on each side between the intermediate and posterior coxæ. The scales are perfectly round and imbedded, as is usual in most of the allied genera, in the derm, and only very slightly separated from one another.

ÆCHMURA EMYS. *Æ.* fusca, omnino sat dense albido-squamosa; rostro capite vix longiore, basi griseo-squamoso, reliquo castaneo; antennis rufo-testaceis, funiculo articulo basali crasso, quam secundo duplo longiore, cæteris transversis; prothorace fortiter transverso; scutello punctiformi; elytris sulcatis, interstitiis late planatis; tarsis rufo-fulvis. Long. $1\frac{1}{2}$ lin.

Hab. Singapore.

Orochlesis maculosa. *O.* elliptica, fusca, maculatim griseo-squamosa; rostro breviusculo, castaneo, tenuiter punctulato; antennis nitide ferrugineis; funiculo articulis duobus basalibus æqualibus; clava distincta; prothorace subconico, vage granulato, vittis tribus indistinctis notato; scutello nigro, minuto: elytris oblongo-cordatis, striato-punctatis, punctis grossis, ovalibus, interstitiis convexis; tarsis articulo tertio valde dilatato. Long. $2\frac{3}{4}$ lin.

Hab. Salwatty.

Differs from the normal forms of *Orochlesis* in its more cordiform elytra.

Odosyllis.

(Cryptorhynchinæ.)

Rostrum paulo arcuatum, sat breviusculum; *scrobes* submedianæ, obliquæ. *Scapus* brevis; *funiculus* articulis ultimis transversis; *clava* ovata, pubescens. *Oculi* rotundati, tenuiter granulati. *Prothorax* late transversus, utrinque fortiter rotundatus, apice tubulatus, lobo scutellari producto, lobis ocularibus aut modice prominulis, aut fere obsoletis. *Scutellum* elevatum, esquamosum. *Elytra* cordiformia, basi prothorace haud latiora, apice acuminata. *Pedes* antici majores; *femora* valida, sublinearia, infra dentata; *tibiæ* breviusculæ, compressæ, arcuatæ; *tarsi* articulo tertio late bilobo. *Rima* pectoralis pone coxas anticas protensa, apice cavernosa. *Abdomen* segmento secundo ampliato. *Processus* intercoxalis modice latus.

The species of this genus have a short compact body with a broadly oval outline, and the upper surface more or less studded with minute granules, those on the interstices of the elytra irregularly arranged in from one to three rows. The ocular lobes are subject to disappear; but they are sufficiently well marked in *O. atomaria* and *O. terrena*. *Nedymora* (*antè*, vol. xi. p. 209) differs from this genus in its pectoral canal, open at the apex and passing beyond the intermediate coxæ, being thrust, as it were, into the metasternum.

Odosyllis congesta. (Pl. I. fig. 5.) *O.* nigra, sejunctim, elytris maculatim griseo-squamosa; rostro modice elongato, piceo, apicem versus subtiliter punctulato; antennis piceo-ferrugineis, funiculo articulis duobus basalibus elongatis, longitudine æqualibus; clava subadnata; prothorace granulis nitidis sat sparse adsperso; scutello oblongo, parte apicali subcuneiformi; elytris sulcatis, interstitiis parum convexis, granulis subbi- vel triseriatim ordinatis; femoribus magis linearibus, dente minuto instructis; tibiis posticis apice biuncinatis. Long. $4\frac{1}{2}$ lin.

Hab. Tondano.

ODOSYLLIS ATOMARIA. *O.* nigra, albido-squamosa; rostro castaneo, apicem versus impunctato; antennis nitide testaceo-ferrugineis; funiculo articulis duobus basalibus cæteris conjunctim duplo brevioribus, secundo primo longiore; clava adnata; prothorace granulis minutis opacis sparse adsperso; scutello nigro; elytris sulcatis, interstitiis convexis, in medio granulis minutis nitidis uniseriatim ordinatis; tibiis anticis valde compressis. Long. 3 lin.

Hab. Singapore.

ODOSYLLIS GRANULICOLLIS. *O.* nigra, sparse griseo-squamosa; rostro castaneo, apicem versus impunctato; antennis nitide testaceo-ferrugineis; funiculo articulis duobus basalibus cæteris conjunctim longitudine æqualibus, secundo primo longiore; clava distincta; prothorace confertim granulato, granulis majoribus minutisque intermixtis; scutello nigro; elytris sulcatis, interstitiis latis, vix convexis, granulis oblongis nitidis subbiseriatim ordinatis: abdomine sat dense squamoso; tibiis anticis longioribus, minus compressis; tarsis subferrugineis. Long. 3 lin.

Hab. Tondano.

ODOSYLLIS VITIOSA. *O.* nigra, fusco-squamosa, obscure maculatim ochraceo-varia; rostro castaneo, apicem versus tenuiter vage punctulato; antennis testaceo-ferrugineis; funiculo articulis duobus basalibus cæteris conjunctim multo brevioribus; clava subadnata; prothorace granulis minutis subnitidis vage adsperso, vittis tribus ochraceis obscure notato; scutello nigro; elytris sulcatis, interstitiis convexis in medio subseriatim granulatis; corpore infra femoribusque sejunctim ochraceo-squamosis; tibiis anticis parum arcuatis; tarsis subferrugineis. Long. 2 lin.

Hab. Waigiou; Saylee.

ODOSYLLIS TERRENA. *O.* fusca, sejunctim griseo-squamosa, prothorace squamis concoloribus vario; rostro tenuiore, piceo, sparse subtiliter punctulato; antennis nitide ferrugineis; funiculo articulis duobus basalibus brevibus, cæteris sat valde transversis; clava distincta, valida, breviter ovata; prothorace granulis plurimis nitidis adsperso;

elytris sulcatis, interstitiis convexis, granulis nitidis subbi- vel triseriatim ordinatis; femoribus dente magno armatis. Long. 3¼ lin.

Hab. Menado.

Odosyllis irrorata. *O.* nigro-fusca, sejunctim griseo-squamosa, prothorace squamis concoloribus vario; rostro piceo subtiliter punctulato; antennis nitide ferrugineis; funiculo articulis duobus basalibus sat longiusculis, longitudine fere æqualibus, cæteris transversis; clava adnata, breviter ovata; prothorace granulis plurimis nitidis adsperso, disco basi utrinque squamis ochraceis magis confertis signato; scutello ovato; elytris sulcatis, interstitiis convexis, granulis oblongis nitidis uni- vel subbiseriatim ordinatis; femoribus dente mediocri armatis. Long. 3 lin.

Hab. Saylee.

Closely resembles the last, but (*inter alia*) with a shorter rostrum, a longer funicle, and an ovate scutellum.

Pelephicus.

(Cryptorhynchinæ.)

Rostrum elongatum, arcuatum; *scrobes* medianæ, obliquæ. *Funiculus* articulis quatuor ultimis submoniliformibus; *clava* oblonga, subcylindrica, tomentosa. *Oculi* rotundati, subtenuiter granulati. *Prothorax* transversus, apice tubulatus, lateribus postice subito verticalis, lobis ocularibus prominulis. *Scutellum* elevatum, punctiforme. *Elytra* cordiformia, basi prothorace haud latiora, apice acuminata. *Pedes* ut in *Odosyllide. Rima* pectoralis ad coxas intermedias protensa, apice subaperta. *Abdomen* segmento secundo ampliato. *Processus* intercoxalis angustus.

One of the peculiarities of this genus is the sudden deflection of the sides of the prothorax posteriorly, and in consequence presenting a sharp angle at the part, below which the side is deeply excavated, apparently for the reception of the anterior femora. In other respects it differs from *Odosyllis* in the cylindrical form of the club of the antennæ, and in the longer pectoral canal nearly open at the apex.

Pelephicus stigmaticus. *P.* fuscus, squamulis concoloribus griseisque, vage intermixtis, vestitus; capite supra oculos maculis tribus, e squamulis minoribus late grisescentibus condensatis, ornato; rostro nitide ferrugineo, tenuiter vage punctulato; antennis testaceo-ferrugineis, funiculo articulis duobus basalibus longitudine æqualibus; prothorace supra subplanato, apice abrupte tubulato, dorso granulis paucis vix nitidis munito; elytris sulcatis, interstitiis latis, modice convexis; tibiis anticis intus longe ciliatis. Long. 3 lin.

Hab. Saylee.

Endymia geminata. *E.* subelliptica, grisea, squamis griseis fuscisque sejunctim vestita; rostro prothorace paulo longiore, castaneo, fere impunctato; antennis pallide castaneis; funiculo articulo primo quam secundo longiore; clava funiculo paulo breviore; prothorace subconico, lobis ocularibus vix prominulis, dorso plaga variegata fusca ornato; elytris substriato-punctatis, singulis in medio plaga fusca indeterminata notatis; corpore infra pedibusque griseo-squamosis, his fusco-subannulatis. Long. 4 lin.

Hab. Batchian.

I have only the female of this species, which differs from the corresponding sex of *E. vipio* in being much broader, more convex, and the club of the antennæ decidedly shorter than the funicle.

Berosiris.

(Cryptorhynchinæ.)

Rostrum attenuatum, elongatum, arcuatum; *scrobes* submedianæ, obliquæ. *Funiculus* articulis duobus basalibus subæqualibus, obconicis, quatuor vel quinque ultimis moniliformibus, in clavam quasi continuatis, sed *clava* distincta, ovata, articulata. *Oculi* grosse granulati. *Prothorax* subconicus, utrinque paulo rotundatus, lobis ocularibus prominulis. *Scutellum* esquamosum, rotundatum. *Elytra* oblonga vel oblongo-ovata, prothorace paulo latiora. *Femora* clavata, infra dente magno instructa; *tibiæ* flexuosæ, squamosæ, haud sulcatæ; *tarsi* normales. *Rima* pectoralis inter coxas intermedias protensa, apice aperta. *Abdomen* segmento secundo ampliato.

Cyamobolus Marci, Boh., belongs to this genus, which is at once differentiated from *Cyamobolus* by its clavate femora armed with a large angular tooth; and the pectoral canal nearly extending to the posterior border of the intermediate coxæ places it nearer *Nechyrus* and *Macromerus*; the former genus, however, may, on the other hand, be thought nearer *Cyamobolus* on account of its sublinear mutic femora.

Berosiris picticollis. (Pl. I. fig. 9.) *B.* fuscus, squamulis brunneo-griseis omnino dense tectus, squamis majoribus adspersus; rostro apicem versus valde remote punctulato; funiculo articulis duobus basalibus brevibus; prothorace in medio linea elevata nuda notato, disco plaga magna læte fusca, utrinque pallide marginata, ornato, lateribus vage punctatis, basi macula fusca notatis; elytris oblongis, striato-foveolatis, interstitiis angustis, macula arcuata indistincta, communi, fuscescente, ante apicem signatis. Long. $5\frac{1}{2}$ lin.

Hab. Sarawak.

Berosiris violatus. *B.* angustior, niger, squamulis griseis dense tectus setulisque interjectis; rostro multo tenuiore, apice vage tenuiter punctulato; funiculo articulis duobus basalibus fere æqualibus, tertio quartoque ovalibus; prothorace haud carinato, dorso in medio fusco et crebre fortiter punctato; elytris oblongis, substriato-foveatis, singulis parum pone medium macula fusca notatis; corpore infra pedibusque subalbido-squamosis, tibiis basin versus annulo fusco variegatis. Long. 5 lin.

Hab. Java.

Berosiris cribratus. *B.* minus elongatus, niger, squamulis maculatim griseis dense tectus; rostro tenuato, obsolete punctato; funiculo ut in præcedente; prothorace in medio carinato, crebre fortiter punctato; elytris profunde fortiter seriatim punctatis, maculis nonnullis albis ornatis; abdomine segmento basali fortiter punctato; femoribus tibiisque fusco subannulatis; tibiis posticis elongatis. Long. $4\frac{1}{2}$ lin.

Hab. Sarawak.

Berosiris hepaticus. *B.* niger, squamulis rufo-brunneis dense tectus; rostro minus tenuato, subtiliter punctulato; funiculo longiusculo, articulo secundo quam primo longiore, tertio quartoque subobconicis; clava sat majuscula; prothorace vage punctato, in medio carinulato; elytris oblongis, basi paulo depressis, lateribus subparallelis, vix striatis, punctis inconspicuis seriatim impressis, singulis plaga magna oblonga ad medium extensa ornatis; abdomine fortiter subvage punctato; pedibus concoloribus. Long. 6 lin.

Hab. Tondano.

The preapical callus is strongly marked in this species.

Berosiris devotus. *B.* ovalis, niger, squamulis albidis, supra fuscescenti varius, omnino dense tectus; rostro tenuato, tenuiter punctulato; funiculo articulo secundo pyriformi et quam primo longiore, tertio ovali; prothorace vage fortiter punctato, haud carinato; elytris oblongo-cordatis, substriato-punctatis, interstitiis latiusculis; abdomine vage sat fortiter punctato. Long. 6 lin.

Hab. Goram.

Lobotrachelus stigma. *L.* breviter ellipticus, niger, nitidus, supra fere esquamosus, infra lateribusque prothoracis dense niveo-squamosis; rostro prothorace vix breviore, ferrugineo, niveo-squamoso; antennis fulvis, clava breviter ovata, quam funiculo multo latiore; prothorace transverso, subconico, lobo scutellari squamis elongatis niveis dense tecto; elytris sulcato-punctatis, subtiliter sparsim albo-pilosis, postice et pone scutellum magis condensatis; femoribus infra dente acuto munitis; tarsis subflavis. Long. 1 lin.

Hab. Australia (Gayndah).

This species is interesting as the only representative at present known in Australia (and the discovery of which we owe to Mr. Masters) of what is evidently a numerous group in the Malay archipelago.

LOBOTRACHELUS PLAGIATUS. *L.* breviter ellipticus, niger, subnitidus, squamis elongatis niveis vestitus, supra plagis nudis notatus; rostro niveo-squamoso; antennis fulvis, clava oblonga, angusta; prothorace transverso, subconico, lobo scutellari triangulariter producto, in medio plaga magna denudata obsito; elytris sulcato-punctatis, pone humeros plaga magna rotundata, alteraque communi ad apicem notatis; corpore infra sat dense niveo-squamoso; femoribus minus squamosis, intermediis infra dente fere obsoleto; tarsis subflavis. Long. 1 lin.

Hab. Flores.

LOBOTRACHELUS LINTEUS. *L.* ellipticus, niger, squamis piliformibus albis sat sparse vestitus, supra plagis esquamosis notatus; rostro niveo-squamoso; antennis fulvis, clava ovali; prothorace modice transverso, basi in medio plaga magna denudata obsito, lobo scutellari acuto; elytris sulcato-punctatis, interstitiis squamis biseriatim ordinatis, pone humeros plaga magna subtransversa alteraque præapicali ad latera notatis; corpore infra magis dense squamoso; pedibus fuscis, vel ferrugineis; femoribus anticis dente cariniformi, intermediis et posticis dente acuto, instructis; tarsis subflavis. Long. 1 lin.

Hab. Macassar.

Remarkable for the cariniform tooth of the anterior femora. The scales are more scattered than in the last, and completely piliform.

LOBOTRACHELUS ALBIROSTRIS. *L.* subellipticus, fuscus, supra pedibusque squamis piliformibus albis sat sparse vestitus; antennis fulvis, tenuioribus, clava ovata acuminata; prothorace modice transverso, lobo scutellari obtuso, lateribus infra dense squamoso; elytris magis elongatis, sulcato-punctatis, interstitiis squamis biseriatim ordinatis; corpore infra sat sparse squamoso; femoribus omnibus dente parvo instructis. Long. 1 lin.

Hab. Macassar.

There is a remarkable rounded hollow occupying a large part of the last abdominal segment in my specimen, which may perhaps be sexual; there is also a slightly elevated longitudinal line on the metasternum.

Brephiope.

(Isorhynchinæ.)

Rostrum subtenuatum, apicem versus latius; *scrobes* submedianæ. *Oculi* subovati, antice supra paulo approximati, fortiter granulati. *Scapus* oculum haud attingens; *funiculus* 7-articulatus, articulo primo crassiore, cæteris a secundo gradatim latioribus; *clava* ovata, distincta. *Prothorax* transversus, conicus, basi bisinuatus. *Scutellum* distinctum. *Elytra* obovata, basi prothorace parum latiora, humeris obsoletis. *Rima* pectoralis inter coxas intermedias terminata, apice paulo cavernosa. *Femora* sublinearia, infra canaliculata et dente minuto instructa; *tibiæ* compressæ, arcuatæ; *tarsi* normales. *Abdomen* segmento secundo quam tertio manifeste longiore, segmentis intermediis ad latera haud arcuatis.

The second abdominal segment is intermediate in length between the two extreme forms in the species serving as the type of of this genus; here, therefore, it is probably only a transitional or specific character. The affinities of the genus are not very obvious; and it is possible a better place may be found for it.

Brephiope castanea. *B.* rufo- vel aliquando fusco-castanea, nitida; rostro prothorace paulo longiore; funiculo articulis quinque ultimis valde transversis; oculis nigris; prothorace subreticulatim punctato; elytris ante medium latioribus, sulcatis, sulcis indistincte lineatim punctatis, interstitiis planatis, uniseriatim subtilissime punctulatis, singulis in medio squamulis oblongis niveis condensatis maculatis; corpore infra sparse punctulato, segmentis tertio quartoque abdominis punctis majusculis in serie unica transversim dispositis; femoribus punctatis, punctis singulis squamulis albis repletis. Long. $1\frac{1}{4}$ lin.
Hab. Sula; Ceram.

Metetra.

(Isorhynchinæ.)

Rostrum parum incrassatum, apicem versus sensim latius. *Rima* pectoralis lata, profunda, postice in mesosterno bene limitata.

Tarsi lobis articuli tertii haud divergentibus. *Cætera* ut in *Lobotrachelo*.

In the species described below the legs are shorter and the prothorax proportionally larger than in *Lobotrachelus*, with which genus, however, it agrees in the remarkable character of having the medi-basal portion of the prothorax prolonged so as to cover the scutellum.

METETRA SUTURALIS. *M.* elliptica, nigra, nitida, sutura lineaque laterali elytrorum niveo-squamosis; rostro toto capiteque inter oculos carinatis, illo piceo, sat confertim oblongo-punctato; antennis fulvis; funiculo articulo primo quam secundo paulo longiore, cæteris brevibus, gradatim incrassatis; prothorace longiore quam latiore, modice confertim punctato; elytris fortiter sulcato-punctatis, interstitiis setulis albis minutis sparse vestitis; corpore infra niveo-squamoso; pedibus piceis; femoribus dente modice elongato instructis; tarsis fulvis, articulis tribus basalibus conjunctim elongato-triangularibus. Long. $1\frac{1}{4}$ lin.

Hab. Waigiou.

TELEPHAË STRIGILATA. *T.* ovalis, rufo-fusca, pilis albis vel ochraceis sparse vestita; antennis subtestaceis; oculis minoribus; prothorace modice transverso, crebre punctato, callo laterali magis limitato; elytris utrinque mediocriter rotundatis, sulcato-punctatis, basi, pone medium apiceque pilis albis longiusculis obsitis, fascias tres indeterminatas formantibus; abdomine segmento secundo valde ampliato. Long. $1\frac{1}{2}$ lin.

Hab. Batchian; Sarawak.

The genus *Telephaë* (*antè*, vol. x. p. 487) must, I think, be placed with the Isorhynchinæ. Lacordaire says that "the only absolute character" which separates that group from the Zygopinæ is found in their "perfectly cylindrical rostrum." I confess, however, failing in most cases to appreciate this subtle distinction; as a rule, perhaps, the rostrum of the Zygopinæ is more subulate, and the eyes occupy a greater portion of the head, at least in the more typical species. One of the best characters seems to be that the eyes are uncovered in repose. They have each a seven-jointed funicle and a small scutellum, in two genera covered by an extension of the prothorax. As a rule, the species are either naked or partially covered with loosely set narrow or hair-like scales, more or less assuming the form of pubescence. All the members of the Isorhynchinæ here described (and there are a few more) are, except one, due to Mr. Wallace's researches;

the exception is the only instance of the occurrence of this group in Australia. *Telephaë* itself might be taken for one of the Prionomerinæ; but it may be at once distinguished, *inter alia*, by the anterior coxæ not being contiguous. The species described above differs from *T. laticollis* in its oval outline, the lateral callus on the prothorax tuberculiform, the prothorax itself considerably less transverse, &c.; the hairs on the elytra are confined to the interstices as in the other species, and give the parts they cover a stripy appearance.

TELEPHAË CONCRETA. *T.* ovalis, nigra, sparse maculatim niveo-pilosa; rostro prothorace paulo breviore, basi sat rude punctato; antennis subtestaceis; oculis ampliatis; prothorace subtransverso, crebre punctato, callo laterali producto et niveo-piloso; elytris convexiusculis, sulcato-punctatis, macula communi pone scutellum, tribus alteris apicem versus sitis, niveo-pilosis; femoribus anticis majoribus; tibiis anticis brevibus; tarsis piceo-testaceis. Long. $1\frac{1}{2}$ lin.

Hab. Batchian.

TELEPHAË LUCTUOSA. *T.* late ovalis, nigra, elytris sparse maculatim niveo-squamosis; rostro prothorace paulo breviore, basi sat rude punctato; antennis piceo-testaceis; oculis modice ampliatis; prothorace modice transverso, crebre punctato, callo laterali obsoleto; elytris in medio paulo depressis, vel fere excavatis, sulcato-punctatis, basi maculis quatuor ornatis, *scil.* una utrinque humerali, et duabus suturalibus communibus, quarum una media, altera apicali, obsitis; femoribus anticis minus ampliatis; tibiis anticis magis elongatis, tarsis piceo-testaceis. Long. 2 lin.

Hab. Batchian; Gilolo; Sarawak.

TELEPHAË DENTICOLLIS. *T.* late ovalis, nigra, sparse maculatim niveo-squamosa; rostro prothorace paulo breviore; antennis fuscis; prothorace subtransverso, crebre punctato, utrinque dente mammilliformi, pilis niveis tecto, instructo; scutello niveo; elytris sulcato-punctatis, basi, interstitio septimo in medio, vittaque suturali ad apicem niveo-squamosis; femoribus anticis magis ampliatis, dente magno armatis; tibiis sat elongatis; tarsis fulvo-piceis. Long. 2 lin.

Hab. Dorey; Sarawak.

TELEPHAË METATA. *T.* ovalis, nigra, maculatim niveo-squamosa, *scil.* macula utrinque basi prothoracis, elytrisque maculis octo, quarum duabus communibus suturalibus, una basali, altera media, et tribus singulo elytro; prothorace confertim tenuiter punctulato; elytris leviter sulcato-punctatis, interstitiis planatis sparse albido-pilosis;

corpore infra nigro, metasterno utrinque niveo-maculato; tarsis fulvis. Long. $1\frac{1}{3}$ lin.

Hab. Batchian.

TELEPHAË REPETITA. *T.* ovalis, nigra, sparse griseo-squamulosa, rostro, pedibus antennisque rufo-castaneis, illo prothorace breviore, nitido, basi solum subtiliter punctulato; prothorace subtransverso, lateribus rotundato, haud calloso; elytris modice convexis, sulcato-punctatis, interstitiis planatis, basi, parum pone medium, apiceque squamulis sat dense obsitis fascias tres bene determinatas formantibus; tibiis anticis brevibus, valde arcuatis. Long. $1\frac{1}{3}$ lin.

Hab. Sarawak.

The underparts are in a fresh state probably covered with round silvery scales; there are indications of this in other species.

TELEPHAË SELLIGERA. *T.* ovalis, fusca, supra sat rude squamulosa; capite nudo, crebre tenuiter punctulato; rostro prothorace breviore; antennis testaceis; oculis majusculis, fere contiguis; prothorace subtransverso, lateribus rotundato, haud calloso; elytris supra depressis, sulcato-punctatis, dorso plaga magna medio, apice lateribusque griseis; pedibus piceis; tibiis tarsisque pallidioribus; tibiis anticis longiusculis. Long. $1\frac{1}{3}$ lin.

Hab. Sarawak.

OTHIPPIA.

(Isorhynchinæ.)

Rostrum mediocre, apicem versus latius, basi longitudinaliter angulatum. *Antennæ* submedianæ; *funiculo* articulo basali incrassato, cæteris tenuatis, gradatim crassioribus; clava distincta. *Oculi* magni, ovati vel rotundati, antice approximantes. *Prothorax* transversus, subconicus, lobo scutellari paulo producto. *Scutellum* distinctum. *Elytra* cordiformia, basi prothorace haud latiora, pygidium obtegentia. *Pedes* mediocres; *femora* modice elongata, valida, sublinearia, infra dente tenuato instructa; *tibiæ* breviusculæ, rectæ, calcaratæ; *tarsi* articulo primo oblongo-triangulari, secundo brevi, tertio lato, bilobo, ultimo minusculo; *unguiculis* parvis. *Rima* pectoralis mesosterno terminata. *Abdomen* segmento secundo breviusculo.

In the first three species described below the eyes are narrowed beneath, and the end of the pectoral canal is distinctly marked by a raised semicircular margin. Patches of snow-white scales on the upper margin of the hind femora occur in most of the species of this genus.

Othippia distigma. *O.* nigra, subnitida, tenuiter pilosa, prothorace utrinque macula magna basali, apiceque elytrorum rufo-ochraceis; rostro piceo-fusco, carinulato, apicem versus manifeste latiore; antennis fulvis; funiculo articulo basali longiore, crasso, reliquis breviusculis, longitudine subæqualibus et gradatim crassioribus; prothorace impunctato, in medio parcius piloso; elytris late sulcatis, interstitiis planatis; corpore infra fusco; abdomine segmentis tribus intermediis longitudine fere æqualibus; pedibus parce pilosis; tarsis fulvis. Long. $1\frac{1}{4}$ lin.

Hab. Sarawak.

The appressed hairs in this species are only seen under a very strong lens, and they appear whitish and silky against the light.

Othippia jubata. *O.* fusca, pilis ochraceis sejunctim vestita; capite rostroque piceo-testaceis, hoc carinulato et apicem versus paulo latiore; antennis fulvis; funiculo articulis secundo tertioque conjunctim primo longioribus; clava breviter ovata; prothorace dimidio basali in medio alte fasciculato-cristato; scutello conspicuo; elytris late sulcatis, interstitiis planatis, sutura ante medium dense fasciculatis; corpore infra castaneo-fusco, verisimiliter niveo-squamoso; abdomine segmento secundo fere obtecto; pedibus rufo-testaceis, parce albido-squamosis. Long. $1\frac{1}{4}$ lin.

Hab. Sarawak.

I have only one example of this very distinct species, which, when fresh, is probably rather closely covered above with coarse ochraceous hairs.

Othippia proletaria. *O.* breviter elliptica, nigra, squamositate subgrisea, squamis interjectis, vestita; rostro ferrugineo, vel nigro, modice arcuato; antennis fulvis; funiculo articulo primo secundo longiore, cæteris breviusculis, clava breviter ovata; prothorace transverso, medio supra scutellum subcristato, lobo scutellari rotundato; elytris sulcatis, basi circa scutellum paulo depressis; corpore infra sat dense albido-squamoso; femoribus intermediis et posticis fere obsolete dentatis. Long. $1\frac{1}{4}$ lin.

Hab. Sarawak.

This species is covered with a somewhat deciduous greyish sort of squamosity like some saccharine exudation.

Othippia funebris. *O.* nigra, nitida, subnuda; rostro basi quinquesulcato; antennis fulvis; funiculo articulis tribus basalibus longitudine fere æqualibus; prothorace transverso, crebre punctato, pone apicem fortiter constricto; elytris sulcato-punctatis, interstitiis subtilissime pilosis, in medio sat valde convexis, regione scutellari depressis, macula basali circa scutellum lineaque suturali pone medium albo-pilosis; corpore infra albo-squamoso. Long. 1¾ lin.

Hab. Ceram.

OTHIPPIA PODAGRICA. *O.* fusca, opaca, subnuda, prothorace nitide nigro; rostro castaneo, basi longitudinaliter angulato; antennis fulvis, funiculo tenuiore, articulo secundo quam primo longiore; prothorace minus transverso, sparse punctulato, haud constricto; elytris sulcato-punctatis, interstitiis tenuiter pilosis, in medio convexis, singulis maculis parvis tribus niveo-pilosis ornatis, scil. una basali prope scutellum, una ad latera fere in medio, tertiaque apicali; corpore infra albo-squamoso; tarsis posticis articulo primo elongato-ampliato. Long. 1¾ lin.

Hab. Mysol.

This and the preceding species are much alike in appearance, but are strongly contrasted in nearly all the characters here given. The form of the basal joint of the posterior tarsi is probably dependent on sex.

EGIONA.

(Isorhynchinæ.)

Rostrum basi rotundatum. *Antennæ* articulo basali funiculi haud incrassato, secundo longiusculo, vix tenuiore. *Pygidium* liberum. *Cæteris* fere ut in *Othippia*, sed femoribus minus elongatis.

In many respects this genus is allied to the preceding; but the three characters here given will not allow of their being conjoined. The eyes in the species described below have extremely minute facets. The dark bands seen in the figure are the uncovered portions of the derm.

EGIONA LÆTA. (Pl. III. fig. 2.) *E.* rufo-castanea, variegatim albido-squamosa; rostro subvalido, sat confertim punctulato, leviter piloso; antennis testaceis; clava parva, oblique articulata; prothorace crebre punctato, supra squamis piliformibus sparse vestito, ad latera magis squamoso; scutello parvo; elytris profunde sulcatis, regione scutellari fasciisque duabus magnis—una mediana, altera apicali—a squamis condensatis formatis, notatis, apicibus valde rotundatis; corpore infra fusco; pedibus sparse pilosis. Long. 1⅓ lin.

Hab. Macassar.

PSENICLEA.

(Isorhynchinæ.)

Rostrum validum, a basi ad apicem gradatim latius; *scrobes* præmedianæ. *Oculi* rotundati, antice approximati, tenuiter granulati. *Scapus* oculum vix attingens; *funiculus* articulo primo ampliato, cæteris gradatim brevioribus et crassioribus; *clava* ovata distincta. *Prothorax* parvus, transversus, basi parum rotundatus. *Scutellum* distinctum. *Elytra* trigonata, convexa, prothorace basi multo latiora. *Pectus* brevissimum. *Coxæ* anticæ parum separatæ, intermediæ distantes. *Femora* modice elongata, incrassata, haud canaliculata, infra dente valido instructa; *tibiæ* subrectæ, apice mucronatæ; *tarsi* articulo ultimo elongato. *Abdomen* segmentis tribus intermediis gradatim paulo brevioribus, ad latera arcuatis.

The shortness of the pectus brings the rostrum in repose directly against the anterior coxæ, and not to pass between them, as in some other genera of this group, owing to their contiguity, or nearly so. The eyes are almost frontal. The affinities of the genus are not very evident.

PSENICLEA PUELLARIS. *P.* tota nitide fulva, mandibulis nigris exceptis, esquamosa; rostro prothorace haud longiore; antennis pallidioribus; prothorace utrinque vix rotundato, basi latiore, sparse punctato; elytris basi prothorace sesquilongiore, valde convexis, leviter sulcatis, sulcis fortiter punctatis, interstitiis parum convexis; metasterno antice processuque intercoxali fortiter sparse punctatis, reliquis impunctatis. Long. $1\frac{1}{4}$ lin.

Hab. Dorey.

PANIGENA.

(Isorhynchinæ.)

Rostrum subtenuatum (vel paulo incrassatum, arcuatum, apicem versus parum dilatatum; *scrobes* submedianæ. *Oculi* mediocres, rotundati, antice approximati, fortiter granulati. *Scapus* gracilis; *funiculus* articulo primo ampliato, secundo longiusculo, cæteris obconicis; *clava* distincta. *Prothorax* conicus, basi ampliatus, bisinuatus. *Scutellum* distinctum. *Elytra* cordata, prothorace multo latiora, humeris obliqua. *Pectus* canaliculatum. *Coxæ* anticæ basi approximatæ. *Femora* sublinearia, infra dentata; *tibiæ* subsulcatæ, flexuosæ, vel intermediæ rectæ, apice calcaratæ. *Abdomen* segmentis duobus basalibus ampliatis. *Corpus* convexum, subrhomboideum, lævigatum.

The pectoral canal is limited behind by the anterior coxæ, and is therefore incapable of receiving the rostrum. The eyes are of moderate size, rounded, and placed just above the base of the rostrum, leaving a tolerably broad front to the head above them; they are nearly contiguous in the first two species, less so in *P. cyanoptera*, and still further apart in *P. pedestris*.

Panigena chalybea. *P.* nitidissima, cyaneo-iridescens; capite rostroque nigris, illo subtiliter vage, hoc basi sat rude punctatis, et prothorace paulo longiore; oculis supra subcontiguis; antennis fulvis; funiculo articulo secundo quam primo manifeste longiore; prothorace impunctato; scutello subquadrato, nigro; elytris circa scutellum paulo elevatis, seriatim fortiter remote punctatis, interstitiis latis; corpore infra nigro; pedibus piceis, squamulis piliformibus albis sparse vestitis; tarsis piceo-fulvis. Long. $1\frac{2}{3}$ lin.

Hab. Batchian.

Panigena violacea. *P.* nitide violacea, capite rostroque nigris, illo subtilissime punctulato, hoc prothorace paulo longiore, apice vix latiore; antennis fulvis; funiculo articulo secundo quam primo longiore; clava valida, ovata; oculis supra contiguis; prothorace impunctato; scutello nitide nigro, rotundato; elytris seriatim sat fortiter remote punctatis; corpore infra nigro; pedibus nigro-piceis; tarsis piceo-fulvis. Long. $1\frac{1}{2}$ lin.

Hab. Batchian.

The eyes are absolutely in contact in this species; it has also a narrower antennal club, and is not so broad and massive as the preceding.

Panigena cyanoptera. *P.* nitide nigra, elytris cyaneis; rostro prothorace parum longiore, cylindrico, apice vix latiore; antennis fulvo-testaceis; funiculo articulis duobus basalibus longitudine æqualibus; clava elongato-ovata; oculis haud contiguis; prothorace magis transverso, impunctato; scutello scutiformi; elytris sat tenuiter seriatim remote punctatis; corpore infra pedibusque piceis; tarsis subfulvis. Long. $1\frac{1}{2}$ lin.

Hab. Saylee.

There is an interval between the eyes equal to about a quarter part the diameter of one of them. In this and the last species the rostrum is nearly cylindrical, only a little flattened, without being dilated, at the apex.

Panigena pedestris. *P.* nitide cyanea; capite castaneo, disperse punctato; rostro valido, prothorace breviore, rufo-piceo; antennis fulvis; funiculo articulo secundo quam primo longiore; clava pallida, ovato-acuminata; oculis haud contiguis; prothorace subtilissime sparsim punctulato; scutello nigro; elytris seriatim tenuiter remote punctatis; corpore infra nigro; metasterno late excavato; pedibus rufo-piceis. Long. $1\frac{1}{2}$ lin.

Hab. Mysol.

This species has a much more robust rostrum than either of the preceding. A variety, probably from Salwatty, has a sensibly finer punctuation of the elytra.

Œbrius.

(Isorhynchinæ.)

Caput parvum ; *rostrum* modice tenuatum, apicem versus dilatatum ; *scrobes* præmedianæ. *Oculi* mediocres, rotundati, prominuli, antice modice approximati, fortiter granulati. *Scapus* elongatus, oculum vix attingens ; *funiculus* articulo primo ampliato, secundo longiusculo, cæteris breviter obconicis ; *clava* ovata. *Prothorax* transversus, subconicus, basi subbisinuatus. *Scutellum* distinctum. *Elytra* cordiformia, prothorace multo latiora. *Pectus* breviusculum, haud canaliculatum. *Coxæ* anticæ approximatæ. *Femora* modice incrassata, infra canaliculata et dentata ; *tibiæ* anticæ rectæ, posticæ et intermediæ arcuatæ, apice haud calcaratæ ; *tarsi* normales. *Abdomen* segmentis duobus basalibus ampliatis, intermediis ad latera arcuatis. *Processus* intercoxalis latissimus.

This genus differs, *inter alia*, from *Panigena* in not having the tibiæ spurred. In the species described below the eyes have remarkably large facets, and the scrobes commence much nearer the apex of the rostrum than is usually the case. The dense patches of snowy scales on the upper margin of the femora are met with also in *Thyestetha*, *Telaugia*, *Idotasia*, and other genera of the Zygopinæ, as well as in *Othippia* (*ante*, p. 49).

Œbrius luteicornis. (Pl. III. fig. 3.) *O.* piceo-niger, nitidus ; rostro prothorace plus sesquilongiore, basi striato, apice lævigato ; antennis luteis, clava infuscata ; prothorace apice angusto, basi valde dilatato, utrinque paulo rotundato, fortiter punctato ; elytris seriatim punctatis, punctis majusculis, linearibus, interstitiis planatis, impunctatis ; corpore infra nitide fusco ; metasterno late excavato, et segmentis duobus basalibus abdominis fortiter punctatis ; femoribus intermediis et posticis infra, præsertim posticis, dente majusculo instructis, margine superiore dense niveo-squamoso. Long. 1½ lin.

Hab. Mysol ; Waigiou.

Lissoglena.

(Isorhynchinæ.)

A *Panigena* differt *rima* pectorali inter coxas anticas continuata et articulo primo *funiculi* majusculo, quam secundo duplo longiore.

The pectoral canal in this genus is continued between the anterior coxæ, the opposite surfaces of these being exposed and forming in part the sides of the canal.

LISSOGLENA PICIPENNIS. *L.* subrhombica; capite prothoraceque rufo-castaneis, elytris piceis; rostro longitudine prothoracis, parum arcuato, apice haud latiore, capite impunctato; antennis rufo-castaneis, clava elongato-ovata, nigricante; oculis contiguis; prothorace subtilissime punctulato; scutello piceo; elytris cordiformibus, seriatim tenuiter remote punctulatis; corpore infra subcastaneo; abdomine segmento primo fortiter punctato, reliquis lævigatis; femoribus tibiisque fusco-piceis; tarsis fulvis. Long. $1\frac{1}{4}$ lin.

Hab. Sumatra.

The subjoined table of the Isorhynchinæ will show the diagnostic characters of the genera I have here proposed.

Intermediate segments of the abdomen nearly equal in length.
  Pectoral canal not passing behind the anterior coxæ.
    Pectus elongate .... *Lobotrachelus*, Schön.
    Pectus very short .... *Pseniclea*, n. g.
  Pectoral canal prolonged to the mesosternum.
    Penultimate joint of the tarsi with divaricate lobes.
                                                  Rhadinocerus, Schön.
    Penultimate joint of the tarsi with approximate lobes.
      Scutellar lobe of the prothorax covering the scutellum.
                                                  Metetra, n. g.
      Scutellar lobe of the prothorax not covering the scutellum.
        Basal joint of the funicle incrassate.
                                                  Othippia, n. g.
        Basal joint of the funicle slender. *Egiona*, n. g.
Second abdominal segment as long or nearly as long as the two next together.
  Anterior femora very large .... *Telephaë*, Pasc.
  Anterior femora of the normal size.
    Pectus canaliculate.
      Pectoral canal passing behind the anterior coxæ.
        Body oblong, pubescent .... *Conophorus*, Schön.
        Body rhomboid or elliptic, naked.
          Eyes contiguous .... *Lissoglena*, n. g.
          Eyes not contiguous .... *Brephiope*, n. g.
      Pectoral canal limited by the anterior coxæ.
        Femora toothed.

Body oblong, pubescent...... *Elattocerus*, Schön.
Body trapezoid, naked ..... *Panigena*, n. g.
Femora not toothed .... *Isorhynchus*, Schön.
Pectus not canaliculate .... *Œbrius*, n. g.

Pseudocholus laticollis. *P.* (♂) obovatus, nitidissime niger, elytris saturate metallico-viridibus; rostro dimidio basali rude, reliquo gradatim minus punctato; antennis nitide ferrugineis; funiculo articulo secundo quam primo parum breviore; prothorace valde ampliato, sat remote tenuiter punctulato; elytris lineatim sulcato-punctatis, sulcis basi rugoso-punctatis, interstitiis planatis, subtiliter remote punctulatis; corpore infra sat tenuiter punctato; pedibus elongatis; tarsis anticis articulis duobus basalibus longe pilosis. Long. 5½ lin.

Hab. Ceram.

The genus *Pseudocholus* was founded by Lacordaire on an imperfect specimen from New Guinea. Mr. Wallace found several species in the Malayan islands, some of which are here described. The antennæ, which were wanting in Lacordaire's type, are slender, the scape scarcely attaining the eye, the first joint of the funicle not enlarged, and the club tomentose and four-jointed. The males have apparently longer or broader tarsi, fringed with long hairs.

Pseudocholus basalis. *P.* (♂) obovatus, niger, nitidus, elytris æneis; rostro sat sparse tenuiter punctulato, punctis apicem versus magis aspersis; antennis ferrugineis; funiculo articulo secundo quam primo sesquilongiore; prothorace tenuiter sparse punctulato; elytris lineatim sulcato-punctatis, interstitiis planatis, impunctatis, basi versus scutellum albo-squamosis; corpore infra tenuiter punctato, punctis singulis squama alba instructis; tarsis anticis articulo primo elongato. Long. 5 lin.

Hab. Gilolo; Morty.

Pseudocholus orichalceus. *P.* subellipticus, orichalceus; rostro sat confertim, basi fortiter punctato; antennis ferrugineis; funiculo articulis duobus basalibus elongatis, longitudine æquali, reliquis conjunctim haud longioribus; prothorace longiore, sat confertim tenuiter punctato; elytris lineatim sulcato-punctatis, sulcis basi latioribus, rugosis, interstitiis planatis subtilissime remote punctatis; corpore infra sat confertim tenuiter punctato. Long. 4½ lin.

Hab. Bouru.

Pseudocholus cinctus. *P.* rhomboideus, æneo-niger, parum nitidus; prothorace elytrisque vitta laterali stramineo-squamosa ornatis; rostro prothorace vix latiore, antennis ferrugineis; prothorace in medio leviter, ad latera fortiter punctato, punctis singulis squama minuta straminea munitis, disco utrinque longitudinaliter excavato, squamis stramineis sat dense obsito; elytris lineatim sulcatis, interstitiis punctulatis; corpore infra fusco-castaneo, subtiliter punctulato; femoribus tibiisque punctis numerosis singulis squama elongata vel filiformi munitis. Long. 4 lin.

Hab. Saylee (New Guinea).

This species will hardly fail to recall the Brazilian *Cholus albicinctus*, Germ. It will be recollected that Lacordaire was struck with the resemblance of the only species he knew to the members generally of that New-World tropical genus.

Metanthia.

(Baridinæ.)

Rostrum robustum, arcuatum, basi gibbosulum, apice depressum, vix dilatatum; *scrobes* submedianæ. *Oculi* ovales, tenuiter granulati. *Antennæ* validæ; *scapus* breviusculus; *funiculus* articulo primo ampliato, cæteris cum clava continuatis. *Prothorax* conicus, lobo scutellari paulo producto, lobis ocularibus haud prominulis. *Scutellum* distinctum. *Elytra* elongato-trigonata. *Pectus* haud ampliatum, canaliculatum. *Coxæ* anticæ manifeste separatæ. *Femora* sublinearia, mutica, infra canaliculata; *tibiæ* rectæ, apice calcaratæ. *Abdomen* segmentis duobus basalibus ampliatis, connatis. *Corpus* anguste subrhomboideum, in *M. nitidula* ellipticum.

From *Ipsichora* this genus differs in its approximate coxæ, less marked, however, in *M. nitidula*, thick rostrum, raised at its base, and short stout scape, not nearly attaining the eye. *M. nitidula* has shorter and more cordate elytra than the first three species.

Metanthia pyritosa. (Pl. III. fig. 4.) *M.* splendide aureo-viridis, igneo micans, scutello, femoribus tibiisque vel læte azureis vel aureo-viridibus, tarsis nigris; rostro sparse subtiliter punctato; antennis ferrugineis; prothorace sparse punctato; elytris seriatim punctatis, interstitiis subtiliter punctulatis; corpore infra inæqualiter punctato. Long. 3¼ lin.

Hab. Dorey; Saylee.

Metanthia ebenina. *M.* omnino atra, nitida, antennis fuscis capite nitidissimo, impunctato; prothorace subtilissime sparse punctato; elytris seriatim punctatis, serie prima basi punctis majoribus, apicem versus gradatim minoribus, seriebus reliquis subtiliter punctatis, interstitiis fere impunctatis; segmento ultimo abdominis bifoveato. Long. $2\frac{2}{3}$ lin.

Hab. Batchian.

METANTHIA CYANEA. *M.* supra saturate cyanea, subtus nigra, omnino nitida; rostro subtiliter punctato; antennis ferrugineis; prothorace subtilissime punctato; elytris tenuiter seriatim punctatis, interstitiis impunctatis; tibiis tarsisque castaneis, articulo ultimo tarsorum piceo. Long. $2\frac{2}{3}$ lin.

Hab. Waigiou.

METANTHIA NITIDULA. *M.* elliptica, atra, nitida, supra minus convexa, impunctata; rostro prothorace haud longiore, subtiliter vage punctulato; antennis ferrugineis; prothorace antice sat subito constricto, lateraliter gradatim leviter latiore; elytris oblongo-cordiformibus, obsolete striatis, basi excepta; corpore infra rarissime subtiliter punctulato; femoribus punctis oblongis majusculis impressis. Long. $2\frac{1}{4}$ lin.

Hab. Batchian.

IPSICHORA.

(Baridinæ.)

Rostrum elongatum, subulatum, basi haud gibbosulum, apice vix dilatatum; *scrobes* submedianæ. *Oculi* ovati, tenuiter granulati. *Scapus* gracilis, oculum haud attingens; *funiculus* articulo basali ampliato, cæteris gradatim crassioribus, in clavam continuatis. *Prothorax* transversus, antice tubulatus, basi bisinuatus. *Elytra* prothorace vix latiora, oblongo-cordiformia. *Pectus* ampliatum. *Coxæ* anticæ valde remotæ. *Pedes* mediocres; *femora* subelongata, modice incrassata, infra canaliculata et dente minuto instructa; *tibiæ* rectæ, apice calcaratæ. *Abdomen* segmentis duobus basalibus ampliatis.

With the rostrum of *Pseudocholus* this genus differs in its shorter legs, and the femora stouter and canaliculate beneath; the species, instead of the bronze or dark olive of that genus, are of a rich blue, but varied, even individually to some extent, by violet or copper reflections. The males appear to have the anterior tarsi larger and fimbriated as in *Pseudocholus*.

IPSICHORA CUPIDO. *I.* subelliptica, ubique nitidissima, supra cærulea, prothorace violaceo vel purpureo; rostro prothorace fere sesquilongiore, obsolete punctato, nigro, basi capiteque chalybeatis; antennis fusco-castaneis; prothorace utrinque modice ampliato, pone apicem in certa luce quasi sulcato, subtilissime vage punctato; elytris fere obsolete striatis, striis subtilissime punctulatis, interstitiis punctulis minutis adspersis; corpore infra metallico-viridi; pedibus plus minusve chalybeatis; tarsis nigris. Long. $3\frac{1}{2}$ lin.

Hab. Ceram.

Ipsichora cœlestis. *I.* subelliptica, ubique nitidissima, supra pedibusque cæruleis; rostro prothorace sesquilongiore, subtiliter punctulato, aliquando basi excepta nigro; antennis ferrugineis; prothorace ut in præcedente, sed paulo magis punctulato; elytris fere obsolete striatis, leviter sed manifeste punctulatis, interstitiis impunctatis; corpore infra metallico-viridi, sparse albo-setuloso; tarsis nigris. Long. $3\frac{1}{2}$ lin.

Hab. Dorey; Saylee.

Very like the preceding, but there is a manifest difference in the punctuation.

Ipsichora pulchella. *I.* elliptica, nitidissima, cærulea, prothorace splendide aureo-cupreo; rostro minus elongato, nigro, basi capiteque metallico-viridibus; antennis nigris; scapo breviusculo; prothorace utrinque minus ampliato, pone apicem quasi sulcato, tenuiter vage punctulato; scutello nigro; elytris fere obsolete striatis, striis subtiliter punctulatis, interstitiis punctulis minutissimis adspersis; corpore infra splendide metallico-viridi; pedibus chalybeatis; tarsis nigris Long. $2\frac{1}{2}$ lin.

Hab. Salwatty (New Guinea).

Ipsichora femorata. *I.* subelliptica, cærulea, rostro pedibusque, femoribus exceptis, chalybeatis; rostro minus elongato, basi paulo curvato; antennis ferrugineis; prothorace subtransverso, sat vage punctato, apice haud sulcato; elytris lineatim striato-punctatis, punctis modice approximatis, interstitiis subtiliter remote punctulatis; femoribus magis incrassatis, rufis, basi apiceque chalybeatis exceptis; tarsis nigris. Long. $2\frac{3}{4}$ lin.

Hab. Aru.

Myctides.

(Baridinæ.)

Rostrum paulo arcuatum, apice haud dilatatum, prothorace duplo longius; *scrobes* antemedianæ. *Scapus* ab oculo remotus; *funiculus* articulo primo elongato, a secundo in clavam continuatus. *Oculi* ovales, magni, tenuiter granulati, prothorace contigui. *Prothorax* conicus, apice angustus, parum productus. *Scutellum* parvum. *Elytra* subconvexa, cordiformia, basi prothorace vix latiora, humeris rotundata. *Pygidium* parvum. *Femora* vix incrassata, infra dente parvo instructa; *tibiæ* rectæ, sulcatæ. *Pectus* ampliatum, convexum. *Coxæ* anticæ distantes. *Prosternum* postice latum, truncatum. *Abdomen* segmentis duobus basalibus ampliatis, connatis. *Corpus* rhomboideum.

The Baridinæ with the sterna forming a continuous level, for which Lacordaire forms his "sous-tribu Madarides"*, appear to be rather abundant in the Malasian islands, *Pseudocholus* being especially well represented. I have here only worked out a few genera, leaving several species undescribed, which I do not think it desirable to publish on the strength of my present materials, so uncertain are the limits to be placed to their generic and specific characters. Thus one of these doubtful forms has a canaliculate pectus, which, according to Lacordaire, would take it out of the "Lyteriides," to which, however, it obviously belongs, and among which I have placed those now described; at the same time I think it probable that such a character is here only of specific value. *Lyterius* itself is unknown to me, except as illustrated by *Baris complanatus* (Dej. Cat.), which, however, disagrees with the genus, as defined by Schönherr, in the scape not attaining the eye, an important character; Lacordaire only knew the American species *melas*, as *instabilis* does not, he says, belong even to the subfamily. I have another species from Fiji. As yet only three or four species of the genus *Baris* out of the whole subfamily are known from Australia.

Myctides barbatus. *M.* niger, nitidus; rostro fusco, sparse punctulato, (♂) infra, basi excepto, ferrugineo-barbato; antennis piceo-fuscis; funiculo articulo primo quam secundo duplo longiore; prothorace punctis parvis raris distinctis impresso; scutello subrotundato; elytris prothorace sesquilongioribus, pone humeros paulo incurvatis, lineato-impressis, lineis, basi versus scutellum excepta, punctatis, interstitiis planatis, subtiliter sparse punctulatis; corpore infra pedibusque punctis argenteo-squamigeris adspersis. Long. $2\frac{3}{4}$ lin.

Hab. Batchian.

Cynethia.

(Baridinæ.)

Rostrum elongatum, basi sulcatum et incrassatum, apice dilatatum; *scrobes* postmedianæ. *Scapus* ab oculo remotus; *funiculus* articulo primo secundo haud crassiore, ultimis brevibus,

* It must be recollected, however, that Lacordaire himself states, "the passage from one to the other is effected in a manner almost insensible."

in clavam continuatis. *Oculi* prothoraci contigui. *Prothorax* subconicus, apice latior, paulo productus. *Scutellum* distinctum. *Elytra* oblonga, supra paulo planata, prothorace vix latiora. *Pygidium* parvum. *Femora* longiuscula, sublinearia, postica infra canaliculata, omnia dente parvo instructa; *tibiæ* anticæ subflexuosæ, reliquæ arcuatæ, sulcatæ, apice fortiter mucronatæ. *Pectus* leviter excavatum. *Coxæ* anticæ distantes. *Prosternum* latum, postice truncatum. *Abdomen* segmentis duobus basalibus ampliatis, connatis.

Allied to *Myctides*, but with the rostrum dilated at the apex, the scrobes commencing behind the middle, the elytra flat along the suture, &c. The species described below is not unlike *Baris virgata*, Boh.*

CYNETHIA INTERRUPTA. (Pl. III. fig. 12.) *C.* elliptica, fusco-nigra, vix nitida, lineis albido-squamosis ornata; rostro basi capiteque crebre punctulatis, illo deinde ad apicem castaneo, subtiliter sparse punctulato; antennis castaneis, scapo pallidiore; prothorace sat confertim punctato, disco lateribus utrinque vittato; elytris pone humeros latioribus, ante apicem callosis, lineatim sulcatis, interstitiis planatis, secundo excepto uniseriatim punctulatis, interstitio tertio vitta interrupta albido-squamosa ornatis; corpore infra castaneo, vittis duabus albido-squamosis ornato. Long. 3 lin.

Hab. Sumatra.

ACYTHOPEUS.

(Baridinæ.)

Caput parvum; *rostrum* arcuatum, basi crassius, supra gibbosulum, versus apicem gradatim tenuatum, apice ipso paulo depressum; *scrobes* medianæ vel postmedianæ. *Scapus* ab oculo remotus; *funiculus* articulo primo ampliato, reliquis in clavam continuatis. *Oculi* tenuiter granulati, prothoraci contigui. *Prothorax* transversus, apice tubulatus, haud productus, basi fortiter bisinuatus. *Scutellum* parvum. *Elytra* prothorace vix latiora (♀?), postice angustiora. *Femora* mutica, infra subcanaliculata. *Cætera* ut in *Myctide*.

Near *Myctides*, only the rostrum is very much curved and thickened at the base, and the femora are entire beneath. The position of the scrobes in the first three species described below shows that it is only a specific character (or possibly sexual); the

* This species, judging from Mr. Wallace's collection, has a distribution extending from Sumatra to New Guinea.

last species is an aberrant form, but there is nothing to warrant its separation generically except the smaller tarsi.

Acythopeus tristis. (Pl. III. fig. 11.) *A.* obovatus, obscure fuscus, opacus; rostro crassiore, basi manifeste magis curvato, leviter gibbosulo et confertim punctato, versus apicem punctis gradatim minoribus et magis adspersis; scrobibus medianis; antennis ferrugineis; prothorace in medio valde ampliato, ubique crebre reticulato-punctato; elytris lineatim sulcatis, interstitiis planatis, transversim rude punctatis; pygidio nigro, transverso; corpore infra pedibusque fuscis, punctis, singulis seta minuta alba instructis, adspersis. Long. $2\frac{1}{2}$ lin.

Hab. New Guinea (Saylee).

Acythopeus tenuirostris. *A.* obovatus, obscure fuscus, opacus; rostro tenuiore, basi supra leviter gibbosulo, punctis vix confertis minus impresso, reliquo fere impunctato; antennis fuscis; prothorace subæquilaterali, apice subito tubulato, confertim punctulato; elytris subcordiformibus, lineatim sulcatis, interstitiis planatis, transversim punctatis; pygidio nigro; corpore infra pedibusque nitide nigris, leviter sparse punctulato. Long. $2\frac{1}{4}$ lin.

Hab. Tondano.

This species may be readily recognized by its slender rostrum, at least in the female.

Acythopeus palmaris. *A.* niger, nitidus, rostrum conferte rude punctatum; scrobibus præmedianis; antennis nigris, scapo longiusculo, clava elongata magna; prothorace ampliato, crebre fortiter punctato; elytris lineatim sulcatis, interstitiis planatis, transversim leviter impresso-punctatis, uniseriatim subtiliter setulosis; pectore utrinque coxas proxime dente obtuso instructo; pedibus anticis multo majoribus, tarsis ipsis majusculis, articulo tertio profunde bilobo. Long. $2\frac{1}{3}$ lin.

Hab. Amboyna.

The length of the fore legs with their broader tarsi and the large tomentose club are at once distinctive of this species. My specimen is, I think, a female, notwithstanding the length of the fore legs.

Acythopeus curvirostris. *A.* niger, subnitidus, rostro piceo, basi valde arcuato, incrassato, crebre rude punctato, (♀) dimidio apicali tenuato, lævigato; scrobibus postmedianis; antennis piceis, clava late ovata; prothorace vix ampliato, confertissime rude punctato; elytris lineatim sulcatis, interstitiis planatis, transversim uni- vel biseriatim punctatis; pectore squamis ochraceis adsperso; epipleura metathoracis segmentoque primo abdominis utrinque dense ochraceo-squamosis. Long. 2 lin.

Hab. Gilolo; Batchian.

The rostrum is more abruptly curved at the base in this than in any other of the species here described; in the male the rostrum is punctured throughout, and the scrobes commence a little nearer the middle. There is a little patch of white scales at the base of the prothorax on each side in two of my specimens.

Acythopeus bigeminatus. *A.* oblongus, ater, subnitidus, elytris albo-quadrimaculatis; rostro ferrugineo, minus elongato, basi profunde inciso et valde gibboso, confertim punctato, punctis apicem versus minutis; antennis subferrugineis; funiculo brevi, articulo primo quam secundo triplo longiore; prothorace haud confertim punctato, lateribus leviter rotundatis; elytris elongato-cordatis, lineatim sulcatis, interstitiis subrugosis, tertio maculis duabus albis—una basali, altera præapicali—e squamis condensatis, notato; pectore sternisque punctis majoribus, abdomine minoribus, punctis albo-setigeris, adspersis; tarsis minusculis. Long. $1\frac{2}{3}$–$2\frac{1}{3}$ lin.

Hab. Batchian; Aru.

Laodia.

(Baridinæ.)

Caput sphæricum; *rostrum* elongatum, cylindricum, apice dilatatum; *scrobes* antemedianæ. *Scapus* ab oculo remotus; *funiculus* in clavam continuatus. *Oculi* ovati, tenuiter granulati, prothorace haud contigui. *Prothorax* suboblongus, utrinque rotundatus, apice angustus, truncatus. *Scutellum* parvum. *Elytra* obovata, prothorace vix latiora. *Pedes* longiusculi, *femora* vix incrassata, mutica; *tibiæ* arcuatæ; *tarsis* articulo ultimo minusculo. *Pectus* ampliatum. *Coxæ* anticæ modice distantes. *Prosternum* postice latum, truncatum. *Abdomen* segmentis duobus basalibus ampliatis, connatis.

The characters in this genus are nearly the same as in *Myctides*; but the dilated apex of the rostrum, the eye not in contact with the prothorax, the small claw-joint, and the different contour are sufficiently diverse. Although the anterior femora are not dentate, there are two or three very small points beneath, probably not always present. My specimens of the two species here described appear to be females.

Laodia niveopicta. (Pl. III. fig. 8.) *L.* anguste ovalis, nitidissima, picea, elytris atris, maculis niveis, e squamis condensatis, notatis, scil. duabus basi prothoracis, duabus singulo elytro—una basali, altera præapicali; rostro piceo, prothorace plus duplo longiore, lineis elevatis longitudinalibus, interstitiis, apice excepto, punctatis, munito; funiculo articulo primo quam secundo fere duplo longiore; prothorace in medio sat sparse punctulato, lateribus confertim granulato; elytris lineatim sulcatis, interstitiis uniseriatim punctulatis; corpore infra sat confertim albo-setosulis; abdomine punctis minutis adspersis. Long. 1 lin.

Hab. Macassar.

Laodia niveosparsa. *L.* ovata, nitidissima, atra, elytris maculis parvis albis quatuor, e squamis condensatis, notatis, scil. singulis una basali, altera apicali; rostro piceo, prothorace triplo longiore, lineato ut in præcedente; funiculo articulis duobus basalibus æqualibus; prothorace in medio sparse punctato, lateribus rugoso-punctatis; elytris lineatim sulcatis, sulcis punctis remotis manifeste impressis, duobus suturalibus ad basin majusculis; corpore infra sparse niveo-setosis; tibiis tarsisque piceis. Long. 1⅔ lin.

Hab. Amboyna.

Lystrus.

(Baridinæ.)

Rostrum paulo arcuatum, apicem versus gradatim dilatatum, prothorace longius; *scrobes* antemedianæ. *Scapus* oculum haud attingens; *funiculus* articulo primo ampliato, a secundo in clavam gradatim continuatus; *clava* magna. *Oculi* rotundati, prothoraci haud contigui, tenuiter granulati. *Prothorax* conicus, apice truncatus, lobo scutellari late emarginato pro receptione basis scutelli. *Scutellum* magnum. *Elytra* equilateraliter triangularia, humeris paulo producta, rotundata. *Femora* subincrassata, infra dentata; *tibiæ* arcuatæ. *Pectus* incurvatum; *prosternum* postice breve. *Coxæ* anticæ fere contiguæ. *Abdomen* segmento primo ampliato.

The anterior coxæ only feebly separated, and with the usual non-continuity of the line of the sterna, imply a technical position of this genus near *Madopterus*; but its trapezoid form compared with the cylindrical one of the latter is not favourable to any consideration of affinity. I have a second species from Tsusima, in the Corean Straits, distinguished, *inter alia*, by its closely *punctured* prothorax.

Lystrus sculptipennis. (Pl. III. fig. 1.) *L.* trapezoideus, fusconiger, parum nitidus; rostro crebre lineatim punctato; antennis ferrugineis; clava articulis sex præcedentibus funiculi longitudine æquali; prothorace confertim granulato, in medio postice linea elevata instructo; scutello transverso; elytris fortiter sulcatis, interstitiis elevato-carinatis, carinis lateraliter impresso-punctatis; corpore infra squamositate subsulphurea tecto; femoribus tibiisque sat crebre punctatis, his lineis elevatis instructis. Long. 2 lin.

Hab. Singapore; Macassar.

SIMOCOPIS.

(Baridinæ.)

Caput parvum, sphæricum; *rostrum* modice elongatum, arcuatum, basi leviter incrassatum, paulo compressum, reliquo valde depresso (vel laminiformi), apicem versus gradatim dilatatum; *scrobes* subbasales. *Oculi* rotundati. *Scapus* oculum haud attingens; *funiculus* articulis duobus basalibus elongatis. *Prothorax* transversus, ampliatus, basi late bisinuatus, lobis ocularibus fere obsoletis. *Scutellum* subquadratum. *Elytra* subcordiformia, prothorace vix latiora, humeris obliquis. *Pectus* leviter excavatum. *Coxæ* anticæ distantes. *Pedes* breviusculi; *femora* incrassata, mutica; *tibiæ* breves, incurvatæ, mucronatæ; *tarsi* articulo ultimo elongato; *unguiculi* liberi. *Abdomen* segmentis duobus basalibus ampliatis.

Like *Elasmorhinus*, Lac., in its depressed rostrum, which is even more remarkable than in that genus on account of its breadth, and the longitudinal middle portion is so attenuated as to be almost diaphanous. In other respects it differs from *Elasmorhinus*, of which I have a second species, in its free claws. I am not quite certain of the habitat of the only example I have seen of this species; unfortunately its antennæ are incomplete.

SIMOCOPIS UMBRINUS. (Pl. III. fig. 10.) *S.* late obovatus, fusco-umbrinus; capite sparse punctato; rostro quam prothorace vix longiore, nitido, impunctato; prothorace nitido, valde transverso, in medio sparse, ad latera irregulariter striato-punctato, basi utrinque squamis elongatis ochraceis vestito; elytris opacis, lineatim sulcato-punctatis, interstitiis rugosis, transversim crebre punctatis, basi squamis elongatis ochraceis vestitis; corpore infra tenuiter sparse setosulo; pedibus, præsertim femoribus, magis dense squamosis. Long. 4 lin.

Hab. Brazil?

The following tabular view of Lacordaire's "groupe Lyteriides," one of the divisions of his "sous-tribu Madarides" (Gen. t. vii. p. 249), includes the new genera proposed above:—

Rostrum cylindrical.
- Pygidium free.
  - Pectus with a horn-like projection .... *Microstates*, Lac.
  - Pectus without a horn-like projection.
    - Rostrum robust .... *Metanthia*, n. g.
    - Rostrum slender.
      - Anterior coxæ slightly separated .. *Lystrus*, n. g.
      - Anterior coxæ widely apart.
        - Rostrum slender throughout.... *Myctides*, n. g.
        - Rostrum thicker at the base.
          - Prothorax produced at the apex. *Cynethia*, n. g.
          - Prothorax truncate at the apex. *Acythopeus*, n. g.
- Pygidium covered, or nearly so.
  - Scape remote from the eye .... *Laodia*, n. g.
  - Scape nearly attaining the eye.
    - Femora canaliculate beneath........ *Ipsichora*, n. g.
    - Femora not canaliculate beneath .... *Pseudocholus*, Lac.

Rostrum lamelliform.
- Claws connate........................ *Elasmorhinus*, Lac.
- Claws free .... *Simocopis*, n. g.

Lyterius, Schön., is omitted as a doubtful member of this group. *Lyterius*, Lac., is probably not identical with Schönherr's genus (see Gen. vii. p. 250). *Eumycterus* (from Asia Minor), unknown to me, is placed by Schönherr in Cossoninæ. It is possible that *Tithene* (*antè*, p. 25) may have affinity with this "groupe."

PRODIOCTES.

(Calandrinæ.)

Megaprocto congruit, sed *scapus* elongatus, *elytra* prothorace latiora, et *femora* magis clavata, postica breviora. *Rostrum* tenuatum, arcuatum. *Pygidium* obtusum. *Tibiæ* flexuosæ.

There are a number of intermediate (and undescribed) species allied to *Sphenocorynus* and *Megaproctus*, which it is almost impossible to distribute into well-limited genera, but which cannot be united without also merging the two above mentioned into one genus with them. For those in my collection belonging to Lacordaire's "groupe Sphenocorynides," which has the pygidium horizontal (or a little deflexed), including the species in question, I have adopted the following genera, under which I have arranged them as well as the variability of the characters will allow me:—

1. Elytra broader than the prothorax.
   Sphenocorynus, Schön. Rostrum short, stout.
   Prodioctes, n. g. Rostrum slender, curved; femora clavate.
   Tyndides, n. g. Rostrum slender, straight; femora sublinear.
2. Elytra not broader, or only very slightly, than the prothorax.
   Megaproctus, Schön. Elytra narrowed from the base to the apex.
   Periphemus, n. g. Elytra with parallel sides; anterior femora stout; club with the spongy part obsolete.
   Zetheus, n. g. Elytra with parallel sides; femora long, slender; club with the spongy part produced.

Under *Prodioctes* I place *Sphenophorus Dehaani*, Gyll., a species with ascending mesothoracic epimera, and select the following for description as best illustrative of the genus. Other species are from the Philippine Islands, Borneo, Ceram, Amboyna, and New Guinea.

Prodioctes quinarius. (Pl. IV. fig. 2.) *P.* ellipticus, umbrinus; rostro prothorace longiore, basi confertim squamigero-punctato, reliquo capiteque nudis, nitide castaneis; scapo funiculo cum clava longiore; prothorace oblongo, pone medium incurvato, basi valde rotundato; scutello minuto; elytris brevibus, pone basin latioribus, haud striatis, maculis majusculis nigro-velutinis, pallide marginatis, decoratis, scil. una communi pone scutellum, et duabus lateralibus, una humerali altera ante apicem, obsitis; pygidio modice elongato, sparse setigero-punctato; corpore infra obscure umbrino-punctato; pedibus vage setigero-punctatis. Long. 8 lin.

Hab. Borneo (Muruk).

Prodioctes pavoninus. *P.* ellipticus, rufo-ferrugineis, supra indumento flavescente guttatim notatus; rostro prothorace breviore, supra ad apicem guttato-punctato; antennis indumento pallido vestitis; funiculo articulo secundo quam primo longiore; prothorace oblongo, guttis numerosis, nonnullis contiguis, dorso lineaque laterali ornato; scutello indumento tecto; elytris latitudine plus sesquilongioribus, seriatim punctatis, interstitiis guttatis, singulis maculis duabus nigris, concinne flavo-marginatis, una humerali, altera ante apicem, ornatis; pygidio apice bifido, utrinque flavescenti-vittato; corpore infra fusco, obscure guttato; femoribus supra indumento albido tectis; tibiis anticis intus fortiter bisinuatis, intermediis et posticis setulis ferrugineis intus dense ciliatis. Long. $5\frac{1}{2}$ lin.

Hab. Sarawak.

Tyndides.

(Calandrinæ.)

Rostrum porrectum, elongatum, rectum, gradatim angustius, sed apicem versus dilatatum; *scrobes* subbasales. *Prothorax* elongato-conicus. *Scutellum* parvum. *Femora* sublinearia, postica elongata, infra dente minuto instructa; *tibiæ* squamoso-maculatæ, intus haud sinuatæ. *Cætera* fere ut in *Megaprocto*.

The two species here described are closely allied; but the second is considerably narrower, the pygidium not compressed at the apex, and the prothorax has a very distinct white line on each side.

Tyndides pustulosus. (Pl. IV. fig. 4.) *T.* ellipticus, fuscus, punctis numerosis, squamositate ochracea repletis, adspersus; capite rostroque basi ochraceo-squamosis, hoc a medio ferrugineo, apice excepto, rugoso-punctato; antennis indumento ochraceo tectis, articulo basali clavæ glabro excepto; prothorace latitudine duplo longiore, paulo planato, punctis plurimis fere contiguis, linea longitudinali media lateribusque exceptis; elytris pone basin paulo latioribus, deinde parum rotundatis et angustioribus, striato-punctatis, interstitiis punctis sæpe confluentibus notatis; pygidio versus apicem compresso, et supra carinato; corpore infra, segmentis abdominis in medio exceptis, pedibusque plus minusve dense squamoso-punctatis, segmento basali rude punctato. Long. 9½ lin. (rost. incl.).

Hab. Sumatra; Malacca.

Tyndides lineatus. *T.* anguste ellipticus, punctis numerosis, squamositate alba repletis, adspersus; cæteris ut in præcedente, sed prothorace utrinque linea alba distincta munito, pygidio conico supra integro, et abdomine rude punctato, segmentis tribus intermediis in medio glabris exceptis. Long. 7½ lin. (rost. incl.).

Hab. Sarawak.

Megaproctus pugionatus. (Pl. IV. fig. 8.) *M.* angustus, elongatus, rufo-ferrugineus; rostro recto, pone medium paulo recurvato, basi gibboso, tuberculis numerosis, apice excepto, adsperso; scrobibus basalibus; scapo flexuoso; prothorace latitudine plus duplo longiore, obscure areolato-guttato, in medio nigro-vittato, utrinque vitta angustiore notato; scutello oblongo-triangulari; elytris breviusculis, regione suturali excavatis, striato-punctatis, interstitiis quinto septimoque paulo elevatis; pygidio horizontali, elongato, postice angusto compresso, apice acuto; corpore infra indumento griseo, segmentis ultimis quatuor abdominis exceptis, tecto; pedibus rufescentibus, sparse setulosis. Long. 7½ lin. (rost. incl.).

Hab. Tondano.

ZETHEUS.

(Calandrinæ.)

Megaprocto congruit, sed *scrobibus* basalibus, *elytris* parallelis, et *femoribus* elongatis gracillimis.

It is to this species that Lacordaire probably alludes in the note t. vii. p. 282. The genus, so far as it is represented by the following species, approaches to some undescribed forms of *Prodioctes* in coloration.

ZETHEUS ELECTILIS. (Pl. IV. fig. 1.) *Z.* angustus, rufo-ferrugineus, supra indumento albido guttatim notatus; rostro paulo arcuato, nitide ferrugineo; scapo modice elongato; funiculo articulo secundo quam primo longiore; clava obovata; prothorace latitudine sesquilongiore, utrinque rotundato, guttis albidis inæqualibus irregulariter adsperso; scutello nitide nigro; elytris latitudine duplo longioribus, supra depressis, obsolete striatis, guttis albis minoribus seriatim obsitis, singulis postice macula magna nigra albo marginata ornatis; pygidio elongato-conico, acuto; corpore infra obscure albido-guttato; pedibus fere nudis; femoribus infra acute dentatis. Long. 4½ lin.

Hab. Penang.

PERIPHEMUS.

(Calandrinæ.)

Rostrum breviusculum, tenuatum, parum arcuatum, cylindricum; *scrobes* basales. *Oculi* transversi, ad prothoracem haud approximati. *Scapus* breviusculus, basi rostri insertus; *clava* parte spongiosa obtecta. *Prothorax* oblongus, cylindricus. *Scutellum* elongatum. *Elytra* parallela, prothorace haud latiora. *Pygidium* declive. *Femora* postica elongata sublinearia, intermedia breviora, antica compressa incrassata, omnia infra mutica; *tibiæ* sulcatæ; *tarsi* articulis tribus basalibus infra spongiosis; *unguiculis* parvis, approximatis. *Corpus* angustum, cylindricum.

The cylindrical form, the short slender rostrum with its basal scrobes, and the spongy part of the club concealed, trenchantly differentiate this genus. The three species composing it are homogeneous in point of form and colour, but differ essentially in sculpture as well as in other characters.

PERIPHEMUS RETRORSUS. (Pl. IV. fig. 3.) *P.* nigrescens, lineis griseo-tomentosis punctisque squamositate grisea repletis ornatis;

capite inter oculos gibboso, dense squamoso; rostro capite longiore, sparse punctulato; prothorace latitudine sesquilongiore, confertim leviter punctato, lineis longitudinalibus tribus instructo; elytris striato-punctatis, interstitiis planatis, vage subtiliter squamoso-punctatis, tertio, apice excepto, griseo, quarto ad septimun postice maculatis, fasciam transversam formantibus; pygidio griseo-squamoso; corpore infra pedibusque sparse griseo-squamosis, illo etiam squamositate sat tenuiter vestito; femoribus posticis margine superiore dense squamosis. Long. $5\frac{1}{2}$ lin.

Hab. Sarawak.

A single row of small scale-bearing punctures marks each of the interstices on the elytra.

Periphemus superciliaris. *P.* nigrescens; capite supra oculos paulo elevato et vage squamoso; rostro capite duplo longiore, æquilato, omnino creberrime sat fortiter punctato; prothorace latitudine vix sesquilongiore, confertim fortiter punctato, lineis tribus longitudinalibus griseo-tomentosis ornato; elytris totis nigris, striato-punctatis, interstitiis subplanatis, uniseriatim fortiter punctatis, punctis extrorsum majoribus et magis confertis; pygidio griseo-squamoso; corpore infra pedibusque nigris, nitidis, parcius griseo-squamosis. Long 5 lin.

Hab. Sumatra.

The punctures on the interstices of the striæ on the elytra are very coarse and approximate, the intervening spaces having the appearance of transverse bars.

Periphemus deletus. *P.* niger; capite supra oculos vix elevato; rostro parum arcuato, squamis erectis sub vage instructo, basi multo crassiore, fortiter sulcato-punctato, dimidio apicali subtiliter vage punctulato; prothorace minus elongato, confertim sat fortiter punctato, lineis tribus longitudinalibus tenuiter griseo-tomentosis ornato; elytris brevioribus, striato-punctatis, interstitiis subplanatis, uniseriatim minus fortiter punctatis, tertio, basi apiceque exceptis, tenuiter griseo-squamosis; pygidio griseo-squamoso; corpore infra pedibusque nigris, nitidis, illo ad latera griseo-squamoso, his sparse squamosis. Long. $4\frac{1}{4}$ lin.

Hab. Cochin-China; Laos.

The interstices on the elytra are in this species also rather strongly punctured, but the punctures are comparatively remote and the intervening spaces smooth.

Poteriophorus congestus. (Pl. IV. fig. 9.) *P.* elongato-ovalis, supra depressus, niger, indumento flavescenti-griseo guttatim notatus; rostro basi confertim apicem versus gradatim minus guttato; antennis, articulo primo funiculi clavæque exceptis, indumento griseo vestitis;

prothorace oblongo, apice tubulato, irregulariter sed plerumque confertim guttato; scutello elongato, angusto, apice acuminato; elytris postice callosis, supra lineatim striatis, interstitiis planatis, guttis numerosis quadratiformibus, in medio (præsertim postice) elevatis, irregulariter notatis; corpore infra æqualiter pluries guttato; pedibus indumento sat dense vestitis, femoribus confertim guttatis. Long. 9–10 lin.

Hab. Malacca.

The coloration, form of the scutellum, &c. are highly distinctive of this fine species.

Barystethus ater. *B.* late ellipticus, niger, supra opacus, subtus lævis, nitidus, capite pedibusque ferrugineis, nitentibus, prothorace utrinque fortiter rotundato, tenuiter subrugoso-punctulato, margine apicali pone oculos læte fulvo ciliato; elytris striato-punctatis, interstitiis latis, convexis, impunctatis; pygidio brevi, obtuso; tibiis intus læte fulvo barbatis. Long. 6–9 lin.

Hab. Dorey.

This fine insect is at once distinguished from its only congener *B. melanosoma*, Bois., by its punctured prothorax. Lacordaire says of *B. melanosoma* that the penultimate joint of the tarsi is alone spongy beneath; but in my specimens of the present species the three joints are so. In the 'Genera' (vi. 287), it appears to me, there is some obscurity in the description of the sterna: in this species at all events the mesosternum is triangular, the angles a little rounded, and its apex received into a notch in the raised subquadrangular portion of the prosternum behind the anterior coxæ.

Diathetes.

(Calandrinæ.)

Barystetho fere congruit, sed lobo scutellari prothoracis minus producto; *tibiis* sulcatis vel lineatim punctatis; *metasterno* cum mesosterno continuato.

In *Barystethus* the scutellum is entirely covered by the scutellar lobe, the metasternum is much swollen or enlarged anteriorly, overlapping the posterior edge of the mesosternum, and the tibiæ are perfectly smooth; in *Diathetes* the metasternum is of the normal form, and the tibiæ are coarsely grooved, the groove formed either by a row of close-set punctures or by fewer punctures connected by lines, the space between the grooves constituting a smooth ridge. This character is, I think, an important one, and is almost entirely neglected by writers on this family. The species are less massive than in *Barystethus*, and have all, except *D. nitidicollis*, a short impressed longitudinal line on the base of the rostrum. The tibiæ are more or less densely fringed with fulvous hairs on the inner margin.

Diathetes ruficollis. (Pl. IV. fig. 7.) *D.* ellipticus, niger, parum nitidus, prothorace toto rufo-fulvus; capite, vertice excepto, rostroque impunctatis; antennis ferrugineis; prothorace oblongo, utrinque modice rotundato, impunctato, in medio linea longitudinali leviter impressa; scutello punctiformi; elytris fortiter sulcatis, sulcis punctis oblongis, singulis seta minuta albida munitis, impressis; pygidio obtuso, basi rufo-fulvo; metasterno abdomineque nitide nigris. Long. 5½–6 lin.

Hab. Waigiou.

Diathetes sannio. *D.* subellipticus, rufescens, nigro varius; capite rostroque subnitide rufo-ferrugineis, illo subtilissime, hoc minus leviter punctulato; antennis fusco-piceis, clava triangulari, parte spongiosa brevissima; prothorace oblongo, utrinque modice rotundato, ocellato-punctato, plagis nigris, una mediana longitudinali, alteris lateralibus, notato; scutello lineari; elytris striato-punctatis, striis nonnullis parum flexuosis, interstitiis convexis, alternis manifeste latioribus, nigris, rufo interruptis; corpore infra pedibusque punctis squamigeris irregulariter adspersis. Long. 7 lin.

Hab. Aru.

This species has ocellate punctures on the prothorax, as in the *Sphenocoryni*.

Diathetes nitidicollis. *D.* ellipticus, omnino nitide niger; capite vage subtilissime punctulato, rostro basi punctis sparsis sat fortiter impresso, reliquo subtiliter punctato; clava transversa, parte spongiosa ampliata; prothorace oblongo, utrinque magis rotundato, in medio impunctato, latera versus punctis gradatim majoribus impresso; scutello elongato-triangulari; elytris sulcato-punctatis, basin versus planatis, postice convexis et in certa luce opacis, vel quasi subvelutinis; corpore infra vage punctato; femoribus infra fulvo ciliatis. Long. 6–8½ lin.

Hab. Amboyna; Goram.

Diathetes strenuus. *D.* robustus, elliptico-ovalis, niger; rostro crassiore, ad apicem manifeste punctulato; clava oblonga; prothorace utrinque versus basin paulo incurvato, disco tenuiter vage punctulato; scutello fere æquilateraliter triangulari; elytris fere ut in præcedente, sed interstitiis basi magis convexis, et ad apicem maculis griseis fasciculatis notatis; pygidio postice utrinque paulo excavato, punctis squamigeris adsperso; corpore infra pedibusque nitidis, illo in medio fere impunctato; pedibus subocellato-punctatis. Long. 10½ lin.

Hab. Aru.

DIATHETES MORIO. *D.* oblongo-ovatus, niger, nitidus; rostro basi parum tumido, toto æqualiter punctulato; antennis fusco-piceis; funiculo in clavam continuata, sed clava distincta; prothorace oblongo, utrinque modice rotundato, subtiliter sat vage punctulato; scutello elongato-triangulari; elytris sulcatis, interstitiis planatis, punctis minutis valde distinctis adspersis; pygidio truncato, punctis albo-squamigeris dispositis; corpore infra subtiliter punctulato. Long. 6 lin.

Hab. Australia (Cape York).

CERCIDOCERUS INDICATOR. *C.* oblongo-ellipticus, supra fuscus, punctis plurimis silaceis notatus; rostro modice arcuato, apice nigro; antennis indumento silaceo tectis; clava angustula, basi excepta, fusca; prothorace oblongo, lineis duabus angustis distinctis, basi paulo divergentibus, notato; scutello elongato-scutiformi; elytris breviter subovatis, tenuiter striatis, interstitiis planatis, secundo quartoque fere omnino fuscis, tertio, quinto et reliquis areolato-punctatis, pone medium maculis tribus approximatis, fasciam abbreviatam formantibus, ornatis; pygidio carinato, rugoso-punctato; corpore infra pedibusque pallide griseis, illo in medio sparse setosulo, lateribus femoribusque areolato-maculatis; tibiis lineatim setulosis, posticis subcompressis, intus bisinuatis. Long. 7 lin.

Hab. Singapore.

The curious malleiform club of the antennæ renders the genus *Cercidocerus* easy of recognition, so far as the males are concerned; in the females it is more like that of *Sphenophorus*. Some of the species are covered with what Lacordaire calls a "velvety efflorescence;" or it may be confined to certain indented spots as in this species. In the Munich Catalogue, *C. albicollis*, Ol. (v. p. 91, pl. xxviii. fig. 414), is omitted; it is a West-African species, and the only one not found in Asia or its great adjacent islands.

CERCIDOCERUS HISPIDULUS. (Pl. IV. fig. 5, ♂.) *C.* latior, breviter hispidulus, supra pallide ochraceus saturatiore variegatus; rostro modice arcuato, sublineatim granulato, apice nigro nudo, in maribus infra barbato; antennis indumento ochraceo tectis; clava, basi excepta, nigra; prothorace sat ampliato, dorso subconfertim areolato-punctato, lineis duabus pallidis, basi divergentibus, ornato; scutello elongato-scutiformi; elytris subcordiformibus, tenuiter striatis, interstitiis planatis, raro subtiliter hispido-punctulatis, sutura fasciisque duabus angustis flexuosis pallide ochraceis notatis; pygidio distincte nigro-punctato; corpore infra subeburneo, punctis setuligeris numerosis instructo; tibiis compressis, lineatim setulosis, anticis intus pilis longis, reliquis brevibus, dense instructis; tarsis articulo quarto unguiculisque nigris. Long. 7½ lin.

Hab. Penang.

A short, stout, handsome species.

Cercidocerus effetus. *C.* ellipticus, pallide ochraceus, opacus; rostro minus arcuato, apice nigro, infra leviter barbato; antennis ut in præc.; prothorace irregulariter punctato, vittis angustis saturatioribus notato, lateribus impresso-areolato-punctato; scutello oblongo-scutiformi; elytris subcordatis, tenuiter striato-punctatis, interstitiis planatis, uniseriatim vage subtilissime setulosis; pygidio fortiter carinato, vage punctato; corpore infra pedibusque subeburneis, punctis setigeris, nonnullis areolatis, numerosis instructis; tibiis lineatim setulosis, intus breviter pilosis. Long. 6 lin.

Hab. Singapore.

This species has a slight resemblance to the last; but, *inter alia*, the upper surface is not setulose, and the sides of the prothorax, metasternum, and its episterna are differently punctured.

Cercidocerus saturatus. *C.* robustus, fusco-umbrinus, subvittatim dilutiore notatis; rostro modice arcuato, indistincte lineatim punctato; antennis totis umbrinis; prothorace ampliato, irregulariter vage punctato; scutello elongato-scutiformi; elytris subcordatis, tenuiter striatis, interstitiis planatis, obsolete punctatis; pygidio minusculo, subcarinato, rude punctato; corpore infra pedibusque fusco-variis, setulis numerosis adspersis; tibiis lineatim setulosis, intus, præsertim anticis pilis longis dense instructis. Long. 8 lin.

Hab. Penang.

A dark brown species, with pale intermediate stripes.

Cercidocerus nervosus. (Pl. IV. fig. 6, ♂.) *C.* subellipticus, grisescenti-niger, supra lineis eburneis ornatus; rostro, sat fortiter arcuato, capiteque supra oculos eburneis, et squamositate granulifero sat confertim vestitis, illo basi linea longitudinali inciso; antennis eburneis; clava magna, albido-tomentosa; prothorace oblongo, areolato-silaceo-guttato, lineis sex, duabus dorsalibus, duabus utrinque, obsito; scutello angusto; elytris oblongis, striato-punctatis, interstitiis duobus suturalibus quartoque planatis, reliquis parum convexis et uniseriatim plus minus conjunctim areolato-silaceo-guttatis, lateribus punctis in striis magis validis, sutura singulatim linea basali guttisque duabus parvis ornatis; pygidio carinis tribus eburneis instructo; corpore infra pedibusque eburneis, setis numerosis adspersis. Long. 6 lin.

Hab. Java.

The breadth of the club in this species (♂) is nearly twice the length of the scape.

AUTONOPIS.

(Calandrinæ.)

Caput parvulum; *rostrum* capite vix crassius, longissimum, arcuatum; *scrobes* præmedianæ. *Oculi* parvi, rotundati, prothorace distantes. *Scapus* oculum haud attingens; *funiculus* articulo basali longiore, cæteris gradatim brevioribus; *clava* ovata, pedunculata. *Prothorax* subconicus, basi truncatus. *Scutellum* oblongum. *Elytra* prothorace perparum angustiora, subparallela. *Pygidium* anguste triangulare. *Pedes* elongati; *femora* linearia, mutica; *tibiæ* graciles arcuatæ, apice unco valido armatæ; *tarsi* breviusculi, articulo primo triangulari, secundo breviore, tertio cordato, quarto elongato; *unguiculis* approximatis, basi contiguis. *Coxæ* anticæ distantes. *Abdomen* articulo primo ampliato, secundo abbreviato.

The pygidium in the Calandrinæ appears to be narrower and larger in the male, but not to any great extent. The genus *Calandra*, represented by our too well-known corn-weevil, is one of the most insignificant of the subfamily in size and appearance. *Autonopis*, on the contrary, is one of the most remarkable, and, in habit, resembles the South-American *Litosomus*. There is another species from Penang, with, *inter alia*, a narrower outline and the rows of punctures on the elytra very much closer.

AUTONOPIS LINEATA. (Pl. IV. fig. 10, ♂.) *A.* anguste elliptica, nigrescens, lineis squamosis albis ornata; capite rostroque ferrugineis, nitidis, hoc corpore longiore, subtiliter punctulato; antennis fuscescentibus; prothorace latitudine fere duplo longiore, apice angustissimo, utrinque paulo rotundato, basi subparallelo, supra crebre punctato, punctis ad latera majoribus, lineis tribus, etiam duabus pectore, ornato; elytris latitudine baseos sesquilongioribus, seriatim punctatis, punctis approximatis, interstitiis planatis, apice parum emarginatis, singulis linea alba, medio interrupta, ornatis; pygidio in mare magis elongato et angustiore; corpore infra nigro, albo-variegato; pedibus parce squamosis. Long. (rost. incl.) 6½ lin.

Hab. Malacca; Sumatra.

LAOGENIA.

(Calandrinæ.)

Caput majusculum, breviter conicum; *rostrum* rectum, gradatim angustius, prothorace vix longius; *scrobes* basales. *Oculi* transversi, infra contigui vel fere contigui, prothorace sat distantes. *Scapus* brevis, prothoracem attingens; *funiculus* articulis modice elongatis, secundo longiore; *clava* oblongo-ovata, articulo basali elongato-obconico, parte spongiosa ampla. *Prothorax* oblongus, apice tubulatus, utrinque rotundatus, basi truncatus. *Scutellum* angustum. *Elytra* brevia, subparallela. *Pygidium* declive, triangulare, haud elongatum. *Pedes* longiusculi; *femora* perparum incrassata, infra dente minuto instructa; *tibiæ* sulcatæ, modice arcuatæ; *tarsi* articulo primo elongato, secundo angusto, tertio cordato, subbilobo, quarto tenuato; *unguiculis* gracilibus divaricatis, basi distantibus. *Coxæ* anticæ distantes. *Abdomen* sutura prima obsoleta.

This genus may for the present rank near *Calandra*.

LAOGENIA SOREX. (Pl. IV. fig. 11.) *L.* oblonga, nigrescens, opaca; capite rostroque fuscis, hoc basi crebre punctato, apicem versus piceo, impunctato; prothorace latitudine sesquilongiore, creberrime punctulato, punctis unisquamigeris; elytris confertim striato-punctatis, interstitiis alternis paulo elevatis, suturaque uniseriatim remote griseo-squamosis, singulis plaga elongata rufo-ferruginea obscure notatis; corpore infra punctis squamis griseis repletis maculato; pedibus disperse griseo-squamosis. Long. 4½ lin.

Hab. Gilolo; Sarawak.

LAOGENIA INTRUSA. *L.* angustior, nigrescens, opaca; rostro ♂ basi parum arcuato, omnino, apice excepto, sat parce punctato; prothorace subtiliter creberrime punctulato, punctis plurimis unisquamigeris; elytris confertim striato-punctatis, interstitiis angustis, alternis acute elevatis squamisque albidis indutis; corpore infra pedibusque ut in præcedente. Long. 4 lin.

Hab. Tondano; Sarawak.

It is requested that the following be substituted for the characters of *Nedyleda* (*antè*, vol. xi. p. 455):—

NEDYLEDA.

Rostrum subvalidum, leviter arcuatum, basi paulo compressum; *scrobes* præmedianæ, oblique flexuosæ. *Oculi* angusti, tenuiter granulati. *Scapus* sensim incrassatus, oculum haud attingens; *funiculus* breviusculus, articulo primo duobus sequentibus conjunctim longiore; *clava* distincta. *Prothorax* parvus, apice angustatus, lateribus basique rotundatus. *Scutellum* minusculum. *Elytra* ampliata. *Pedes* mediocres; *femora* breviuscula, mutica; *tibiæ* fere rectæ, intus subflexuosæ; *tarsi* articulis tribus basalibus sensim dilatatis; *unguiculi* approximati. *Coxæ* posticæ distantes. *Processus* intercoxalis late truncatus.

This genus agrees with *Dorytomus* in the absence of ocular lobes, and with *Erirhinus* in its mutic femora. I compare it with these two genera as being, in this subfamily, the most familiar to entomologists. But it is quite distinct from both; and, like many other genera I have proposed in these "Contributions," it is only as an approximation in aid of the systematist that I venture to do so. In this immense family of Curculionidæ there are so many modifications of a common form, which, once seen, is never mistaken for any other, that it becomes almost impossible to fix the limits in many instances either of genera or of species; and their affinities will frequently depend solely on the relative degrees of importance that may be attached to certain characters; and these characters again will have a generic, or even a tribual, importance in some cases, and only an individual importance in others.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Rhinoscapha Staintoni*; *a*, side view of the head.
2. —— *verrucosa*.
3. —— *sellata*.
4. *a*, head of *Rhinoscapha carinata*.
5. *Odosyllis congesta*; *a*, fore leg.
6. *Perrhæbius ephippiger*; *a*, side view of the head.
7. *Orthorhinus palmaris*.
8. *Zeneudes sterculiæ*; *a*, antenna.
9. *Berosiris picticollis*; *a*, hind leg.
10. *Brachycerus tursio*.
11. *Cydostethus solutus*; *a*, side view of the head.
12. *Cyamobolus subsellatus*.
13. Side view of the head of *Endymia geminata*; *a*, antenna.
14. Front view of the head of *Imachra ruficollis*; *a*, side view.
15. Fore leg of *Pelephicus stigmaticus*.

Plate II.

Fig. 1. *Polycreta metrica*; *a*, side view of the head.
2. *Talaurinus tenuipes*; *a*, side view of the head.

Fig. 3. *Acantholophus gladiator*; *a*, side view of the head.
4. *Alexirhea notata*; *a*, side view of the head.
5. *Myotrotus obtusus*; *a*, side view of the head.
6. *Anascoptes muricatus*; *a*, side view of the head.
7. *Talaurinus capito*; *a*, front view of the head.
8. —— *lævicollis*; *a*, front view of the head.
9. *Molochtus gagates*; *a*, front view of the head; *b*, side view.
10. *Chriotyphus acromialis*; *a*, side view of the head.
11. *Sclerorhinus tessellatus*; *a*, front view of the head.
12. Side view of the head of *Cubicorhynchus cichlodes*.

Plate III.

Fig. 1. *Lystrus sculptipennis*; *a*, side view of the head.
2. *Egiona læta*.
3. *Œbrius luteicornis*.
4. *Metanthia pyritosa*; *a*, side view of the head.
5. *Ochyromera dissimilis*.
6. *Euops divisa*.
7. *Themeropis fimbriata*; *a*, side view of the head; *b*, fore leg.
8. *Laodia niveopicta*; *a*, side view of the head.
9. *Cenchrena fasciata*; *a*, side view of the head; *b*, hind leg.
10. *Simocopis umbrinus*; *a*, side view of the head; *b*, front view.
11. *Acythopeus tristis*; *a*, side view of the head.
12. *Cynethia interrupta*; *a*, side view of the head.
13. *Tithene microcephala*; *a*, side view of the head; *b*, fore tibia and tarsus.
14. Hind tarsus of *Othippia podagrica*.
15. Scape and side view of the head of *Myctides barbatus*.
16. Hind leg of *Thechia pygmæa*.
17. Scape and side view of the head of *Acythopeus bigeminatus*.
18. Side view of the head of *Ipsichora cupido*.
19. Side view of the head and first two joints of the antenna of *Euops Jekelii*.

Plate IV.

Fig. 1. *Zetheus electilis*.
2. *Prodioctes quinarius*.
3. *Periphemus retrorsus*; *a*, side view of the head.
4. *Tyndides pustulosus*; *a*, side view of the head.
5. *Cercidocerus hispidulus*.
6. —— *nervosus*; *a*, antenna.
7. *Diathetes ruficollis*.
8. *Megaproctus pugionatus*; *a*, side view of the head.
9. *Poteriophorus congestus*.
10. *Autonopis lineata*; *a*, side view of the head; *b*, hind tarsus.
11. *Laogenia sorex*; *a*, side view of the head.
12. Antenna of *Cercidocerus indicator*.

Fig. 13. Parts of the sterna, between the anterior and intermediate coxæ, of *Barystethus ater*: *a*, prosternal process; *b*, *c*, parts of prosternum slightly overlapping the anterior coxæ; *d*, mesosternum; *e*, gibbous anterior portion of metasternum.

The following is a systematic list of the species published in the four parts of these "Contributions."

BRACHYDERINÆ.

Ottistira, n. g., xi. p. 440.
—— bispinosa, *l. c.* p. 440. Pl. X. fig. 6. Dorey; Aru; Mysol; Waigiou; Amboyna.
—— bicornis, *l. c.* p. 441 .... New Guinea.
—— planidorsis, *l. c.* p. 441............ Batchian; Amboyna.
—— ocularis, *l. c.* p. 441............... Singapore.
—— pulchella, *l. c.* p. 441 .... Morty; Macassar.
—— leucogenys, *l. c.* p. 442 .... Sula.
—— gibbosa, *l. c.* p. 442............... Malacca.
—— naso, *l. c.* p. 442 .... Flores; Menado.
—— punctata, *l. c.* p. 442 .... Tondano.
Mitophorus vittatus, xi. p. 154 .... White Nile.
Rhadinosomus impressus, x. p. 448...... Western Australia.
—— Lacordairei, *l. c.* p. 449 .... Queensland.
Ochrometa, n. g., x. p. 449.
—— amœna, *l. c.* p. 450. Pl. XVII. fig. 6. Western Australia.
Œnassus, n. g., x. p. 470.
—— sellifer, *l. c.* p. 471. Pl. XVIII. fig. 12 .... Old Calabar.
Rhinoscapha basilica, xii. p. 1 .... Kaioa; Gilolo; Batchian; Makian; Ternate; Morty; Dorey.
—— aulica, *l. c.* p. 2 .... Batchian.
—— Staintoni, *l. c.* p. 2. Pl. I. fig. 1 .. New Guinea.
—— formosa, *l. c.* p. 2.................. Morty.
—— alma, *l. c.* p. 3 .... Aru.
—— opalescens, *l. c.* p. 3............... Waigiou; Mysol; Dorey.
—— verrucosa, *l. c.* p. 4. Pl. I. fig. 2 .. Matabello; Goram; Bouru; Amboyna; Sula; Java.
—— sellata, *l. c.* p. 4. Pl. I. fig. 3 .... Batchian.
—— stolifera, *l. c.* p. 4................. Waigiou.
—— miliaris, *l. c.* p. 5 .... Mysol.
—— carinata, *l. c.* p. 5................. Morty.
Pachyrhynchus argus, xi. p. 154. Pl. VI. fig. 8 .... Philippine Islands.

Pachyrhynchus congestus, xi. p. 155	Philippine Islands.
—— cingulatus, *l. c.* p. 155............	" "
—— inclytus, *l. c.* p. 155..............	" "
—— pinorum, *l. c.* p. 156..............	Luzon.
Apocyrtus erosus, xi. p. 156............	"
—— Wallacei, *l. c.* p. 156	Batchian.
—— satelles, *l. c.* p. 157..............	Kaioa; Morty.
—— nitidulus, *l. c.* p. 157	Waigiou; Salwatty.

Otiorhynchinæ.

Siteytes glabratus, xi. p. 157	Saylee.
Elytrurus caudatus, x. p. 471. Pl. XVIII. fig. 5	Fiji.
Psidiopis, n. g., xi. p. 443.	
—— filicornis, *l. c.* p. 444	Amazons.
Episomus fimbriatus, xi. p. 158	Sarawak.
—— turritus, *Gyll.*, *l. c.* p. 158	North China.
—— iconicus, *l. c.* p. 158...............	Cambodia.
Demenica, n. g., xi. p. 158.	
—— compressa, *l. c.* p. 159............	West Africa.
Bryochæta, n. g., xi. p. 160.	
—— sufflata, *l. c.* p. 160	Old Calabar.
—— viridis, *l. c.* p. 160	" "
—— pusilla, *l. c.* p. 161	West Africa.
Eupiona, n. g., xi. p. 161.	
—— attalica, *l. c.* p. 161	Old Calabar.
Antinia, n. g., xi. p. 161.	
—— eupleura, *l. c.* p. 161. Pl. VI. fig. 3.	Penang.
Platyomicus pedestris, xi. p. 162. Pl. VI. fig. 8	West Africa.
—— cordipennis, *l. c.* p. 162	N'Gami.
Cychrotonus, n. g., xi. p. 162.	
—— viduatus, *l. c.* p. 163	"
Zyrcosa, n. g., x. p. 438.	
—— Murrayi, *l. c.* p. 439. Pl. XVII. fig. 7.	Old Calabar.
Euphalia, n. g., x. p. 467.	
—— pardalis, *l. c.* p. 468. Pl. XIX. fig. 14	Western Australia.
Atmesia, n. g., x. p. 468.	
—— marginata, *l. c.* p. 469. Pl. XVIII. fig. 3	South Australia.
—— glaucina, xi. p. 446	Western Australia.
Proxyrus, n. g., x. p. 437.	
—— abstersus, *l. c.* p. 438. Pl. XVII. fig. 8.	Western Australia (Champion Bay).

Proxyrus lecideosus, *l. c.* p. 438 .... Western Australia (Champion Bay).
Cyrtozemia, n. g., xi. p. 443.
—— dispar, *l. c.* p. 443. Pl. X. fig. 9 .. India (Bombay).
Telenica, n. g., xi. p. 444.
—— sublimbata, *l. c.* p. 445 .... West Australia.
—— nebulosa, *l. c.* p. 445 .... ,, ,,
Timareta, n. g., xi. p. 445.
—— figurata, *l. c.* p. 446. Pl. XII. fig. 8. Swan River (Fremantle).
—— satellina, *l. c.* p. 446 .... Fremantle.
Onychopoma, n. g., xi. p. 445.
—— parda, *l. c.* p. 445. Pl. X. fig. 8 .. Cochin-China; Pegu.

EREMNINÆ.

Acanthotrachelus albus, xi. p. 447 ...... Malabar.
Platytrachelus chloris, x. p. 458 .... Western Australia.

LEPTOPINÆ.

Onesorus, n. g., x. p. 483.
—— maculosus, *l. c.* p. 483. Pl. XIX. fig. 13 .... Cape York.
—— obesus, *l. c.* p. 483 .... Western Australia.
—— tigrinus, *l. c.* p. 483 .... Australia.
—— candidus, *l. c.* p. 484 .... ,,
Lysizone, n. g., x. p. 485.
—— alternata, *l. c.* p. 486 .... Western Australia.
Cherrus silaceus, xi. p. 157 .... King George's Sound.
—— punctipennis, *l. c.* p. 158 .... Swan River.
—— Mastersii, *l. c.* p. 158. Pl. VI. fig. 9 .... King George's Sound.
Leptops colossus, x. p. 451 .... W. Australia (Champion Bay).
—— Duboulayi, *l. c.* p. 452 .... Western Australia (Champion Bay).
—— retusus, *l. c.* p. 452 .... Queensland.
—— superciliaris, *l. c.* p. 452 .... ,,
—— dorsatus, *l. c.* p. 453 .... West Australia.
—— acerbus, *l. c.* p. 453 .... Western Australia.
—— polyacanthus, *l. c.* p. 453 ...... Australia.
—— ebeninus, *l. c.* p. 454 .... Queensland.
Dystirus, n. g., xi. p. 447.
—— strumosus, *l. c.* p. 447. Pl. XIII. fig. 10 .... Mexico.
Essolithna, n. g., x. p. 457.
—— pluviata, *l. c.* p. 457. Pl. XVIII. fig. 7 .... Western Australia (Nicol Bay).

Essolithna rhombus, *l. c.* p. 457 .... W. Australia (Champion Bay).
Gyponychus, n. g., x. p. 485.
—— porosus, *l. c.* p. 485. Pl. XIX. fig. 10........................ Mozambique.
Polyteles decussatus, x. p. 441. Pl. XVII. fig. 1 .... Peru (Nauta).
Entimus arrogans, xi. p. 448 .... Panama.
Demimæa, n. g., x. p. 440.
—— luctuosa, *l. c.* p. 441. Pl. XVII. fig. 3. Burmah.
Esmelina, n. g., x. p. 484.
—— flavovittata, *l. c.* p. 484. Pl. XIX. fig. 8 .... Queensland.

Brachycerinæ.

Brachycerus tursio, xii. p. 6. Pl. I. fig. 10........................ Damara Land.

Byrsopinæ.

Ixodicus, n. g., xi. p. 448.
—— occlusus, *l. c.* p. 448. Pl. XIII. fig. 8. Cape of Good Hope.
—— sordidus, *l. c.* p. 448.............. " "
Synthocus nigropictus, x. p. 463. Pl. XIX. fig. 11 .... Damara Land.
—— adustus, *l. c.* p. 464 .... N'Gami.

Amycterinæ.

Acantholophus nasicornis, xii. p. 6 ...... West Australia.
—— gladiator, *l. c.* p. 6. Pl. II. fig. 3 .. " "
—— simplex, *l. c.* p. 7................ " "
Anascoptes, n. g., xii. p. 7.
—— muricatus, *l. c.* p. 7. Pl. II. fig. 6.. Swan River.
Polycreta, n. g., xii. p. 8.
—— metrica, *l. c.* p. 8. Pl. II. fig. 1.... Champion Bay.
Sclerorhinus tæniatus, xii. p. 8........... South Australia.
—— molestus, *l. c.* p. 9 .... " "
—— marginatus, *l. c.* p. 9 .... " "
—— echinops, *l. c.* p. 10 .... West Australia.
—— meliceps, *l. c.* p. 10 .... Queensland.
Talaurinus victor, xii. p. 10 .... South Australia.
—— funereus, *l. c.* p. 11 .... West Australia.
—— pustulatus, *l. c.* p. 11 .... " "
—— carbonarius, *l. c.* p. 12 .... " "
—— phrynos, *l. c.* p. 12 .... Queensland.
—— molossus, *l. c.* p. 13.............. West Australia.

Talaurinus melanopsis, *l. c.* p. 13 ...... West Australia.
—— simulator, *l. c.* p. 13.............. " "
—— Macleayi, *l. c.* p. 14.............. King George's Sound.
—— encaustus, *l. c.* p. 14 .... " " "
—— tenuipes, *l. c.* p. 15. Pl. II. fig. 2.. Swan River.
—— tessellatus, *l. c.* p. 15 .... West Australia.
—— geniculatus, *l. c.* p. 16............ " "
—— lemmus, *l. c.* p. 16 .... " "
—— pupa, *l. c.* p. 16 .... " "
—— cariosus, *l. c.* p. 16 .... " "
—— capito, *l. c.* p. 17. Pl. II. fig. 7.... Champion Bay.
—— lævicollis, *l. c.* p. 17. Pl. II. fig. 8. Victoria.
Molochtus, n. g., xii. p. 18.
—— gagates, *l. c.* p. 18. Pl. II. fig. 9 .. West Australia.
Cubicorhynchus cichlodes, xii. p. 18 .... " "
—— sterilis, *l. c.* p. 19................ Victoria.
Chriotyphus, n. g., xii. p. 19.
—— acromialis, *l. c.* p. 19. Pl. II. fig. 10......................... Western Australia (Champion Bay).
Alexirhea, n. g., xii. p. 19.
—— notata, *l. c.* p. 20. Pl. II. fig. 4 .. West Australia.
—— aurita, *l. c.* p. 20 .... " "
—— falsifica, *l. c.* p. 21 .... Western Australia (Champion Bay).
Myotrotus, n. g., xii. p. 22.
—— obtusus, *l. c.* p. 22. Pl. II. fig. 5 .. Queensland (Rockhampton).
Euomus retusus, xi. p. 449. Pl. XII. fig. 12......................... Western Australia.
Dialeptopus serricollis, xi. p. 449 ...... " "
—— granulatus, *l. c.* p. 449............ " "
—— plantaris, *l. c.* p. 449. Pl. XII. fig. 11 .... " "

RHYPAROSOMINÆ.

Geobyrsa, n. g., xi. p. 450.
—— nodifera, *l. c.* p. 450. Pl. XIII. fig. 1 .... Nicaragua (Chontales).
Ophryota, n. g., xi. p. 451.
—— squamibunda, *l. c.* p. 451 .... South Australia (Port Augusta).
Zephryne, n. g., x. p. 471.
—— sordida, *l. c.* p. 472. Pl. XIX. fig. 12 .... Australia.
Dysostines, n. g., x. p. 472.

Dysostines valgus, *l. c.* p. 473. Pl. XIX. fig. 1 .... Queensland.

Molytinæ.

Tiphaura, n. g., xi. p. 164.
—— funerea, *l. c.* p. 164. Pl. VI. fig. 10. Para.

Scythropinæ.

Catachænus scintillans, xii. p. 22........ Philippine Islands.
Eugnathus bracteatus, xii. p. 23 .... Tsusima.
—— chloroticus, *l. c.* p. 23 .... Formosa; North China.

Gonipterinæ.

Oxyops aulicus, x. p. 479............... Queensland.
—— concretus, *l. c.* p. 479 .... New South Wales.
—— crassirostris, *l. c.* p. 480 .... Champion Bay.
—— irrasus, *l. c.* p. 480 .... Queensland.
—— bilunaris, *l. c.* p. 480 .... Gawler.
—— vitiosus, *l. c.* p. 481 .... Queensland.
—— gemellus, *l. c.* p. 481 .... Western Australia.
—— marginalis, *l. c.* p. 481............ Queensland.
—— arciferus, *l. c.* p. 481 .... ,,
—— arctatus, *l. c.* p. 482............... South Australia (Adelaide).
Bryachus, n. g., x. p. 478.
—— squamicollis, *l. c.* p. 479 .... Queensland; Western Australia; South Australia.
Gonipterus ferrugatus, x. p. 477 .... Queensland.
—— cinnamomeus, *l. c.* p. 477 .... ,,
—— balteatus, *l. c.* p. 477 .... South Australia.
—— sepulchralis, *l. c.* p. 478 .... ,, ,,
—— cionoides, *l. c.* p. 478 .... South Australia; New South Wales.
Styanax, n. g., xi. p. 164.
—— carbonarius, *l. c.* p. 165. Pl. IX. fig. 4 .... Sumatra.
Pantoreites, n. g., x. p. 462.
—— virgatus, *l. c.* p. 463. Pl. XVIII. fig. 4 .... South Australia.
—— scenicus, *l. c.* p. 463.............. New South Wales.
—— vittatus, xi. p. 451 .... Australia.

Hyperinæ.

Saginesis, n. g., xi. p. 452.
—— latipennis, *l. c.* p. 452. Pl. X. fig. 4. Aru.

ATERPINÆ.

Aparete, n. g., xi. p. 165.
—— palpebrosa, *l. c.* p. 166 .... South Australia.
Dexagia, n. g., xi. p. 166.
—— superciliaris, *l. c.* p. 166. Pl. VII. fig. 2 .... Batchian.
Hypermetra, n. g., xi. p. 167.
—— analis, *l. c.* p. 167. Pl. IX. fig. 5 .. Mysol.
Medicasta, n. g., x. p. 441.
—— leucura, *l. c.* p. 442. Pl. XVII. fig. 11 .... W. Australia (Champion Bay).
Rhinoplethes, n. g., x. p. 469.
—— foveatus, *l. c.* p. 469 .... West Australia.
Iphisaxus, n. g., x. p. 469.
—— asper, *l. c.* p. 470. Pl. XIX. fig. 7 .. „ „

HYLOBIINÆ.

Pæpalosomus zonatus*, xi. p. 168 ...... Batchian; Morty; Gilolo; Ceram; Kaioa; Key; Aru; Dorey; Saylee.
Hylobius fasciatus, xi. p. 168. Pl. VII. fig. 9 .... Morty; Batchian; Ceram.
—— notatus, *l. c.* p. 169 .... Java; Sarawak.
—— scrofa, *l. c.* p. 169 .... Sarawak.
—— rubidus, *l. c.* p. 169 .... „
—— papulosus, *l. c.* p. 170 .... Java.
—— aphya, *l. c.* p. 170 .... India.
Ectinura, n. g., xi. p. 170.
—— brenthoides, *l. c.* p. 171. Pl. VII. fig. 10 .... „ ?
Scolithus, n. g., xi. p. 171.
—— acuminatus, *l. c.* p. 172. Pl. VII. fig. 8 .... Sarawak.
Aclees porosus, xi. p. 172 .... Sarawak; Batchian; Kaioa; Ceram; Morty; Bouru; Amboyna; Matabello; Ternate; Aru; Dorey; Saylee.
—— Gyllenhallii, *l. c.* p. 172 .... Waigiou; Amboyna.

* M. Jekel considers this species to be a variety of *P. dealbatus*, Boisd.,—the insect known to Schönherr, Lacordaire, and others as *P. dealbatus*, Boisd., being specifically and generically distinct; and the genus he has named *Pæpalophorus* (Ann. Soc. Ent. de Fr. 1873, p. 433 *et seq.*). My numerous specimens of both species scarcely vary, except from abrasion.

Seleuca, n. g., xi. p. 173.
—— amicta, *l. c.* p. 173. Pl. IX. fig. 7 . . Singapore.
—— leucospila, *l. c.* p. 173 . . . . Singapore; Penang; Sarawak.
Niphades, n. g., xi. p. 174.
—— pardalotus, *l. c.* p. 174. Pl. IX. fig. 8 . . . . Sarawak.
—— costatus, *l. c.* p. 174 . . . . Aru; Batchian; Macassar.
Ozoctenes, n. g., xi. p. 174.
—— jubatus, *l. c.* p. 175. Pl. IX. fig. 3. Amazons (Ega).
Cechides, n. g., xi. p. 453.
—— amœnus, *l. c.* p. 453. Pl. XII. fig. 7. West Australia (Champion Bay).
Cycotida, n. g., xi. p. 453.
—— lineata, *l. c.* p. 454. Pl. XII. fig. 6. West Australia.
Orthorhinus palmaris, xii. p. 23. Pl. I. fig. 7. Ceram.
—— arrogans, *l. c.* p. 23 . . . . Ceram; Amboyna; Bouru.

Erirhininæ.

Nemestra, n. g., xi. p. 454.
—— incerta, *l. c.* p. 455. Pl. XII. fig. 5. West Australia (Fremantle).
Nedyleda, n. g., xi. p. 455 and xii. p. 76.
—— semiusta, *l. c.* p. 455. Pl. XII. fig. 9 . . . . West Australia.
Orichora, n. g., x. p. 486.
—— trivirgata, *l. c.* p. 486. Pl. XIX. fig. 3 . . . . King George's Sound.
Cenchrena, n. g., xii. p. 24.
—— fasciata, *l. c.* p. 24. Pl. III. fig. 9 . . Aru; Waigiou.
—— pœcila, *l. c.* p. 24 . . . . Batchian.
—— suturalis, *l. c.* p. 25 . . . . Sula.
Thechia, n. g., xii. p. 25.
—— pygmæa, *l. c.* p. 25 . . . . Champion Bay.
Peliobia, n. g., xi. p. 456.
—— geniculata, *l. c.* p. 457. Pl. XIII. fig. 3 . . . . Ecuador (Macas).
Tithene, n. g., xii. p. 25.
—— microcephala, *l. c.* p. 26. Pl. III. fig. 13 . . . . Sarawak.

Oxycoryninæ.

Metrioxena, n. g., x. p. 442.
—— serricollis, *l. c.* p. 443. Pl. XVII. fig. 10 . . . . Macassar.
—— subvittata, xii. p. 26 . . . . „

BELINÆ.

Dicordylus pupillatus*, xi. p. 175. Pl. VI.
fig. 1 .... Chili.
—— luctuosus, *l. c.* p. 176 .... „
—— amœnus, *l. c.* p. 176............... „
Belus anguineus, xi. p. 457 .... West Australia (Nicol Bay).
—— aphthosus, *l. c.* p. 457 .... South Australia.
—— farinarius, *l. c.* p. 458 .... West Australia.
—— acicularis, *l. c.* p. 458 .... West Australia (Albany).
—— parallelus, *l. c.* p. 458. Pl. XII.
fig. 10 .... W. Australia (Champion Bay)
—— plagiatus, x. p. 475 .... Queensland.
—— linearis, *l. c.* p. 475 .... „
—— serpens, *l. c.* p. 475 .... West Australia.
—— Wallacei, xii. p. 26 .... Aru.
—— inornatus, xii. *l. c.* p. 27 .... Mysol; Morty.

EURHYNCHINÆ.

Ctenaphides, n. g., x. p. 476.
—— porcellus, *l. c.* p. 477. Pl. XVIII.
fig. 10 .... Western Australia.
Cyrotyphus, n. g., x. p. 445.
—— fascicularis, *l. c.* p. 445. Pl. XVII.
fig. 5 .... South Australia (Gawler).
Agnesiotis, n. g., x. p. 474.
—— pilosula, *l. c.* p. 474. Pl. XVIII.
fig. 6 .... Queensland.

ATTELABINÆ.

Euops cœlestina, xii. p. 27 .... New Guinea (Dorey).
—— violacea, *l. c.* p. 27 .... Ceram.
—— plicata, *l. c.* p. 28................ Macassar.

* Some species of *Dicordylus* were first published by Philippi in 1859, in the 'Anales de la Universidad de Chile' (a work apparently unnoticed by recent writers), and referred by him to *Rhinotia*. From this it follows that *Dicordylus ithyceroides*, Lac., must yield to *D. binotatus*, Phil., and *D. heilipoides*, Lac., to *D. marmoratus*, Phil., also my *D. pupillatus* to *D. annulifer*, Phil. There is also, I understand, a little pamphlet of half-a-dozen pages or so, published by Fairmaire and Germain, which I have not seen, but which is quoted in the Munich Catalogue as "Col. Chil. 1860." They describe four species of *Homalocerus*, referrible probably to *Dicordylus*; and that their *albidovarius* is *marmoratus*, their *argus*=*annulifer*, their *balteatus*=*binotatus* is probable; and their *exquisitus* may be my *amœnus*. If this be so, *D. luctuosus* is the only one of the above three species which will stand.

Euops trigemmata, *l. c.* p. 28 .... Batchian; Dorey.
—— ærosa, *l. c.* p. 28 .... Batchian; Sarawak; Sula.
—— clavigera, *l. c.* p. 28 .... Queensland.
—— eucalypti, *l. c.* p. 28.............. Queensland (Gayndah).
—— amethystina, *l. c.* p. 29 .... Singapore.
—— divisa, *l. c.* p. 29 .... Dorey; Saylee; Batchian; Mysol.
—— Jekelii, *l. c.* p. 29................ Aru; Dorey; Salwatty; Waigiou; Amboyna.

RHINOMACERINÆ.

Agilaus, n. g., xi. p. 176.
—— pedestris, *l. c.* p. 177. Pl. VII. fig. 11 .... Sarawak.

SCOLOPTERINÆ.

Nyxetes, n. g., for Curculio bidens, *Fab.*, x. p. 456.

ERODISCINÆ.

Atenistes * = Toxeutes, *Schön.* nec *Newm.*
—— longirostris, x. p. 464 .... Brazil.
—— denticollis, *l. c.* p. 465. Pl. XIX. fig. 6. ,,
Erodiscus analis, x. p. 465 .... ,,

ANTHONOMINÆ.

Imachra, n. g., xii. p. 30.
—— ruficollis, *l. c.* p. 30 .... Sarawak.

CERATOPODINÆ.

Polydus, n. g., xi. p. 459.
—— dumosus, *l. c.* p. 459. Pl. XIII. fig. 4 .... Brazil (Bahia).

PRIONOMERINÆ.

Ectyrsus, n. g., xi. p. 177.
—— villosus, *l. c.* p. 178. Pl. VII. fig. 5 .... Brazil (Rio).
Themeropis, n. g., xii. p. 30.
—— fimbriata, *l. c.* p. 31. Pl. III. fig. 7. Amazons.
Ochyromera, n. g., xii. p. 31.
—— dissimilis, *l. c.* p. 31. Pl. III. fig. 3. Sarawak.
—— rufescens, *l. c.* p. 32.............. Singapore.

* *Ludovix*, Cast., has priority.

Zeiona, n. g., xi. p. 179.
—— pulchella, *l. c.* p. 179. Pl. VII. fig. 6 .... Sarawak.
Synnada, n. g., xii. p. 32.
—— currucula, *l. c.* p. 32.............. Macassar.
Nychiomma*, n. g., xi. p. 456.
—— testacea, *l. c.* p. 456 .... Sarawak.
Omphasus, n. g., xi. p. 178.
—— æratus, *l. c.* p. 178. Pl. VII. fig. 12. ,,

Tychiinæ.

Zephiantha, n. g., xii. p. 33.
—— pubipennis, *l. c.* p. 33 .... Sumatra.

Læmosaccinæ.

Læmosaccus notatus, xi. p. 180. Pl. VI. fig. 4 .... Queensland; King George's Sound.
—— electilis, *l. c.* p. 180 .... Australia.
—— catenatus, *l. c.* p. 180 .... Queensland.
—— peccuarius, *l. c.* p. 180............ South Australia.
—— ustulus, *l. c.* p. 181 .... Victoria (Melbourne).
—— brevipennis, x. p. 439 .... Queensland.
—— tantulus, *l. c.* p. 439................ W. Australia (Champion Bay).
—— synopticus, *l. c.* p. 440............. Queensland.

Alcidinæ.

Alcides Saundersii, x. p. 459. Pl. XIX. fig. 4 .... Siam.
—— magicus, *l. c.* p. 460.............. Cambogia.
—— delta, *l. c.* p. 460 .... Ceylon; Ceram; Amboyna.
—— trifidus, *l. c.* p. 460 .... North China; Japan; Mantchuria.
—— ligatus, *l. c.* p. 461 .... Java.
—— discedens, *l. c.* p. 461 .... Singapore; Sarawak.
—— asphaltinus, *l. c.* p. 461 .... Batchian; Gilolo.
—— Semperi, *l. c.* p. 462 .... Philippine Islands.
—— magister, xi. p. 181. Pl. IX. fig. 9. Aru.
—— fastuosus, *l. c.* p. 182 .... Sarawak.
—— auritus, *l. c.* p. 182. Pl. IX. fig. 11. Cochinchina.
—— erro, *l. c.* p. 182 .... China.
—— micronychus, *l. c.* p. 183.......... Cochinchina.
—— frontalis, *l. c.* p. 183 .... Morty; Batchian.

* Erroneously placed in Erirhininæ.

Haplonychinæ.

Haplonyx myrrhatus, x. p. 488	South Australia.
—— ustipennis, *l. c.* p. 488	Sydney.
—— dotatus, *l. c.* p. 488	West Australia.
—— lucius, *l. c.* p. 489	Champion Bay.
—— vestigialis, *l. c.* p. 489	Queensland.
—— fallaciosus, *l. c.* p. 489	,,
—— maialis, *l. c.* p. 490	,,
—— scolopax, *l. c.* p. 490	,,
—— ericeus, *l. c.* p. 490................	South Australia.
—— venosus, *l. c.* p. 491	Gawler.
—— centralis, *l. c.* p. 491	,,
—— cionoides, *l. c.* p. 491	,,
—— turtur, *l. c.* p. 492	,,
Syarbis sciurus, x. p. 444	Western Australia.
—— gonipteroides, *l. c.* p. 444	,,
Aolles, n. g., x. p. 450.	
—— rubiginosus, p. 451................	,,
—— nuceus, *l. c.* p. 451................	,,
Zeopus, n. g., xi. p. 460.	
—— storeoides, *l. c.* p. 460	South Australia.
Metatyges cupreus, x. p. 443	Gold Coast.

Menemachinæ.

Acicnemis pardalis, xi. p. 460............	Java; Batchian.
—— subsignata, *l. c.* p. 461	Madras.
—— peduncularis, *l. c.* p. 461	Singapore; Sarawak; Java.
—— frenata, *l. c.* p. 461................	Sarawak.
—— meriones, *l. c.* p. 462. Pl. X. fig. 5. .	Batchian.
—— palliata, *l. c.* p. 462................	Japan.
—— pachymera, *l. c.* p. 462	Laos.
—— brevipennis, *l. c.* p. 463	Batchian; Amboyna.
Berethia, n. g., xi. p. 463.	
—— medinotata, *l. c.* p. 463. Pl. X. fig. 3.	Ceram.
—— sannio, *l. c.* p. 463. Pl. X. fig. 2	,,
Semelima, n. g., xi. p. 464.	
—— triangulum, *l. c.* p. 464. Pl. X. fig. 1.	Sarawak.

Cholinæ.

Cholus pulchellus, xi. p. 464	Cayenne.
—— æmulus, *l. c.* p. 465	Amazons.
—— brominus, *l. c.* p. 466	Peru (Quito).
—— uniformis, *l. c.* p. 466..............	Para.
—— nivosus, *l. c.* p. 466	New Granada.

Cholus atomarius, *l. c.* p. 466	Venezuela.
—— delumbis, *l. c.* p. 467..............	Ecuador (Macas).
—— bufonius, *l. c.* p. 467	Amazons.
—— calamita, *l. c.* p. 467	Brazil.
—— sycophanta, *l. c.* p. 468..............	New Granada.
—— mimetes, *l. c.* p. 468	Nicaragua (Chontales).
—— curialis, *l. c.* p. 468................	,, ,,
—— viduatus, *l. c.* p. 469	,, ,,
—— nitidicollis, *l. c.* p. 469	Bogota.
—— Buckleyi, *l. c.* p. 469. Pl. XI. fig. 3.	Ecuador (Canales).
—— hæmatostictus, *l. c.* p. 469..........	Bogota.
—— lecideosus, *l. c.* p. 470..............	Nicaragua (Chontales).
—— notabilis, *l. c.* p. 470. Pl. XI. fig. 1..	Amazons.
—— prætorius, *l. c.* p. 470. Pl. XI. fig. 2.	Panama.
Erethistes, n. g., xi. p. 471.	
—— leucospilus, *l. c.* p. 471	Cayenne.
—— licheneus, *l. c.* p. 471. Pl. XI. fig. 6.	Ecuador (Sarayacu).
—— ochriventris, *l. c.* p. 472............	Venezuela (Santa Marta).
—— congestus, *l. c.* p. 472	,, ,,
Anænomus, n. g., xi. p. 472.	
—— rubigineus, *l. c.* p. 472. Pl. XI. fig. 5.	Brazil.
Astyage, n. g., xi. p. 473.	
—— lineigera, *l. c.* p. 473. Pl. XI. fig. 8	,,
Ozopherus, n. g., xi. p. 473.	
—— muricatus, *l. c.* p. 474. Pl. XI. fig. 9.	Amazons (Para); Cayenne.
Neædus, n. g., xi. p. 474.	
—— bivittatus, *l. c.* p. 474. Pl. XI. fig. 7.	Amazons.
Callinotus microspilotus, *l. c.* p. 474	Brazil.
Solenopus bilineatus, *l. c.* p. 475	Cayenne; Mexico.
—— transversalis, *l. c.* p. 475. Pl. XI. fig. 4.	Brazil.
Cryptaspis, n. g., xi. p. 476.	
—— amplicollis, *l. c.* p. 476. Pl. XI. fig. 10	New Granada.

Cryptorhynchinæ.

(Ithyporides vrais, *Lac.*).

Ectatorhinus Adamsii, xi. p. 478	Tsusima (Japan).
—— femoratus, *l. c.* p. 478. Pl. X. fig. 10	Sarawak.
Colobodes nodulosus, xi. p. 485..........	Batchian.
—— fasciculatus, *l. c.* p. 485. Pl. X. fig. 7	Amboyna.
Perrhæbius, n. g., xii. p. 34.	

Perrhæbius ephippiger, *l. c.* p. 34. Pl. I. fig. 6 .... Dorey; Aru; Macassar; Morty.
Mitrephorus capucinus, xi. p. 185 .... Brazil.
—— albifrons, *l. c.* p. 186 .... „

(Psepholacides, *Lac.*).

Glechinus, n. g., xi. p. 184.
—— talpa, *l. c.* p. 184 .... New Caledonia.

(Strongylopterides, *Lac.*).

Inozetes, n. g., xi. p. 479.
—— petechialis, *l. c.* p. 479. Pl. X. fig. 11. Batchian.
Osseteris, n. g., xi. p. 479.
—— scutellaris, *l. c.* p. 480 .... New Guinea.
Therebus, n. g., xi. p. 480.
—— cepuroides, *l. c.* p. 480 .... Western Australia.

(Guioperides, *Lac.*).

Guioperus variolosus, x. p. 456. Pl. XVIII. fig. 2 .... Columbia.
—— subpalliatus, *l. c.* p. 456 .... Cayenne.
—— eques, xi. p. 476.................. Nicaragua (Chontales).

(Ocladiides, *Lac.*).

Ocladius Barani, xii. p. 35 .... Syria.

(Sophrorhinides, *Lac.*).

Metrania, n. g., xi. p. 481.
—— palliata, *l. c.* p. 482. Pl. XIII. fig. 11 .... Cayenne.

(Camptorhinides, *Lac.*).

Pachyonyx araneosus, xii. p. 34 .... Cochinchina.

Gen. incertæ sedis.

Diaphna, n. g., x. p. 445.
—— signata, *l. c.* p. 446. Pl. XVII. fig. 4.......................... Natal.
—— acutipennis, *l. c.* p. 446 .... „
Deretiosus, n. g., xi. p. 184.
—— aridus, *l. c.* p. 185. Pl. VIII. fig. 10. Dorey; Saylee; Ceram.

(Tylodides, *Lac.*).

Perichius, n. g., xi. p. 186.
—— verrucosus, *l. c.* p. 186. Pl. VIII. fig. 9.......................... Waigiou.

Erebaces, n. g., xi. p. 187.
—— angulatus, *l. c.* p. 187. Pl. VIII. fig. 8 .... Batchian.
—— pleuricausta, *l. c.* p. 187 .... Morty.
Poropterus exitiosus, xi. p. 189 .... Queensland.
—— ellipticus, *l. c.* p. 189 .... New South Wales (Illawarra).
—— Waterhousei, *l. c.* p. 189 .... Queensland.
—— morbillosus, *l. c.* p. 190 .... Tasmania.
—— flexuosus, *l. c.* p. 190 .... South Australia.
—— mastoideus, *l. c.* p. 190 .... Batchian.
—— approximatus, *l. c.* p. 191 .... Kaioa.
—— hariolus, *l. c.* p. 191. Pl. VII. fig. 7. Queensland.
—— sphacelatus, *l. c.* p. 191 .... „
—— verres, *l. c.* p. 192 .... „
—— porrigineus, *l. c.* p. 483 .... Victoria.
—— musculus, *l. c.* p. 483 .... Tasmania.
—— bisignatus, *l. c.* p. 484 .... Moreton Bay.
—— foveipennis, *l. c.* p. 484 .... New South Wales (Illawarra).
Hexymus, n. g., xi. p. 188.
—— tuberosus, *l. c.* p. 188. Pl. VII. fig. 3. Queensland.
—— monachus, *l. c.* p. 485 .... Queensland (Rockhampton).
Petosiris cordipennis, xi. p. 485. Pl. XII. fig. 3 .... „
Salcus, n. g., x. p. 447.
—— globosus, *l. c.* p. 448. Pl. XVII. fig. 2 .... Cape York.
Imalithus, n. g., x. p. 465.
—— patella, *l. c.* p. 466. Pl. XIX. fig. 2. Queensland.

(Cryptorhynchides vrais, *Lac.*).

Zeneudes, n. g., xii. p. 35.
—— sterculiæ, *l. c.* p. 36. Pl. I. fig. 8. Queensland (Gayndah).
Cyamobolus bicinctus, xii. p. 36 .... Malacca.
—— subsellatus, *l. c.* p. 36. Pl. I. fig. 12. Saylee.
—— duplicatus, *l. c.* p. 37 .... „
Cydostethus, n. g., xii. p. 37.
—— solutus, *l. c.* p. 38. Pl. I. fig. 11 .. Ceram.
—— lineolatus, *l. c.* p. 38 .... Amboyna; Tondano.
Syrotelus, n. g., for Cyamobolus Falleni, *Böh.*, xii. p. 38.
Euthyrhinus navicularis, x. p. 455 .... Western Australia.
—— iconicus, xi. p. 477 .... Mysol.
—— pictus, *l. c.* p. 477. Pl. X. fig. 12 .. Singapore.
Cechania, n. g., xii. p. 38.

Cechania eremita, *l. c.* p. 39 .... Japan (Nagasaki).
Æchmura, n. g., xii. p. 39.
—— emys, *l. c.* p. 39 .... Singapore.
Orochlesis, n. g., xi. p. 194.
—— annularis, *l. c.* p. 195. Pl. VIII. fig. 2 .... Dorey; Batchian; Penang.
—— solea, *l. c.* p. 195 .... Batchian.
—— flesina, *l. c.* p. 195 .... Aru.
—— maculosa, xii. p. 40 .... Salwatty.
Odosyllis, n. g., xii. p. 40.
—— congesta, *l. c.* p. 40. Pl. I. fig. 5 .. Tondano.
—— atomaria, *l. c.* p. 41 .... Singapore.
—— granulicollis, *l. c.* p. 41 .... Tondano.
—— vitiosa, *l. c.* p. 41 .... Wagiou; Saylee.
—— terrena, *l. c.* p. 41 .... Menado.
—— irrorata, *l. c.* p. 42 .... Saylee.
Pelephicus, n. g., xii. p. 42.
—— stigmaticus, *l. c.* p. 42 .... ,,
Axionicus, n. g., x. p. 455.
—— insignis, *l. c.* p. 455. Pl. XVIII. fig. 8 .... Queensland.
Orphanistes, n. g., x. p. 454.
—— eustictus, *l. c.* p. 454. Pl. XVIII. fig. 9 .... ,,
Perissops, n. g., xi. p. 193.
—— mundus, *l. c.* p. 194 .... ,,
—— iliacus, *l. c.* p. 194 .... Gilolo; Dorey; Aru; Mysol.
Platytenes, n. g., x. p. 466.
—— varius, *l. c.* p. 467. Pl. XVIII. fig. 1. Aru; Macassar; Key; Gilolo; Batchian; Waigiou; Ternate.
Apries, n. g., xi. p. 196.
—— eremita, *l. c.* p. 196. Pl. IX. fig. 6. Batchian.
—— palliatus, *l. c.* p. 196 .... Saylee.
Aonychus lineatus, x. p. 443 .... West Australia.
—— luctuosus, xi. p. 477. Pl. XII. fig. 1. ,, ,,
Zeugenia, n. g., xi. p. 197.
—— histrio, *l. c.* p. 198. Pl. VIII. fig. 11. Sarawak.
—— histrionica, *l. c.* p. 198 .... Penang.
—— figurata, *l. c.* p. 197 .... Sarawak.
Omydaus, n. g., xi. p. 198.
—— plinthoides, *l. c.* p. 199 .... New South Wales (Illawarra).
Metyrus, n. g., xi. p. 482.
—— collaris, *l. c.* p. 482. Pl. XII. fig. 4. . West Australia.
Endymia, n. g., xi. p. 199.

Endymia vipio, *l. c.* p. 200. Pl. VIII. fig. 5 Batchian; Dorey.
—— geminata, xii. p. 43 . . . . Batchian.
Panopides, n. g., xi. p. 200.
—— anticus, *l. c.* p. 201. Pl. VIII. fig. 4. Tondano.
Glyphagia, n. g., xi. p. 201.
—— insculpta, *l. c.* p. 201 . . . . Batchian.
Sybulus, n. g., xi. p. 202.
—— peccuarius, *l. c.* p. 202 . . . . ,,
—— incensus, *l. c.* p. 202 . . . . Singapore.
Rebius, n. g., xi. p. 203.
—— latifasciatus, *l. c.* p. 203. Pl. VIII. fig. 3 . . . . Tondano.
Diatassa, n. g., xi. p. 192.
—— phalerata, *l. c.* p. 193. Pl. IX. fig. 2. Mysol.
Nechyrus, n. g., xi. p. 203.
—— lemur, *l. c.* p. 204. Pl. VIII. fig. 7. Amboyna; Goram; Batchian.
—— puncticollis, *l. c.* p. 204 . . . . Aru; Saylee.
—— ruidus, *l. c.* p. 205 . . . . Batchian.
—— geniculatus, *l. c.* p. 205 . . . . Mysol.
—— paniscus, *l. c.* 205 . . . . Amboyna.
—— notatus, *l. c.* p. 206 . . . . Saylee.
—— funebris, *l. c.* p. 206 . . . . Batchian.
—— porcatus, *l. c.* p. 206 . . . . Ceram.
—— satyrus, *l. c.* p. 207 . . . . Gilolo.
Berosiris, n. g., xii. p. 43.
—— picticollis, *l. c.* p. 43. Pl. I. fig. 9 . . Sarawak.
—— violatus, *l. c.* p. 44 . . . . Java.
—— cribratus, *l. c.* p. 44 . . . . Sarawak.
—— hepaticus, *l. c.* p. 44 . . . . Tondano.
—— devotus, *l. c.* p. 44 . . . . Goram.
Æsychora, n. g., xi. p. 209.
—— notaticollis, *l. c.* p. 210 . . . . Sarawak.
Syrichius, n. g., xi. p. 207.
—— roridus, *l. c.* p. 207 . . . . Kaioa.
—— dissipatus, *l. c.* p. 208 . . . . Morty.
—— frontalis, *l. c.* p. 208 . . . . Bouru; Ceram.
—— proletarius, *l. c.* p. 208 . . . . Matabello; Gilolo.
—— servulus, *l. c.* p. 208 . . . . Dorey.
Nedymora, n. g., xi. p. 209.
—— ventricosa, *l. c.* p. 209. Pl. VIII. fig. 1 . . . . Aru.

(Mecistostylides, *Lac.*).

Protopalus cristatus, x. p. 448 . . . . Queensland.
Blepiarda voluta, xi. p. 210 . . . . Dorey; Salwatty.

Blepiárda vitiata, *l. c.* p. 210 .... Aru.
—— neophyta, *l. c.* p. 211.............. Dorey.
Amalthus, n. g., xi. p. 211.
—— insignis, *l. c.* p. 212. Pl. VII. fig. 4. Morty.
Doetes, n. g., xi. p. 212.
—— albo-pictus, *l. c.* p. 212. Pl. VIII. fig. 6......................... Goram.

(Sympiezoscelides, *Lac.*).

Amydala, n. g., xi. p. 213.
—— abdominalis, *l. c.* p. 213. Pl. VI. fig. 11 .... Queensland.

ZYGOPINÆ.

Latychus, n. g., xi. p. 486.
—— rivulosus, *l. c.* p. 486. Pl. XIII. fig. 9.......................... Brazil.
Hedycera, n. g., x. p. 457.
—— megamera, *l. c.* p. 457. Pl. XVIII. fig. 11.......................... Cayenne.
Chirozetes, n. g., x. p. 447.
—— pectorosus, *l. c.* p. 447. Pl. XVII. fig. 9.......................... Cambodia.
Agametis, n. g., x. p. 473.
—— festiva, *l. c.* p. 474. Pl. XIX. fig. 5. Sarawak; Ceram; Batchian; Amboyna.

TACHYGONINÆ.

Ixalina, n. g., xi. p. 214.
—— rufescens, *l. c.* p. 214. Pl. IX. fig. 1. Singapore.

ISORHYNCHINÆ.

Lobotrachelus stigma, xii. p. 44.......... Australia (Gayndah).
—— plagiatus, *l. c.* p. 45 .... Flores.
—— linteus, *l. c.* p. 45 .... Macassar.
—— albirostris, *l. c.* p. 45 .... „
Brephiope, n. g., xii. p. 46.
—— castanea, *l. c.* p. 46................ Sula; Ceram.
Metetra, n. g., xii. p. 46.
—— suturalis, *l. c.* p. 47 .... Waigiou.
Telephaë, n. g., x. p. 487.
—— laticollis, *l. c.* p. 487. Pl. XIX. fig. 9. Macassar.
—— strigilata, xii. p. 47................ Batchian; Sarawak.
—— concreta, *l. c.* p. 48................ Batchian.

Telephaë luctuosa, *l. c.* p. 48 .... Batchian; Gilolo; Sarawak.
—— denticollis, *l. c.* p. 48 .... Dorey; Sarawak.
—— metata, *l. c.* p. 48 .... Batchian.
—— repetita, *l. c.* p. 49 .... Sarawak.
—— selligera, *l. c.* p. 49 .... „
Othippia, n. g., xii. p. 49.
—— distigma, *l. c.* p. 50 .... Sarawak.
—— jubata, *l. c.* p. 50 .... „
—— proletaria, *l. c.* p. 50 .... „
—— funebris, *l. c.* p. 50 .... Ceram.
—— podagrica, *l. c.* p. 51 .... Mysol.
Egiona, n. g., xii. p. 51.
—— læta, *l. c.* p. 51. Pl. III. fig. 2 ...... Macassar.
Pseniclea, n. g., xii. p. 51.
—— puellaris, *l. c.* p. 52 .... Dorey.
Panigena, n. g., xii. p. 52.
—— chalybea, *l. c.* p. 53 .... Batchian.
—— violacea, *l. c.* p. 53 .... „
—— cyanoptera, *l. c.* p. 53 .... Saylee.
—— pedestris, *l. c.* p. 53 .... Mysol.
Œbrius, n. g., xii. p. 54.
—— luteicornis, *l. c,* p. 54. Pl. III. fig. 3 .... Mysol; Waigiou.
Lissoglena, n. g., xii. p. 54.
—— picipennis, *l. c.* p. 55 .... Sumatra.

CEUTHORHYNCHINÆ.

Mecysmoderes consularis, x. p. 482 ...... Formosa.

BARIDINÆ.

Methyorrhina, n. g., xi. p. 487.
—— hispida, *l. c.* p. 487 .... Brazil.
Pithecomus, n. g., xi. p. 487.
—— ursulus, *l. c.* p. 488. Pl. XIII. fig. 5 .... Bogota.
Bebelatus, n. g., xi. p. 488.
—— aranea, *l. c.* p. 489. Pl. XIII. fig. 7 .. Amazons.
Eurypages, n. g., xi. p. 489.
—— pennatus, *l. c.* p. 489. Pl. XIII. fig. 6 .... Brazil (Morro Velho).
Pseudocholus laticollis, xii. p. 56 .... Ceram.
—— basalis, *l. c.* p. 56 .... Gilolo; Morty.
—— orichalceus, *l. c.* p. 56 .... Bouru.
—— cinctus, *l. c.* p. 56 .... Saylee.

Metanthia, n. g., xii. p. 57.
—— pyritosa, *l. c.* p. 57. Pl. III. fig. 4 .. Dorey; Saylee.
—— ebenina, *l. c.* p. 57 .... Batchian.
—— cyanea, *l. c.* p. 58 .... Waigiou.
—— nitidula, *l. c.* p. 58 .... Batchian.
Ipsichora, n. g., xii. p. 58.
—— cupido, *l. c.* p. 58 .... Ceram.
—— cœlestis, *l. c.* p. 59.................. Dorey; Saylee.
—— pulchella, *l. c.* p. 59 .... Salwatty.
—— femorata, *l. c.* p. 59 .... Aru.
Myctides, n. g., xii. p. 59.
—— barbatus, *l. c.* p. 60 .... Batchian.
Cynethia, n. g., xii. p. 60.
—— interrupta, *l. c.* p. 61. Pl. III. fig. 12. Sumatra.
Acythopeus, n. g., xii. p. 61.
—— tristis, *l. c.* p. 62. Pl. III. fig. 11 .. Saylee.
—— tenuirostris, *l. c.* p. 62 .... Tondano.
—— palmaris, *l. c.* p. 62 .... Amboyna.
—— curvirostris, *l. c.* p. 62 .... Gilolo; Batchian.
—— bigeminatus, *l. c.* p. 63 .... Batchian; Aru.
Laodia, n. g., xii. p. 63.
—— niveopicta, *l. c.* p. 63. Pl. III. fig. 8.. Macassar.
—— niveosparsa, *l. c.* p. 64 .... Amboyna.
Lystrus, n. g., xii. p. 64.
—— sculptipennis, *l. c.* p. 64. Pl. III. fig. 1. Singapore; Macassar.
Simocopis, n. g., xii. p. 65.
—— umbrinus, *l. c.* p. 65. Pl. III. fig. 10. Brazil?

CALANDRINÆ.

Protocerius fervidus, xi. p. 216 .... Kumaon.
Prodioctes, n. g., xii. p. 66.
—— quinarius, *l. c.* p. 67. Pl. IV. fig. 2. Borneo (Muruk).
—— pavoninus, *l. c.* p. 67.............. Sarawak.
Tyndides, n. g., xii. p. 68.
—— pustulosus, *l. c.* p. 68. Pl. IV. fig. 4. Sumatra; Malacca.
—— lineatus, *l. c.* p. 68................ Sarawak.
Megaproctus pugionatus, xii. p. 68. Pl. IV.
fig. 8 .... Tondano.
Zetheus, n. g., xii. p. 69.
—— electilis, *l. c.* p. 69. Pl. IV. fig. 1 ... Penang.
Periphemus, n. g., xii. p. 69.
—— retrorsus, *l. c.* p. 69. Pl. IV. fig. 3.. Sarawak.
—— superciliaris, *l. c.* p. 70 .... Sumatra.
—— deletus, *l. c.* p. 70 .... Cochinchina; Laos.

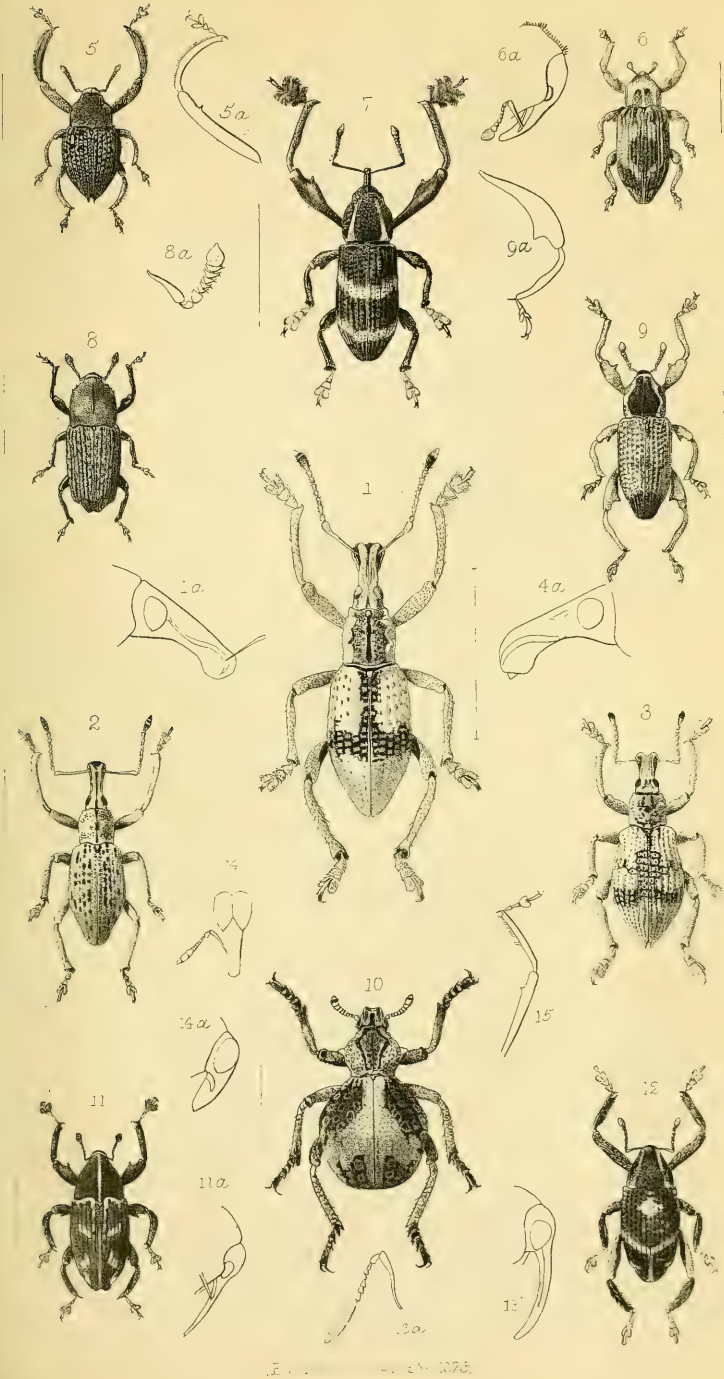
Poteriophorus congestus, xii. p. 70. Pl. IV. fig. 9 .... Malacca.
Barystethus ater, xii. p. 71 .... Dorey.
Diathetes, n. g., xii. p. 71.
—— ruficollis, *l. c.* p. 72. Pl. IV. fig. 7 .. Waigiou.
—— sannio, *l. c.* p. 72 .... Aru.
—— nitidicollis, *l. c.* p. 72.............. Amboyna; Goram.
—— strenuus, *l. c.* p. 72 .... Aru.
—— morio, *l. c.* p. 73.................. Australia (Cape York).
Cercidocerus indicator, xii. p. 73 .... Singapore.
—— hispidulus, *l. c.* p. 73. Pl. IV. fig. 5. Penang.
—— effetus, *l. c.* p. 74 .... Singapore.
—— saturatus, *l. c.* p. 74 .... Penang.
—— nervosus, *l. c.* p. 74. Pl. IV. fig. 6 .. Java.
Autonopis, n. g., xii. p. 75.
—— lineata, *l. c.* p. 75. Pl. IV. fig. 10 .. Malacca; Sumatra.
Laogenia, n. g., xii. p. 75.
—— sorex, *l. c.* p. 76. Pl. IV. fig. 11.... Gilolo; Sarawak.
—— intrusa, *l. c.* p. 76 .... Tondano; Sarawak.
Aphyoda, n. g., xi. p. 214.
—— diura, *l. c.* p. 215. Pl. VII. fig. 1 .. Dorey; Batchian; Ceram; Saylee.
—— brenthoides, *l. c.* p. 215............ Waigiou.
Ithaura, n. g., xi. p. 215.
—— strangulata, *l. c.* p. 216. Pl. VI. fig. 2.......................... Columbia.

COSSONINÆ.

Phænomerus notatus, xi. p. 490. Pl. XIII. fig. 2.......................... New Guinea.
—— exilis, *l. c.* p. 490.................. Queensland (Gayndah).

ERRATA.

Vol. x. p. 440, line 16, *for* confluent *read* nearly confluent.
451, „ 12, *for* latitudine *read* longitudine.
„ „ 12, *for* longiore *read* latiore.
xi. p. 180, „ 11, *for* 3 *read* 2.
„ „ 25, *for* $3\frac{1}{2}$ *read* $2\frac{1}{2}$.
„ „ 38, *for* $3\frac{1}{3}$ *read* $2\frac{1}{3}$.
181, „ 24, *for* Adelaide *read* Victoria.
445, last line, *after* basalibus *add* elongatis, longitudine æqualibus.
446, line 11, *for* tarsi *read* tibiæ.
456, „ 8 from bottom, *for* PELIEBIA *read* PELIOBIA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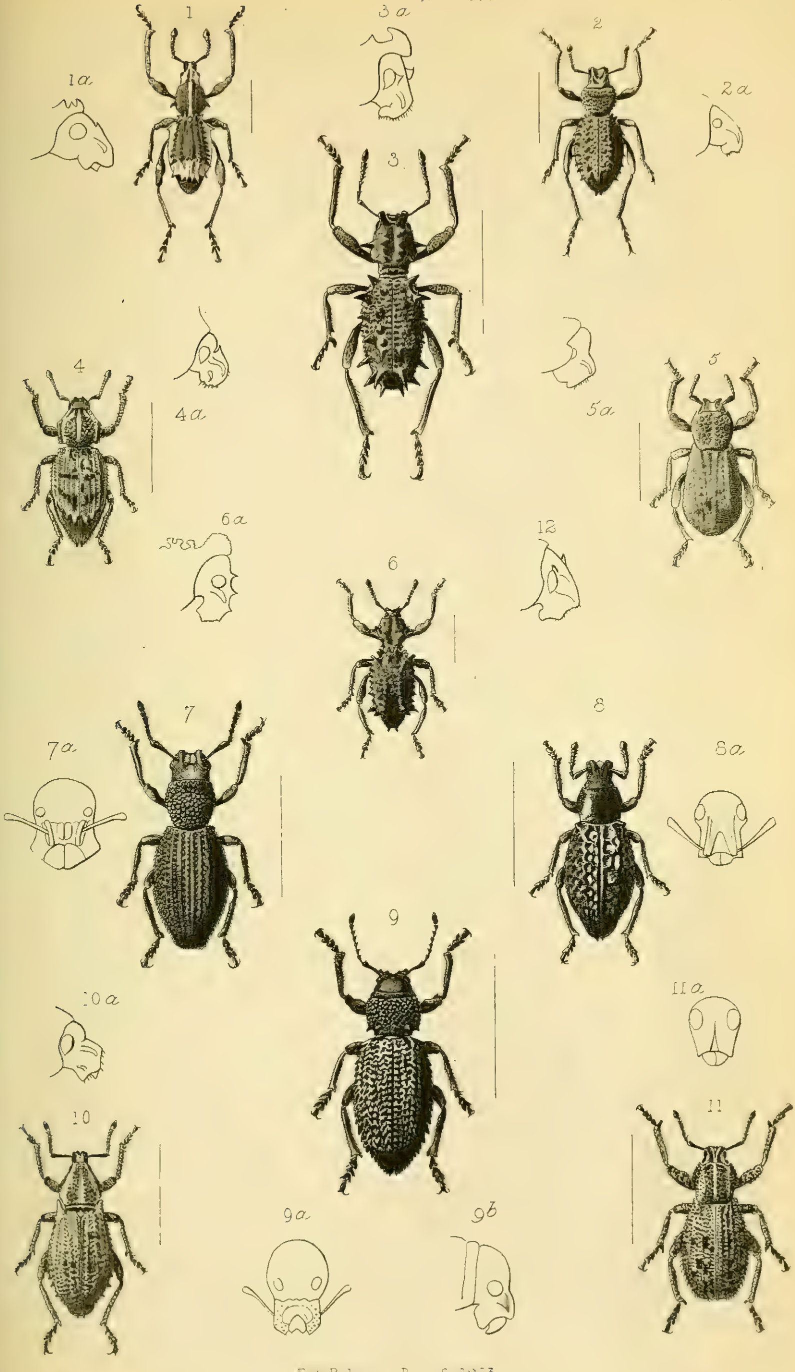

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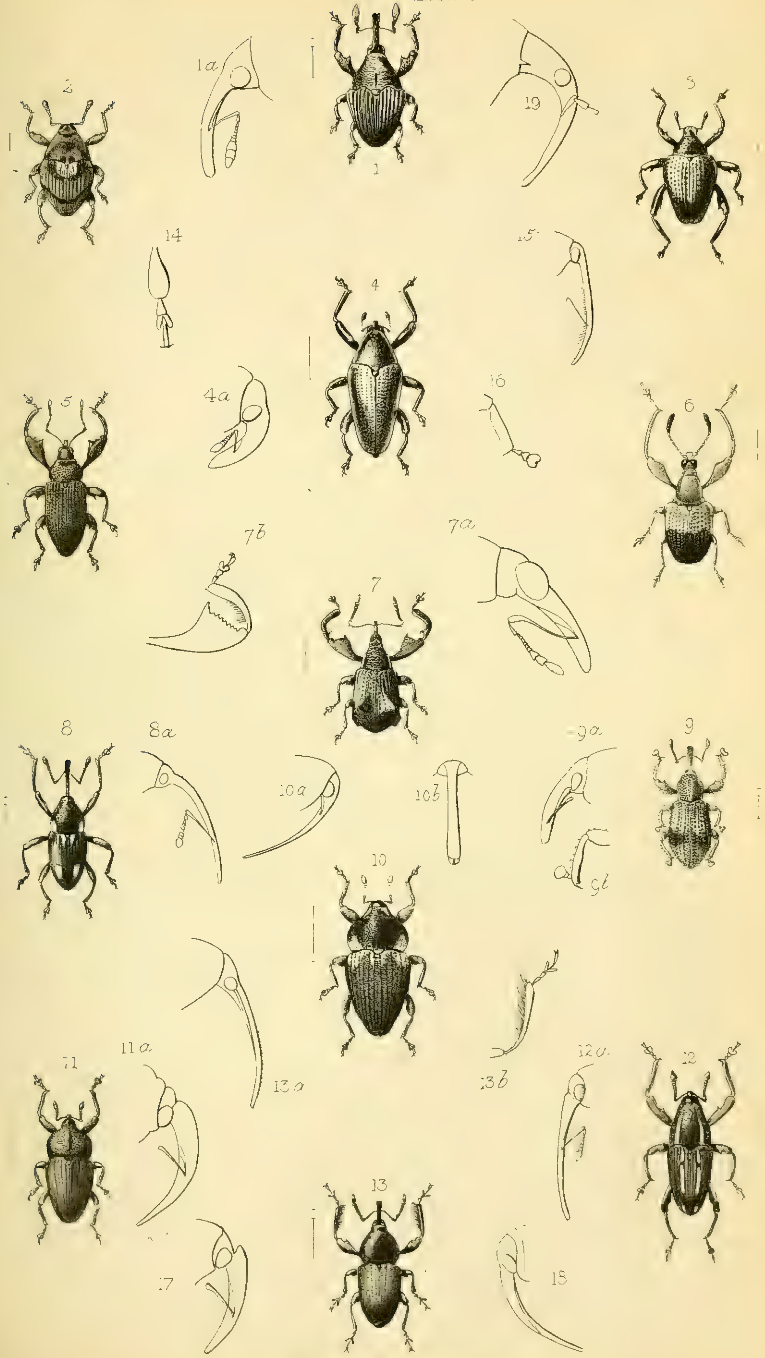

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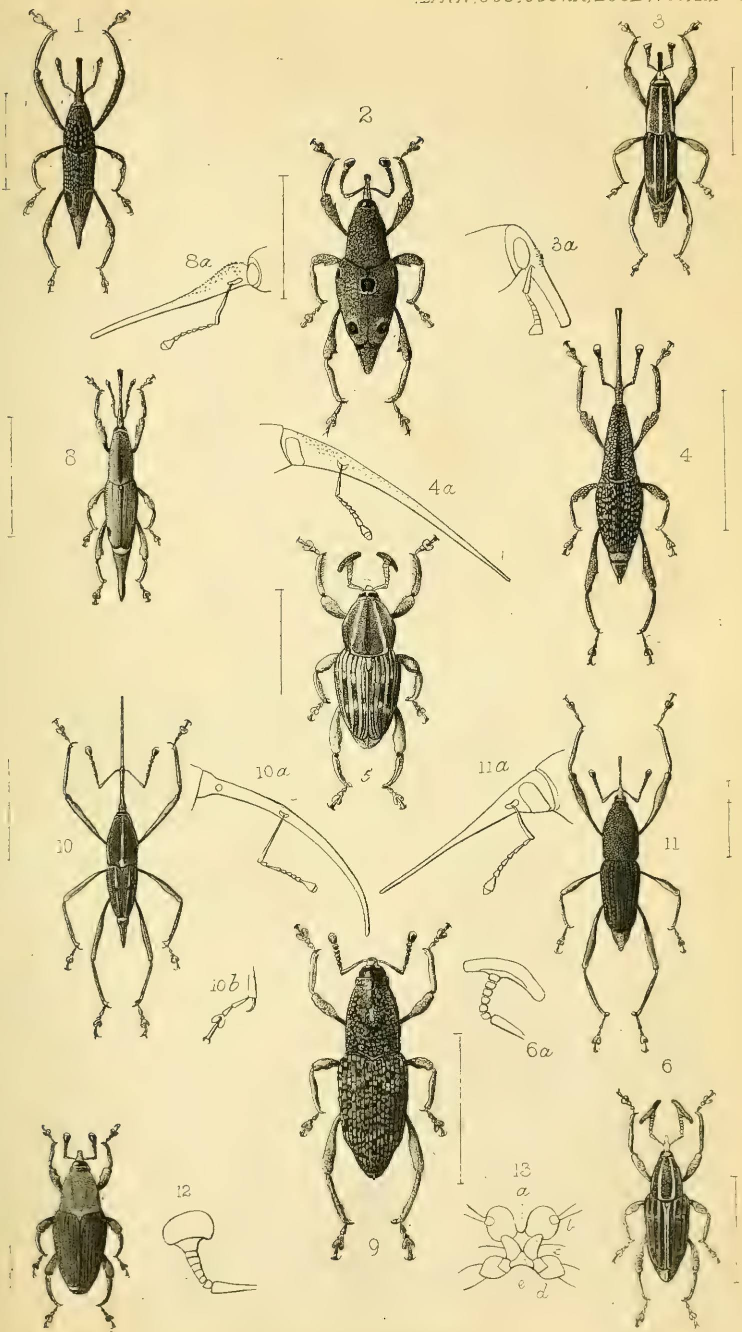

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CONTENTS.

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1874.

Poteriophorus congestus, xii. p. 70. Pl. IV. fig. 9 .... Malacca.
Barystethus ater, xii. p. 71 .... Dorey.
Diathetes, n. g., xii. p. 71.
—— ruficollis, *l. c.* p. 72. Pl. IV. fig. 7 .. Waigiou.
—— sannio, *l. c.* p. 72 .... Aru.
—— nitidicollis, *l. c.* p. 72.............. Amboyna; Goram.
—— strenuus, *l. c.* p. 72 .... Aru.
—— morio, *l. c.* p. 73.................. Australia (Cape York).
Cercidocerus indicator, xii. p. 73 .... Singapore.
—— hispidulus, *l. c.* p. 73. Pl. IV. fig. 5. Penang.
—— effetus, *l. c.* p. 74 .... Singapore.
—— saturatus, *l. c.* p. 74 .... Penang.
—— nervosus, *l. c.* p. 74. Pl. IV. fig. 6 .. Java.
Autonopis, n. g., xii. p. 75.
—— lineata, *l. c.* p. 75. Pl. IV. fig. 10 .. Malacca; Sumatra.
Laogenia, n. g., xii. p. 75.
—— sorex, *l. c.* p. 76. Pl. IV. fig. 11.... Gilolo; Sarawak.
—— intrusa, *l. c.* p. 76 .... Tondano; Sarawak.
Aphyoda, n. g., xi. p. 214.
—— diura, *l. c.* p. 215. Pl. VII. fig. 1 .. Dorey; Batchian; Ceram; Saylee.
—— brenthoides, *l. c.* p. 215............ Waigiou.
Ithaura, n. g., xi. p. 215.
—— strangulata, *l. c.* p. 216. Pl. VI. fig. 2.......................... Columbia.

Cossoninæ.

Phænomerus notatus, xi. p. 490. Pl. XIII. fig. 2.......................... New Guinea.
—— exilis, *l. c.* p. 490.................. Queensland (Gayndah).

ERRATA.

Vol. x. p. 440, line 16, *for* confluent *read* nearly confluent.
451, „ 12, *for* latitudine *read* longitudine.
„ „ 12, *for* longiore *read* latiore.
xi. p. 180, „ 11, *for* 3 *read* 2.
„ „ 25, *for* $3\frac{1}{2}$ *read* $2\frac{1}{2}$.
„ „ 38, *for* $3\frac{1}{3}$ *read* $2\frac{1}{3}$.
181, „ 24, *for* Adelaide *read* Victoria.
445, last line, *after* basalibus *add* elongatis, longitudine æqualibus.
446, line 11, *for* tarsi *read* tibiæ.
456, „ 8 from bottom, *for* Peliebia *read* Peliobia.

On some species of Japanese Marine Shells and Fishes, which inhabit also the North Atlantic. By J. GWYN JEFFREYS, LL.D., F.R.S., F.L.S.

[Read January 15, 1874.]

DURING the survey made by Capt. St. John in H.M.S. 'Sylvia' of the coasts of Japan between 43° 34′ and 33° 23′ N. lat., and 145° 20′ and 131° 40′ E. long., in the years 1871 and 1872, the dredge was occasionally used; and the results have been kindly placed at my disposal by Capt. St. John and the Hydrographer Royal. All the specimens of natural history, except those shells which I now propose to notice, have been placed in the British Museum.

Our present knowledge of the geographical distribution of the marine Mollusca is so imperfect that any contribution to the subject cannot but have its value. The accuracy of Capt. St. John's hydrographic surveys is universally recognized; and I will endeavour to be equally careful in determining and naming the Japanese shells, which, on comparison with those from European seas, I regard as belonging to the same species. I am quite aware of the difference of opinion entertained by many experienced conchologists as to the identity of species which inhabit widely separated tracts of the ocean, and that such species are called by some conchologists "representative" instead of identical; but certain species (e. g. *Saxicava rugosa* or *arctica*) unquestionably have a world-wide distribution. Moreover the love or ambition of species-making is perhaps inherent in the nature of many naturalists, however conscientious they may be. For myself I would renew my expression of unqualified approval of the opinion entertained by the learned authors of the 'Flora Indica,' that the discovery of a form uniting two others previously thought to be distinct, is much more important than that of a totally new species, inasmuch as the correction of an error is a greater boon to science than is a step in advance. The variation of species among the Mollusca cannot be less than among plants.

The marine shells of Japan have been noticed and described by several writers, from Carl Peter Thunberg in 1788 to Dr. C. E. Lischke in 1872. This last excellent conchologist gave, in the first volume of his 'Mollusca Japonica,' a valuable synoptical table of those species which inhabit other parts of the world. He showed that the following species are common to Japan and the Mediterranean—*Triton olearium* (properly *olearius*), Linné, *Saxicava arctica*, L. (*S. rugosa*, var.), and *Lima squamosa*, Lamarck; and common to Japan and the Atlantic coast of Europe, *Triton olearium*, *Saxicava arctica*, *Mya arenaria*, L., and *Modiola* (*Mytilus*) *modiolus*, L. In his second volume he noticed *Lasæa rubra*, Montagu, which inhabits also the Mediterranean and the Atlantic coast of Europe. We have thus five species in the same category. Three of these species (viz. *Mytilus modiolus*, *Lasæa rubra* and *Mya arenaria*) are inhabitants of the shore and shallow water; *Saxicava rugosa* has a wide range of depth from low-water mark to 1230 fathoms; and *Lima squamosa* occurs in the coralline zone. All the five species are Atlantic. I now propose to record from Capt. St. John's dredgings thirty-nine species as common to Japan and the North Atlantic. These are exclusive of *Lima squamosa* and *Triton olearius*, which have been already noticed by Dr. Lischke; and the number may be increased by adding three species of Brachiopods (*Terebratula vitrea*, Gmelin, var. *minor*, *T. caput-serpentis*, L., and *Terebratella Spitzbergensis*, Davidson) mentioned by Mr. Davidson in the Proceedings of the Zoological Society of London for 1871; three species of other Mollusca (*Gemma gemma*, Totten, *Coralliophya lithophagella*, Lam., and *Piliscus commodus*, Middendorff) mentioned by Mr. Arthur Adams in the Proceedings of the same Society for 1863; *Limopsis abyssicola*, A. Adams, P. Z. S, 1869, *Fossarus Japonicus*, A. Adams = *F. costatus*, Brocchi.; besides *Limopsis aurita*, two species of *Pecchiolia* (*P. acute-costata*, Philippi, and *P. granulata*, Seguenza), *Pyramidella nitidula*, A. Adams, and other species which were dredged by me in the Bay of Biscay during the 'Porcupine' expedition of 1870, as well as by Mr. A. Adams in the Japanese seas.

In giving the geographical distribution for the species now about to be enumerated, I have added the range of depth for such of them as I procured in the 'Porcupine' Explorations of 1869 and 1870. This information will, I believe, be found useful.

It will be observed that some of the species are littoral or inhabit shallow water, while others inhabit the coralline and deep-water zones. The modes of migration or transport from the North Pacific to the North Atlantic, or *vice versâ*, must consequently be of different kinds. Some marine currents and tides are superficial; others are deep and sweep the bottom of the sea. Now the latter kind of currents seem to be almost unknown.

The stream and drift currents of the Atlantic and Pacific Oceans, with the surface temperature, are, indeed, most carefully laid down in the 'Pilot Charts' which have been lately published by our Admiralty under the superintendence of its eminent Hydrographer; but the direction and force of the abyssal currents ought to be fully investigated before we can explain the distribution of deep-water Mollusca, especially of the bivalves and such of the univalves as cannot swim, and whose fry do not rise to the surface and become for a short time oceanic. Voluntary migration seems to have little, if any, share in the work of diffusion. It is to be hoped that the present expedition of H.M.S. 'Challenger' will contribute much information on this very important and interesting subject, in the same way that to a limited extent was done in the 'Porcupine' expeditions. It is difficult to account for the occurrence of so many of the same species in the seas of Japan and the North Atlantic Ocean. Probably those species which inhabit deep water may have had a common origin or birthplace in high northern latitudes, and have found their way to Japan on the one side and Europe on the other by means of a bifurcation of the great Arctic current. Their entry into the Mediterranean from the Atlantic may have taken place through a wide channel which formerly existed between the lower part of the Bay of Biscay and the Gulf of Lyons, and which has been satisfactorily shown on geological grounds to have been made since the Tertiary epoch. The present communication through the Straits of Gibraltar seems to be also of a comparatively modern date.

With respect to the fishes which are common to Japan and the Mediterranean or the North Atlantic, I have been favoured by Dr. Albert Günther, F.R.S., with a list and note, which, with the permission of the Society, I will append to this paper. His authority as an ichthyologist is so great that his communication will be valuable on its own account, as well as in showing the distribution of the species not only among the invertebrates but also in the vertebrate fauna in the northern divisions of the Atlantic and Pacific Oceans.

Subkingdom MOLLUSCA.

Brachiopoda.

Rhynchonella psittacea, *Gmelin*; young.
35 fathoms. Lat. 41° 41′ N.; long. 141° 0′ E. Circumpolar.

CONCHIFERA.

LIMA ELLIPTICA, *Jeffreys*.

6 fathoms. Lat. 34° 23′ N.; long. 136° 55′ E.

The specimens (three in number) are much smaller than those from Skye; but the characters peculiar to this species, and which distinguish it from *L. auriculata*, are the same, viz. shape, sculpture, and obliquity of the central furrow. In the Japanese specimens the upper part of the anterior and posterior margins is sinuous, while in European specimens this part is flexuous. I do not regard this slight difference as a specific character.

North-east Atlantic and Mediterranean 'Porcupine' expeditions, 45–690 fathoms.

MYTILUS EDULIS, *Linné*, var. UNGULATA.

Endermo. The largest specimen measures 5 inches by 2¼.

Var. GALLOPROVINCIALIS.

Yokooka Dock, Gulf of Yedo; North Atlantic and Mediterranean.

MODIOLARIA MARMORATA, *Forbes*.

Three specimens.

Yokooka Dock.

Smaller than European specimens and darker-coloured.

North-east Atlantic and Mediterranean; Arabian and Persian Gulfs (*McAndrew*)! 'Porc.' exp. 165 fathoms.

MODIOLARIA DISCORS, *L.*; var. SUBSTRIATA, Gray.

One specimen, 1½ inch long by 1 inch wide.

11 fathoms. E. Yeso.

North-east Atlantic and Mediterranean.

CRENELLA FABA, *Fabricius*.

48 fathoms. Three specimens, one of which is ¾ of an inch long.

More finely striated than usual, but evidently this species.

Circumpolar.

NUCULA TENUIS, *Montagu*.

Numerous specimens.

3 to 48 fathoms.

North Atlantic and Mediterranean. 'Porc.' exp. 20–1630 fathoms.

LEDA LANCEOLATA, *James Sowerby*.

= Nucula arctica, *Broderip & G. B. Sowerby* (not of Gray or Sars, the latter being *Nucula lanceolata* of Lamarck=*N. limatula*, Say,= *Yoldia hyperborea*, Lovén).

= N. oblonga, *G. B. Sowerby.*

= Yoldia arctica, *Möller.*

Several specimens of different ages.

From 3 to 48 fathoms.

The sculpture is very variable. In some specimens the striæ are at first transverse and close-set, and afterwards become oblique and distant; in others the striæ are confined to the anterior side of the shell, as in *L. semistriata* of Mr. S. Wood, while in others the striæ are almost entirely absent. In the description of *Nucula lanceolata* by James Sowerby the shell is described as "smooth." Perhaps he intended the Crag shell referred by Mr. Wood to *Leda myalis* of Couthouy, but which does not appear to be that species.

Circumpolar.

LEDA FRIGIDA, *Torell.*

= L. nana, *Sars.*

Several specimens.

3 to 48 fathoms.

Also Spitzbergen, Norway, and southwards to the coast of Portugal, 50–1380 fathoms. Fossil at Messina, in the Zanclean division of the Pliocene formation (*Seguenza*)!

LEDA MINUTA, *Müller.*

Two specimens. Ooshima, and 48 fathoms. Agreeing in the most minute particulars with specimens dredged by me in St. Magnus Bay, Shetland.

North Atlantic. 'Porc.' exp.: W. coast of Ireland, 164–420 fathoms; Bay of Biscay, 305–717 fathoms.

CARDIUM GRŒNLANDICUM, *Chemnitz.*

Several young specimens from 48 fathoms.

Spitzbergen (*Torell*); United States (*Gould and others*); Behring's Strait (*Stimpson*). Circumpolar.

CARDIUM ISLANDICUM, *Ch.*

Several young specimens from 3–48 fathoms.

United States (*Gould and others*); Wellington Channel (*Belcher*). Circumpolar.

CARDITA BOREALIS, *Conrad.*

Endermo Harbour, 4–7 fathoms.

Undistinguishable from Crag specimens of *C. orbiculata*, S.

Wood; while certain specimens of *C. borealis* from Canada and the United States equally approach *C. analis* from Bridlington and *C. scalaris* from the Crag. Our Crag species are deplorably multiplied.

VENUS FLUCTUOSA, *Gould.*

Rather common in from 3 to 48 fathoms.

Spitzbergen (*Torell*). Circumpolar.

Varies in colour from olive-green to yellowish-white.

TAPES DECUSSATUS, *L.*

Common in 4–35 fathoms. A trapeziform variety occurs from Hakodadi. Japanese as well as European specimens differ among themselves in shape and sculpture; and it is impossible to separate the so-called *T. indicus* from *T. decussatus* by any other than a geographical character.

North-east Atlantic and Mediterranean.

TELLINA INFLATA, *Stimpson.*

Four specimens from 5–48 fathoms.

United States (*Stimpson*); Gulf of St. Lawrence (*Whiteaves*); Spitzbergen (*Torell*); Wellington Channel (*Belcher*).

LYONSIA HYALINA, *Conrad.*

Two specimens from 5 fathoms.

United States (*Conrad and others*).

Allied to *L. Norvegica.* Both species are very distinct from *L. arenosa,* which is circumpolar.

SAXICAVA RUGOSA, *L.*; var. ARCTICA.

7 fathoms; var. *præcisa,* Yokooka Harbour. Ubiquitous. 'Porc.' exp. 20–1230 fathoms.

MYA ARENARIA, *L.*

5–48 fathoms.

North Atlantic.

GASTROPODA.

TECTURA TESTUDINALIS, *Müll.*

Everywhere from the shore to 7 fathoms.

Circumpolar, and North-east America.

I cannot detect any difference between this species and *T. patina* of Eschscholtz, notwithstanding Middendorff's ingenious distinction as to the sculpture.

LEPETA CÆCA, *Müll.*

From 4 to 48 fathoms.

Circumpolar, and North-east America.

PUNCTURELLA NOACHINA, *L.*

Yamada Harbour, 7 fathoms.

Circumpolar, and North-east America. 'Porc.' exp. 66–1095 fathoms.

TROCHUS VARICOSUS, *Mighels & Adams.*

= Margarita elegantissima, *Bean.*

= M. plicata, *Sars.*

= M. polaris, *Danielssen.*

A single specimen from 48 fathoms.

Spitzbergen (*Torell*); Gaspé Bay, Gulf of St. Lawrence (*Whiteaves*); New Brunswick, Newfoundland, and Nova Scotia (*Mighels & Adams*, *Willis*, and *Stimpson*); Norway (*Sars*, *Koren*, and *Danielssen*). Fossil in the Bridlington Glacial bed (*Bean*).

LACUNA DIVARICATA, *Fabr.*; var. ECANICULATA.

A single specimen from 7 fathoms.

Northern Europe, Asia, and America. The absence of a canal is also noticeable in every other British species of *Lacuna*.

LITTORINA RUDIS, *Maton.*

A single dead specimen from 7 fathoms, probably carried out by the tide or voided by a fish.

North Atlantic, Mediterranean, and North Pacific.

MENESTHO ALBULA, *Fabr.*

Several specimens.

Spitzbergen and Greenland.

NATICA AFFINIS, *Gm.*

= N. clausa, *Broderip & Sowerby.*

Three specimens.

North of Europe, Asia, and America. 'Porc.' exp. 203–664 fathoms.

N. GRŒNLANDICA, *Ch.*

Endermo; Yeso, 3 fathoms.

Same range as last species. 'Porc.' exp. 173–725 fathoms.

ADMETE VIRIDULA, *Fabr.*

A single specimen from 48 fathoms.

Spitzbergen (*Torell*); Norway, Greenland, and N.E. America. 'Porc.' exp. 114–420 fathoms.

PURPURA LAPILLUS, *L.*

Shore to 4 fathoms.

North Atlantic, Mediterranean, and North Pacific.

Murex erinaceus, *L.*; var. fauce purpurea.

A single specimen from 7 fathoms.

North-east Atlantic and Mediterranean. The same variety is found in Jersey.

Trophon clathratus, *L.*; var. Gunneri.

Several specimens from 3 to 48 fathoms.

Circumpolar and North-east America. 'Porc.' exp. 155–345 fathoms.

Nassa reticulata, *L.*

A single specimen from 6 fathoms.

North Atlantic, Mediterranean, and Black Sea.

Ringicula auriculata, *Menard.*

A single specimen from 5 fathoms.

North Atlantic, Mediterranean, and Gulf of Suez. 'Porc.' exp. 15–128 fathoms.

Pleurotoma turricula, *Montagu.*

Two young specimens from 48 fathoms.

North Atlantic. 'Porc.' exp. 10–994 fathoms.

P. mitrula, *Lovén.*

A single specimen from 7 fathoms.

Norwegian.

P. Renieri, *Scacchi.*

One specimen from Matoza Harbour, in N. lat. 34° 23′, E. long. 136° 55′. It differs only in the apex being more elongated.

Bay of Biscay and Mediterranean, in 45–539 fathoms.

Cylichna alba, *Brown.*

= C. corticata, *Möll.*

Two specimens.

Circumpolar, North Atlantic and North Pacific. 'Porc.' exp. 114–1366 fathoms.

British Museum, 7/5/73.

My dear Sir,—I enclose the list of fishes found in the Mediterranean (including Madeira) and in Japan. I have also made a column for such of the species as occur in the West Indies. The list might have been much increased by looking carefully through more recent records. The species included in it are either pelagic or deep-sea species (that is, species having naturally a very wide range); and most of those enumerated occur also in other parts of the Atlantic, Indian, and Pacific Oceans. Some of them, like *Serranus octocinctus*, *Centriscus gracilis*, *Lophotes*, have hitherto not been found in intermediate regions.

It is a fact known for a long time that a great number of the pelagic species spawn in the open sea, which will go far to account for their wide geographical range.

Can I be of further assistance to you?

Yours very truly,
A. Günther.

J. Gwyn Jeffreys, Esq., F.R.S.

	Mediterranean or Madeiran.	West Indies.	Japan.
Anthias oculatus	*	*	*
Serranus octocinctus	....	*	*
Scomber pneumatophorus	*	....	*
Echeneis remora	*	*	*
—— brachyptera	*	*	*
—— naucrates	*	*	*
Caranx hippos	....	*	*
Seriola dumerilii	*	....	*
—— lalandii	*	*	*
Centriscus gracilis	*	....	*
Lophotes	*	....	*
Macrurus	*	....	*
Saurus myops	....	*	*
Albula conorhynchus	*	*	*
Elops saurus	....	*	*
Conger vulgaris	*	*	*
Myrus	*	....	*
Hippocampus antiquorum	*	....	*
—— guttulatus	....	*	*
Monacanthus setifer	*	*	*
—— monoceros	....	*	*
Orthagoriscus mola	*	....	*
Galeocerdo tigrinus	....	*	*
Zygæna malleus	*	*	*
Lamna cornubica	*	*	*
Rhina squatina	*	....	*
Rhinobatus columnæ	*	....	*
Trygon pastinaca	*	*	*
Pteroplatea hirundo	*	....	*
	22	18	29

Zoological Department, British Museum,
December 17, 1873.

My dear Sir,—I return the list of species of marine fishes common to the North Atlantic and Japan. In Ichthyology the affinity of these two districts has been ascertained for a long time; and it would become still more apparent if regard had been had not only to species (some of which have a very wide range) but also to genera—and, secondly, if the marine fauna of Western North America had been drawn within your present researches.

Of course you are aware that a large proportion of the terrestrial animals of Northern Japan are European types.

I remain, yours very truly

A. Günther.

J. Gwyn Jeffreys, Esq., F.R.S.

Note on a New Species of Japanese Brachiopoda. By Thomas Davidson. Communicated by J. Gwyn Jeffreys, Esq., LL.D., F.R.S., F.L.S.

[Read January 15, 1874.]

In the Proceedings of the Zoological Society of London for April 1871, I described and illustrated all the species of Brachiopoda (twenty in number) that had been procured from the Japanese waters.

Since then Dr. C. E. Lischke obtained from the Bay of Jedo several examples of a coppery-coloured and green *Lingula*, approaching in size and character to *Lingula smaragdina*, Adams, a species common to the China sea, and which will before long be described in that naturalist's work 'Japoniacks Musei Conchilica.'

In 1872 Captain St. John, of Her Majesty's Ship 'Sylvia,' dredged five or six species of Brachiopoda in North Japan, namely :—*Terebratella Coreanica*, Adams & Reeves, 48 fathoms; *T. frontalis*, Middendorff, 35 fathoms; *Laqueus rubella*, Sow., 35 fathoms; *Waldheimia Grayii*, Dav., and its var. *transversa*, 35 fathoms; *Rhynchonella psittacea*, Gmelin, 35 fathoms.

We are therefore indebted to Captain St. John for the knowledge of one additional species in the Japanese waters, viz. *Terebratella frontalis*, Middendorff; and it is interesting to add that during the year 1873 Mr. Dall has dredged several living specimens and many dead ones of his rare species at Atka Island, of the Aleutian Chain, but originally described from the Ochotsk Sea. He informs me also by letter that its range in the island is from Attu, at the western side of the chain, to Atka, and that, so far as he has been able to discover, it does not extend further east.

Observations on Bees and Wasps. By Sir John Lubbock, Bart., F.R.S., M.P., F.L.S., Vice-Chancellor of the University of London.

[Read March 19, 1874.]

The Social Hymenoptera, according to Messrs. Kirby and Spence*, "have the means of communicating to each other information of various occurrences, and use a kind of language which is mutually understood .... and is not confined merely to giving intelligence of the approach or absence of danger; it is also coextensive with all their other occasions for communicating their ideas to each other."

Huber assures us as regards Ants † that he has "frequently seen the antennæ used on the field of battle to intimate approaching danger, and to ascertain their own party when mingled with the enemy; they are also employed in the interior of the ant-hill to warn their companions of the presence of the sun, so favourable to the development of the larvæ, in their excursions and emigrating to indicate their route, in their recruitings to determine the time of departure," &c. Elsewhere also he says ‡ "that should an Ant fall in with any of her associates from the nest they put her in the right way by the contact of their antennæ."

These statements are most interesting; and it is much to be regretted that he has not given us in detail the evidence on which they rest. In another passage, indeed, he himself says § "if they have a language, I cannot give too many proofs of it." Unfortunately, however, the chapter which he devotes to this important subject is very short, and occupied with general statements rather than with the accounts of the particular experiments and observations on which those statements rest. Nor is there any serious attempt to ascertain the nature, character, and capabilities of this antennal language. Even if by motions of these organs Bees can caress, can express love, fear, anger, &c., it does not follow that they can narrate facts or describe localities.

* Introduction to Entomology, ii. p. 50. † *L. c.* p. 206.
‡ *L. c.* p. 157. § *L. c.* p. 205.

Nor are the facts recorded by Kirby and Spence more explicit. It is therefore disappointing to read in the chapter especially devoted to this subject *, that, as regards the power possessed by Ants and Bees to communicate and receive information, "it is only necessary to refer you to the endless facts in proof, furnished by almost every page of my letters on the history of Ants and of the Hive Bee. I shall therefore but detain you for a moment with an additional anecdote or two, especially with one respecting the former tribe, which is valuable from the celebrity of the narrator."

The first of these anecdotes refers to a Beetle (*Ateuchus pilularius*), which having made for the reception of its eggs a pellet of dung too heavy for it to move "repaired to an adjoining heap and soon returned with three of his companions. All four now applied their united strength to the pellet and at length succeeded in pushing it out, which being done, the three assistant Beetles left the spot and returned to their own quarters." This observation rests on the authority of an anonymous German artist; and though we are assured that he was a "man of strict veracity," I am not aware that any similar fact has been recorded by any other observer.

The second case is related by Kalm, on the authority of Dr. Franklin; but it does not seem to me to justify the conclusions drawn from it by Messrs. Kirby and Spence. Dr. Franklin having found a number of Ants in a jar of treacle, shook them out and suspended the jar "by a string from the ceiling. By chance one Ant remained, which, after eating its fill, with some difficulty found its way up the string, and, thence reaching the ceiling, escaped by the wall to its nest. In less than half an hour a great company of Ants sallied out of their hole, climbed the ceiling, crept along the string into the pot and began to eat again; this they continued until the treacle was all consumed, one swarm running up the string while another passed down. It seems indisputable that the one Ant had in this instance conveyed news of the booty to his comrades, who would not otherwise have at once directed their steps in a body to the only accessible route" †.

As regards Wasps, Huber states that they are also acquainted with the mode of imparting information to their companions. When a single Wasp discovers a strong-hold of sugar, honey,

* *L. c.* p. 422. † *L. c.* p. 422.

or other article of food, it returns to its nest and brings off in a short time a hundred other Wasps; but we are yet ignorant if it be by visible or palpable signs they are mutually informed of this discovery" *.

A short but very interesting paper by Dujardin on this subject is contained in the 'Annales des Sciences' for 1852. He satisfied himself that some Bees which came to honey put out by him for the purpose "avaient dû recevoir dans la ruche un avertissement porté par quelques-unes de celles qui étaient venues isolément, soit à dessein, soit par hasard" †. That no doubt might remain, he tried the following experiment, which, he says, "me paraît tout-à-fait concluante".

"Dans l'épaisseur d'un mur latéral, à 18 mètres de distance des ruches A et B, se trouve une niche pratiqué, suivant l'usage du pays, pour constater la mitoyenneté, et recouverte par un treillage et par une treille, et cachée par diverses plantes grimpantes. J'y introduisis, le 16 novembre, une soucoupe avec du sucre légèrement humecté; puis j'allai présenter une petite baguette enduite de sirop à une abeille sortant de la ruche A. Cette abeille s'étant cramponnée à la baguette pour sucer le sirop, je la transportai dans la niche sur le sucre, où elle resta cinq ou six minutes jusqu'à ce qu'elle se fut bien gorgée; elle commença alors à voler dans la niche, puis deçà et delà devant le treillage, la tête toujours tournée vers la niche, et enfin elle prit son vol vers la ruche, où elle rentra.

"Un quart d'heure se passa sans qu'il revînt une seule abeille à la niche; mais, à partir de cet instant, elles vinrent successivement au nombre de trente, explorant la localité, cherchant l'entrée de la niche qui avait dû leur être indiquée, et où l'odorat ne pouvait nullement les guider, et, à leur tour, vérifiant, avant de retourner à la ruche, les signes qui leur feraient retrouver cette précieuse localité ou qui leur permettraient de l'indiquer à d'autres. Tous les jours suivants les abeilles de la ruche A vinrent plus nombreuses à la niche où j'avais soin de renouveler le sucre humecté, et pas une seule de la ruche B n'eut le moindre soupçon de l'existence de ce trésor et ne vint voler de ce côté. Il était facile, en effet, de constater que les premières se dirigeaient exclusivement de la ruche à la niche, et réciproquement."

* Huber's Natural History of Ants, p. 374.
† Ann. des Sci. Nat. 1852, p. 233.

Considering the immense number of bees in a hive and the number of very young ones, it seems almost incredible that the bees of a hive should all be known to one another. Yet we are assured by some writers that it is so. Gelieu, for instance, says, " Qu'une abeille tombe par accident, ou soit poussé par le vent dans une ruche qui n'est pas la sienne, elle est saisie et mise à mort à l'instant, comme suspecte de mauvais desseins "*.

Burmeister also, in his excellent 'Manual of Entomology,' says that " The power of communicating to their comrades what they purpose is peculiar to insects. Much has been talked of the so-called signs of recognition in bees, which is said to consist in recognizing their comrades of the same hive by means of peculiar signs. This sign serves to prevent any strange bee from intruding into the same hive without being immediately detected and killed. It, however, sometimes happens that several hives have the same signs, when their several members rob each other with impunity. In these cases the bees whose hive suffers most alter their signs, and then can immediately detect their enemy."†.

Huber mentions that some ants which he had kept in captivity having accidentally escaped, "met and recognized their former companions, fell to mutual caresses with their antennæ, took them up by their mandibles, and led them to their own nests; they came presently in a crowd to seek the fugitives under and about the artificial ant-hill, and even ventured to reach the bell-glass, where they effected a complete desertion by carrying away successively all the ants they found there. In a few days the *ruche* was depopulated. These ants *had remained four months without any communication*"‡. This statement has been very naturally copied by succeeding writers, and adopted without hesitation. See, for instance, Kirby and Spence's 'Introduction to Entomology,' vol. ii. p. 66, and Newport, 'Trans. of the Entomological Society of London,' vol. ii. p. 239.

Latreille also mentions that he once cut off the antennæ of an ant, and that one of its companions, " evidently pitying its sufferings, anointed the wounded part with a drop of transparent fluid from its mouth;" but the constant repetition of this statement in works on entomology indicates that other similar cases have not been met with. Messrs. Kirby and Spence, indeed, say that " whoever

* 'Le Conservateur des Abeilles,' p. 140.

† Burmeister's 'Entomology,' p. 502.

‡ Huber, p. 172.

attends to what is going forward in the neighbourhood of one of their nests, will be pleased to observe the readiness with which they seem disposed to assist each other in difficulties. When a burthen is too heavy for one, another will soon come to ease it of part of the weight; and if one is threatened with an attack, all hasten to the spot to join in repelling it" *.

These statements imply, on the part of bees, wasps, and ants, a great amount of intelligence. As I have already observed, however, the observations recorded do not seem to me in all cases to bear out the inferences that have been drawn from them. Moreover, when the conclusions are so important, we cannot be too sure of the facts; and however eminent, therefore, the authority may be, it is most desirable that the observations should be repeated.

Another question connected with these insects on which I was anxious to make some experiments was the use of the antennæ. That they are the means of communication there can be no doubt; but it is also the general opinion that they are, in addition, organs of sense. Whether, however, their functions are olfactory, or whether they serve as ears, is still a poiut on which entomologists are divided.

Our great entomologist Newport, in a paper specially devoted to the subject, says:—

"These facts, connected with the previous experiments, have convinced me that the antennæ in all insects are the auditory organs, whatever may be their peculiar structure—and that, however this is varied, it is appropriated to the perception and transmission of sound."

Dr. Ormerod also, who was so careful an observer of our British wasps, was of opinion that "the proper function of the antennæ seems to be that of an instrument of communication in the social tribes, and of an organ of hearing in insects generally" ‡.

"The majority of modern physiologists and entomologists agree in explaining the antennæ as organs of hearing, as we have already remarked. Kirby and Spence's representation (whose names were inadvertently omitted to be mentioned there as the authorities for our opinions) conveys so much conviction that we may

* Vol. ii. p. 55.

† Newport, "On the Antennæ of Insects.' Trans. Ent. Soc. vol. ii. p. 245.

‡ Natural History of Wasps, p. 73.

almost consider it settled, although we must at the same time admit that all the difficulties are not solved"*.

Dr. Braxton Hicks, also, and M. Lespès, who have specially studied the anatomical structure of antennæ, are of opinion that they are organs of hearing†.

The weight of authority, then, in favour of this view (comprising, as it does, Sulzer, Scarpa, Schneider, Borkhausen, Bonsdorf, Carus, Straus-Dürckheim, Oken, Burmeister, Kirby and Spence, Lespès, and Hicks) is very great. Nevertheless other eminent entomologists, as, for instance, Lyonet, Küster, Robineau-Desvoidy, Vogt, and Erichson, regard these organs as the seat of the sense of smell.

These are but a few of the many interesting questions which yet remain unsolved with reference to the social Hymenoptera. I present, therefore, the following observations to the Society with much diffidence; for I am well aware that they are but fragmentary. It will, however, be some months before I shall be able to prosecute them any further; and I trust that in some points they may be found not devoid of interest. I hope also that in consequence of bringing them before the Society I may receive some suggestions with reference to future inquiries.

Bees.

It will be observed that the current statements with reference to the language of social insects depend much on the fact that when one of them, either by accident or in the course of its rambles, has discovered a stock of food, in a very short time many others arrive to profit by the discovery. This, however, does not necessarily imply any power of describing localities. If the Bees or Ants merely follow their more fortunate comrade, the matter is simple enough; if, on the contrary, others are sent, the case becomes very different.

In order to test this, I proposed to keep honey in a given place for some time, in order to satisfy myself that it would not readily be found by the Bees, and then, after bringing a Bee to the honey, to watch whether it brought others, or sent them—the latter of course implying a much higher order of intelligence and power of communication.

I therefore placed some honey in a glass, close to an open

* Burmeister's 'Entomology,' p. 415.

† Transactions of the Linnean Society, vol. xxii. p. 395.

window in my sitting-room and watched it for sixty hours of sunshine, during which no bees came to it.

I then, at 10 o'clock in the month of June, went to my hives, and took a bee which was just starting out, brought it in my hand up to my room (a distance of somewhat less than 200 yards), and gave it some honey, which it sucked with evident enjoyment. After a few minutes it flew quietly away, but did not return; nor did any other bee make its appearance.

The following morning I repeated the same experiment. At 7·15 I brought up a bee, which sipped the honey with readiness, and after doing so for about five minutes flew away with no appearance of alarm or annoyance. It did not, however, return; nor did any other bee come to my honey.

On several other occasions I repeated the same experiments with a like result. Altogether I tried it more than twenty times; and I am satisfied that these bees cannot all have lost themselves or met with accidents. Indeed I never found bees to return if brought any considerable distance at once. By taking them, however, some twenty yards each time they came to the honey, I at length trained them to come to my room. On the whole, however, I found it more convenient to procure one of Marriott's observatory hives, both on account of its construction and also because I could have it in my room, and thus keep the bees more immediately under own eye. My room is square, with two windows on the south-west side, where the hive was placed, and one on the south-east. Besides the ordinary entrance from outside, the hive had a small postern door opening into the room; this door was provided with an alighting-board and closed by a plug; as a general rule the bees did not notice it much unless the passage was very full of them.

I then placed some honey on a table close to the hive, and from time to time fed certain bees on it. Those which had been fed soon got accustomed to come for the honey; but partly on account of my frequent absence from home, and partly from their difficulty in finding their way about, and their tendency to lose themselves, I never could keep any marked bee under observation for more than a few days.

Out of a number of similar observations I give the following in detail, as throwing some light on the power of communicating facts possessed by the bees; they will also illustrate the daily occupations of a working bee.

August 24. I opened the postern door at 6.45 and watched some marked bees till the middle of the day.

Bee no. 1.

6.50. One came to the honey. She then flew to the window, but after buzzing about for some time returned to the hive.
7.21. Back to honey. 7.23. Back to hive.
7.26. „ 7.30. Flew to window and then fell on the floor. I was afraid she would be trodden on, so at 7.45 I showed her the way to the hive.
8.40. Back to honey. 8.45. Back to hive. I now closed the postern door till 10.15.
10.35. Back to honey. 10.39. To hive.
10.45. „ and then to hive.
12.35. „ 12.37. To hive again.

Bee no. 2.

7. 0.	She came to the honey.	7. 5.	She went back to the hive.
7.12.	Back to the honey.	7.22.	„
7.24.	„	7.30.	„
7.42.	„	7.46.	„
7.52.	„	7.57.	„
8. 5.	„	8. 9.	„
8.15.	„	8.20.	„
8.26.	„	8.30.	„
8.40.	„	8.44.	„
8.55.	„	9. 0.	„

I then closed the door till 10.15; at 9.5, however, she came round to the honey through an open window, but could not find her way back, so I had to put her into the hive.

10.15.	Back to the honey.	10.17.	She went back to the hive.
10.20.	„	10.23.	„
10.30.	„	10.33.	„
10.50.	„	10.55.	„
11. 1.	„	11. 6.	„
11.17.	„	11.23.	„
11.33.	„	?	„
11.45.	„	11.50.	„
12. 0.	„	12. 3.	„
12.10.	„	12.15.	„
12.24.	„	12.30.	„

12.37. Back to the honey.	12.43. She went back to the hive.
12.52. ,,	12.56. ,,

Bee no. 3.

Also on August 24.

10.16. Came to honey.	10.19. Returned to hive.
10.30. ,,	10.34. ,,
10.55. ,,	10.57. ,,
11. 2. ,,	11. 5. ,,
11.11. ,,	11.15. ,,
11.24. ,,	11.27. ,,
11.35. ,,	11.37. ,,
11.45. ,,	11.47. ,,
11.57. ,,	? ,,
12.13. ,,	12.16. ,,
12.26. ,,	12.30. ,,
12.36. ,,	12.42. ,,
12.56. ,,	12.59. ,,

The next day I timed this bee as follows:—

7.23. Came to honey.	7.25. Returned to hive.
7.35. ,,	7.37. ,,
7.44. ,,	7.45. ,,
8.10. ,,	8.12. ,,
8.53. ,,	8.55. ,,
(The door was then closed till 9.30.)	
9.35. ,,	9.40. To window, and at 9.49 to hive.
10. ,,	10. 5. Returned to hive.
10.13. ,,	10.15. ,,
10.22. ,,	10.26. ,,
10.35. ,,	10.40. ,,
10.45. ,,	10.48. ,,
10.56. ,,	? ,,
11. 7. ,,	11.12. ,,
11.18. ,,	11.20. ,,
11.35. ,,	11.37. ,,
11.47. ,,	11.51. ,,
12. 2. ,,	12. 6. ,,
12.25. ,,	12.29. ,,
12.51. ,,	12.54. ,,

August 26. Opened the postern at 6.30.

6.46. The same bee as before came to the honey.	6.47. Back to hive.
6.58. She returned to the honey.	7. 0. "
7.23. "	7.25. "
7.32. "	7.35. "
7.45. "	7.48. "
7.55. "	7.59. "
8. 4. "	8. 7. "
8.19. "	8.22. "
8.39. "	8.43. "

During these observations scarcely any unmarked bees came to the honey.

In these cases, the postern being small, and on one side, was not very easily found. If the honey had been in an open place, no doubt the sight of their companions feasting would have attracted other bees; but in this case the honey was rather out of sight, being behind the hive-entrance, and was moreover only accessible by the narrow and winding exit through the little postern door.

But however exposed the honey might be, I found similar results, unless the bees were visible to their fellows. Thus on the 2nd, 3rd, 4th, and 5th October two or three marked bees were paying regular visits to some honey in my sitting-room; but during the whole time very few unmarked bees came to the honey.

I will now give a few more cases which tend to show that bees which have found a supply of sweets do not tell their fellows of the discovery.

9.19. I brought a bee to some honey.	9.24. She returned to the hive.
9.55. She came back to the honey.	10. 0. " "
10. 8. " "	10.10. " "
10.16. " "	10.19. " "
10.28. " "	10.30. " "
10.37. " "	10.40. " "
10.50. " "	10.53. " "
11. 0. " "	11. 4. " "
11.11. " "	11.15. " "
11.22. " "	11.27. " "
11.34. " "	11.37. " "
11.46. " "	11.50. " "
11.55. " "	12. 0. " "
12. 6. " "	12. 7. " "

12.40.	She came back to the honey.	12.46.	She returned to the hive.
12.54.	" "	12.57.	" "
1. 2.	" "	1. 4.	" "
	Flew about.		
1.15.	" "	1.18.	" "
1.23.	" "	1.27.	" "
1.34.	" "	1.41.	" "
1.54.	" "	2. 0.	" "

After which she did not return. During this time no other bee came to the honey.

Again on another occasion I watched several bees, which on my list of marked bees stood as Nos. 3, 4, 7, 8, 10 and 11.

9.45.	Bee No. 10 came.	9.50.	Went back to hive.
10. 0.	" 10 "	10. 3.	"
10.18.	" 10 "	10.21.	"
10.26.	" 11 "	10.30.	"
10.30.	" 4 "	10.35.	"
10.36.	" 7 "	10.45.	"
10.46.	" 4 "	10.52.	"
10.49.	" 7 "	10.52.	"
11. 0.	" 7 "	11. 9.	"
11. 5.	" 4 "	11. 9.	"
11.11.	" 7 "	11.16.	"
11.21.	" 7 "	11.29.	"
11.22.	A strange bee came.		
11.26.	Bee No. 4 came.	11.31.	"
11.30.	" 7 "	11.39.	"
"	" 10 "	11.36.	"
11.40.	" 4 "	11.45.	"
11.45.	" 7 "	11.50.	"
11.47.	" 10 "	11.59.	"
"	Another strange bee came.		
12. 1.	Bee No. 4 "	12. 6.	"
12. 2.	" 7 "	12. 8.	"
12. 3.	" 3 "	12. 7.	"
12. 4.	" 10 "	12. 7.	"
12.14.	" 7 "	12.18.	"
12.17.	" 4 "	12.21.	"
12.24.	" 7 "	12.31.	"
12.30.	" 10 "	12.33.	"
12.36.	" 7 "	12.46.	"
12.37.	" 4 "	12.44.	"
12.37.	" 10 "	12.40.	"
12.45.	" 10 "	12.49.	"
12.50.	" 7 "	12.54.	"
12.50.	" 4 "	12.54.	"
12.53.	" 10 "	12.56.	"

12.57.	Bee No.	7	came.	1. 0.	Went back to hive.
12.57.	,,	4	,,	1. 2.	,,
1. 0.	,,	10	,,	?	,,
1. 2.	,,	7	,,	1. 6.	,,
1. 9.	,,	4	,,	1.12.	,,
1.10.	,,	8	,,	1.16.	,,
1.10.	,,	7	,,	1.16.	,,
1.16.	,,	4	,,	1.19.	,,
1.17.	,,	5	,,	1.21.	,,
1.20.	,,	7	,,	1.24.	,,
1.20.	,,	8	,,	1.25.	,,
1.21.	,,	4	,,	1.24.	,,
1.23.	,,	5	,,	1.27.	,,
1.29.	,,	4	,,		
1.29.	,,	7	,,		

After this I ceased recording in detail; but the above shows that while the marked bees came regularly, only in two cases did any unmarked bees come to the honey.

In the above cases the honey was poured into saucers, but not weighed. In the following I used a wide-mouthed jar containing rather more than 1 lb. of honey.

1.44.	Bee No.	5	came.	1.45.	Went away.	
1.54.	,,	5	,,	1.58.	,,	
2. 2.	,,	5	,,	2. 5.	,,	
2. 9.	,,	5	,,	2.13.	,,	
2. 9.	,,	1	,,	2.15.	,,	
2.18.	,,	5	,,	2.20.	,,	
2.19.	,,	1	,,	2.21.	,,	
2.28.	,,	1	,,	2.31.	,,	
2.37.	,,	1	,,	2.41.	,,	
2.32.	,,	5	,,	2.40.	,,	
3.49.	,,	5	,,	2.51.	,,	
2.52.	,,	1	,,	2.55.	,,	
3.10.	A stranger came which I numbered as No. 14.					
3.11.	Bee No.	1	came.	3.13.	Went away.	
3.19.	,,	5	,	3.22.	,,	
3.20.	,,	1	,,	3.23.	,,	
3.19.	,,	14	,,	3.23.	,,	
3.30.	,,	5	,,	3.32.	,,	
3.31.	,,	14	,,	3.33.	,,	
3.37.	,,	1	,,	3.40.	,,	
3.38.	,,	5	,,	3.42.	,,	
3.38.	,,	14	,,	3.41.	,,	
3.47.	,,	5	,,	3.49.	,,	
3.46.	,,	14	,,	3.51.	,,	She was disturbed.
3.54.	,,	14	,,	3.56.	,,	

4.	Bee No. 1 came.	4. 3.	Went away.
4.	„ 5 „	4. 3.	„
4. 5.	„ 14 „	4.11.	„
4.10.	„ 5 „	4.12.	„
4.15.	„ 14 „	4.20.	„
4.22.	„ 1 „	4.25.	„
4.24.	„ 14 „	4.29.	„
4.26.	„ 5 „	4.29	„

During the whole of this time only one strange bee came, as recorded above.

In the following case I put out, besides 1 lb. of honey, also 4 oz. of honey spread over two plates.

12.15.	One of my marked bees came.	12.21.	She went.	
12.26.	She returned.	12.31.	„	
12.36.	„	12.44.	„	
12.51.	„	12.57.	„	
1. 4.	„	1.12.	„	
1.15.	„	1.19.	„	
1.25.	„	1.32.	„	
1.38.	„	1.44.	„	
1.49.	„	1.55.	„	
2.	„	2. 7.	„	
2.14.	„	2.19.	„	
2.25.	„	2.33.	„	
2.38.	„	2.44.	„	
2.50.	„	2.58.	„	
3. 5.	„	3.13.	„	
3.20.	„	3.32.	„	She was dis-
3.39.	„	3.45.	„	[turbed.
3.52.	„	4.	„	
4. 7.	„	4. 9.	„	
4.15.	„	4.20.	„	
4.27.	„	4.32.	„	
4.43.	„	4.45.	„	
4.50.	„	4.59.	„	
5. 7.	„	5.13.	„	
5.25.	„	5.31.	„	
5.42.	„	5.48.	,	
5.56.	„	6. 1.	„	
6.14.				

During this time no other bee came to the honey.

Not satisfied with this, I procured a fine honeycomb weighing 12½ lbs, and brought to it one of my marked bees

at 2.40.	2.47. She went back to the hive.
3. 4. She returned.	3.13. „ „
3.27. „	3.37. „ „
3.46. „	3.56. „ „
4. 6. „	4.18. „ „
4.26. „	4.44. „ „
4.54. „	5.10. „ „
5.18. „	5.26. „ „
5.36. „	5.46. „ „
5.54. „	6. 7. „ „
6.16. „	6.27. „ „
6.34. „	6.46. „ „
6.51. „	7. 4. „ „
7.14. „	

During the whole of which time only one strange bee came. In this case it will be observed that she remained longer at the honey than in the previous instances. The intervals during which she was away were as follows:—

1st	visit	9	minutes,
2nd	„	10	„
3rd	„	8	„
4th	„	10	„
5th	„	8	„
6th	„	10	„
7th	„	8	„
8th	„	9	„
9th	„	7	„
10th	„	5	„
11th	„	10	„

It seems obvious, then, that the bees which had found the honey did not communicate their discovery to the others.

Though the bees came readily out through the little postern door of my observatory hive, they had much difficulty in finding their way back until they had done so several times. For instance, the following may be taken as a typical case:—

August 8th.

At 6.50 a bee came out through the little postern door. After she had fed, she evidently did not know her way home; so I put her back.

At 7.10 she came out again. I again fed her and put her back.

At 10.15 she came out a third time; and again I had to put her back.

At 10.55 she came out again, and still did not remember the door. Though I was satisfied that she really wished to return, and was not voluntarily remaining outside, still, to make the matter clear, I turned her out of a side window into the garden, when she at once returned to the hive.

At 11.15 she came out again; and again I had to show her the way back.

At 11.20 she came out again; and again I had to show her the way back (this makes five times); when, however,

at 11.30 she came out again after feeding, she returned straight to the hive.

At 11.40 she came out, fed, and returned straight to the hive.

At 11.50 she came out, fed, and returned straight to the hive; she then stayed in for some time.

At 12.30 she came out again, but seemed to have forgotten the way back; after some time, however, she found the door and went in.

Again:—August 24 at 7.20 a bee came through the postern; I fed her; and though she was not frightened or disturbed, when she had finished her meal she flew to the window and had evidently lost her way; so at 8 o'clock I in pity put her back myself.

August 29. A bee came out to the honey at 10.10; at 10.12 she flew to the window and remained buzzing about till 11.12, when, being satisfied that she could not find her way, I put her in.

Nay, even those who seemed to know the postern, if taken near the other window, flew to it, and seemed to have lost themselves.

This cost me a great many bees. Those which got into my room by accident continually died on the floor near the window.

This is also well shown by the following experiments:—At 10.15 I put a bee into a bell-glass 18 inches long and with a mouth $6\frac{1}{2}$ inches wide, turning the closed end to the window; she buzzed about till 11.15, when, as there seemed no chance of her getting out, I put her back into the hive. Two flies, on the contrary, which I put in with her, got out at once. At 11.30 I put another bee and a fly into the same glass; the latter flew out at once. For half an hour the bee tried to get out at the closed end; I then turned the glass with its open end to the light, when she flew out at once. To make sure, I repeated the experiment once more, with the same result.

Some bees, however, have seemed to me more intelligent in this respect than others. A bee which I had fed several times and which had flown about in the room, found its way out of the glass in a quarter of an hour, and when put in a second time came out at once. Another bee, when I closed the postern door, used to come round to the honey through an open window.

Bees seem to me much less clever in finding things than I had expected. One day (April 14, 1872) when a number of them were very busy on some berberries, I put a saucer with some honey between two bunches of flowers; these were repeatedly visited, and were so close that there was hardly room for the saucer between them, yet from 9.30 to 3.30 not a single bee took any notice of the honey. At 3.30 I put some honey on one of the bunches of flowers, and it was eagerly sucked by the bees; two kept continually returning till past five in the evening.

One day when I came home in the afternoon I found that at least a hundred bees had got into my room through the postern and were on the window, yet not one was attracted by an open jar of honey which stood in a shady corner about 3 feet 6 inches from the window.

One day (29th April, 1872) I placed a saucer of honey close to some Forget-me-nots, on which bees were numerous and busy; yet from 10 A.M. till 6 only one bee went to the honey.

I put some honey in a hollow in the garden wall opposite the hives at 10.30 (this wall is about five feet high and four feet from the hives); yet the bees did not find it during the whole day.

On the 30th March, 1873, a fine sunshiny day, when the bees were very active, I placed a glass containing honey at 9 in the morning on the wall in front of the hives; but not a single bee went to the honey the whole day. On April 20 I tried the same experiment, with the same result.

September 19. At 9.30 I placed some honey in a glass about four feet from and just in front of the hive; but during the whole day not a bee observed it.

As it then occurred to me that it might be suggested that there was something about this honey which rendered it unattractive to the bees, on a following day I placed it again on the top of the wall for three hours, during which not a single bee came, and then moved it close to the alighting-board of the hive. It remained unnoticed for a quarter of an hour, when two bees observed it; and others soon followed in considerable numbers.

Some days, indeed, the bees did not seem to care about honey. Thus, September 19, I placed eleven bees one by one on some honey not far from the hive; they all fed well and returned quietly to the hive, but not one came back to the honey.

Indeed, under such circumstances, though the bees almost invariably fed with every appearance of enjoyment, comparatively few returned to the honey, even when it was not above 20 or 30 yards from the hive.

As regards time, the examples given above may be taken as fair illustrations; and on the whole it seems that, if honey is easily procurable and near the hive, a bee will on an average make about five excursions in the hour.

Sometimes, however, a bee will stay for hours inside the nest, even when the day is suitable and other bees are out; for instance, on the 24th August a marked bee remained in the hive all the morning.

Burmeister, in the passage already quoted (ante p. 115), says that bees have a sign which serves to prevent any strange bee from intruding into the hive without being immediately detected and killed, This seems to rest on a statement of Gélien, who believed that in each hive the bees had some common sign or pass-word. As evidence of this, he mentions * that one of his hives had been for some days robbed by the bees from another; "et je désespérais de conserver cet essaim, lorsqu'un jour, sur le soir, je le vis fort inquiet, fort agité, comme s'il eût perdu sa reine. Les abeilles couraient en tout sens sur le devant et le tablier de la ruche, se flairant, se tâtant mutuellement, comme si elles eussent voulu se dire quelque chose. C'était pour changer leur signe de reconnaissance, qu'elles changèrent en effet pendant la nuit. Toutes les pillardes qui revinrent le lendemain, furent arrêtées et tuées. Plusieurs échappèrent aux gardes vigilantes qui défendaient l'entrée, avertirent sans doute les autres du danger qu'elles avaient couru, et que l'on ne pouvait plus piller impunément. Aucune de celles qui voulurent recommencer leur déprédation, ne pénétra dans la ruche dont elles avaient fait leur proye, et qui prospéra merveilleusement."

Dujardin, however, has suggested another explanation of this case. He thinks that the behaviour of the bees indicated not a change of sign or password, but an alteration in the state of the

* Le Conservateur des Abeilles, p. 143.

queen in relation to the colony, which thus resumed its ordinary condition, and found itself in a position to repel the invaders. However this may be, the observation of Gélien, though curious and interesting, scarcely seems to bear out the conclusion he has drawn from it.

So far as my own observations go, though bees habitually know and return to their own hive, still, if placed on the alighting-board of another, they enter it without molestation. Thus :—

On May 4 I put a strange bee into a hive at 2 o'clock. She remained in till 2.20, when she came out, but entered again directly. I was away most of the afternoon, but returned at 5.30; at six she came out of the hive, but soon returned; and after that I saw no more of her.

May 12. A beautiful day, and the bees very active. I placed twelve marked bees on the alighting-board of a neighbouring hive. They all went in; but before evening ten had returned home.

May 13. Again put twelve marked bees on the alighting-board of another nest; eleven went in. The following day I found that seven had returned home; the other five I could not see.

May 17. Took a bee and, after feeding her and marking her white, put her to a hive next but one to her own at 4.18. She went in.

4.22. Came out and went in again.
4.29. Came out. I fed her and sent her back.
4.35. Came out. Took a little flight and came back. 4.45 went in, but returned. 4.52. Went in.
4.53. Came out. 4.56. „
4.57. „ 4.58. „
5. 1. „ , took another little flight, and returned. I fed her again. 5.25. Went in again.
5.28. Came out again. 5.29. „
5.31. „ 5.33. „
5.36. „ 5.40. „
5.46. Shut her and the others in with a piece of note-paper.
6.36. One of the bees had eaten its way through. I opened the door; and several, including the white one, came out directly. Till 6.50 she kept on going in and out every minute or two. Hardly any bees were flying, only a few standing at the doors of most of the hives. At 7.20 she was still at the hive-door.

May 20. Between 6 and 7 I marked a bee and transferred her to another hive.

May 21. Watched from 7.30 to 8.9 in the morning without seeing her. At half past six went down again, directly saw and fed her. She was then in her new hive; but a few minutes after I observed her on the lighting-stage of her old hive; so I again fed her, and when she left my hand she returned to the new hive.

May 22. 8 o'clock. She was back in her old hive.

May 23. About 12.30 she was again in the new hive.

As far as my experience goes, bees which have stung and lost their sting always die; not, however, immediately. On August 25 a bee which had come several times to my honey was startled, flew to one of the windows, and had evidently lost her way. While I was putting her back, she stung me, and lost her sting in doing so. I put her in through the postern, and for twenty minutes she remained on the landing-stage; she then went into the hive, and after an hour returned to the honey. After this, however, I did not see her any more.

As regards the affection of bees for one another, it is no doubt true that when they have got any honey on them, they are always licked clean by the others; but I am satisfied that this is for the sake of the honey rather than of the bee. On the 27th of September, for instance, I tried with two bees: one had been drowned, the other was smeared with honey. The latter was soon licked clean; of the former they took no notice whatever. I have, moreover, repeatedly placed dead bees by honey on which live ones were feeding, but the latter never took the slightest notice of the corpses.

Dead bees are indeed usually carried out of the hive; but if one is placed on the alighting-stage, the others seem to take no notice of it, though it is soon pushed off by the movements of the others. I have even seen the bees sucking the juices of a dead pupa.

Light.—Though bees do not come out at night, they seem to be much affected by light. One evening I lit a small covered lamp to go down to the cellar. A bee which was out came to it, and, flying round and round like a moth, followed me the whole of the way there.

Colour.—I have also made a number of experiments with reference to colours, on which, however, I will not now dwell. I will only say that it seems clear that bees can distinguish colours. For instance, on the 2nd of October I placed some honey on slips of glass resting on black, white, yellow, orange, green, blue, and red paper. A bee which was placed on the orange returned twenty times to that slip of glass, only once or twice visiting the others, though I moved the position and also the honey. The next morning again two or three bees paid twenty-one visits to the orange and yellow, and only four to all the other slips of glass. I then moved the glass, after which, out of thirty-two visits, twenty-two were to the orange and yellow. These and other experiments seemed to me to show a real disposition, which was also well marked in the case of wasps, towards the orange and yellow. That they can see blue, however, is indicated by the following experiment:—Oct. 6. I had ranged my colours in a line, with the blue at one end. It was a cold morning, and only one bee came. She had been several times the preceding day, generally to the honey which was on the blue paper. This day also she came to the blue; I moved the blue gradually along the line one stage every half hour, during which time she paid fifteen visits to the honey, in every case going to that which was on the blue paper.

Sound.—Aug. 29. The result of my experiments on the hearing of bees has surprised me very much. It is generally considered that to a certain extent the emotions of bees are expressed by the sounds they make *, which seems to imply that they possess the power of hearing. I do not by any means intend to deny that this is the case. Nevertheless I never found them take any notice of any noise which I made, even when it was close to them. I tried one of my bees with a violin. I made all the noise I could, but to my surprise she took no notice. I could not even see a twitch of the antennæ. The next day I tried the same with another bee, but could not see the slightest sign that she was concious of the noise. On Aug. 31 I repeated the same experiment with another bee, with the same result. On the 12th and 13th of September I tried several bees with a dog-whistle and a shrill pipe; but they took no notice whatever, nor did a set of tuning-forks which I tried on a subsequent day have any more effect. These tuning-forks extended over three octaves, beginning with *a* below the ledger-line. I also tried with my voice, shouting &c. close to the head of a bee; but in spite of my utmost efforts, the

* See for instance Landois, Zeits. f. wiss. Zool. 1867, p. 184.

bees took no notice. I repeated these experiments at night when the bees were quiet; but no noise that I could make seemed to disturb them in the least.

Temper.—I found the temper of the bees very variable. Generally they allowed me to handle them without any sign of irritation; while at other times, without any reason which I could discover, they stung me sometimes several times in a day; they seemed the more prone to do so the hotter the weather.

Wasps.

Sept. 18. I had in my room a nest of Humble Bees, which I fed with honey. The honey was also visited by wasps. One evening I marked one of these wasps (No. 1) which visited this honey; she was a large female of *V. germanica*; her last visit to the honey that day was at 6.30.

The next morning she came for the first time

at 7.25, and fed till 7.28, when she began flying about the room and even into the next; so I thought it well to put her out of the window, when she flew straight away to her nest. My room, as already mentioned, had windows on two sides; and the nest was in the direction of a closed window, so that the wasp had to go out of her way in going out through the open one.

At 7.45 she came back. I had moved the glass containing the honey about 2 yards; and though it stood conspicuously, the wasp seemed to have much difficulty in finding it. Again she flew to the window in the direction of her nest, and I had to put her out, which I did at 8.2.

At 8.15 she returned to the honey almost straight. 8.21, she flew again to the closed window, and apparently could not find her way; so at 8.35 I put her out again. It seems obvious from this that wasps have a sense of direction, and do not find their way merely by sight.

At 8.50 back to honey, and 8.54 again to wrong window; but finding it closed, she took two or three turns round the room, and then flew out through the open window.

At 9.24 back to the honey; and 9.27 away, first, however, paying a visit to the wrong window, but without alighting.

At 9.36. Back to the honey, and 9.39 away, but, as before, going first to wrong window. She was away therefore 9 minutes.

9.50.	,,	,,	9.53	away,	this time straight.	,,	11	,,
10.	,,	,,	10. 7	,,		,,	11	,,
10.19.	,,	,,	10.22	,,		,,	12	,,
10.35.	,,	,,	10.39	,,		,,	13	,,
10.47.	,,	,,	10.50	,,		,,	9	,,
11. 4.	,,	,,	11. 7	,,		,,	14	,,
11.21.	,,	,,	11.24	,,		,,	14	,,
11.34.	,,	,,	11.37	,,		,,	10	,,
11.49.	,,	,,	11.52	,,		,,	11	,,
12. 3.	,,	,,	12. 5	,,		,,	11	,,
12.13.	,,	,,	12.15½	,,		,,	8	,,
12.25.	,,	,,	12.28	,,		,,	10	,,
12.39.	,,	,,	12.43	,,		,,	11	,,
12.54.	,,	,,	12.57	,,		,,	11	,,
1.15.	,,	,,	1.19	,,		,,	18	,,
1.27.	,,	,,	1.30	,,		,,	8	,,

Here for the first time another specimen came to the honey.

At 1.37. Back to the honey, and 1.39 away (was rather disturbed,

1.46.	,,	,,	1.49	,,	as I tried to	Interval	7	,,
1.54.	,,	,,	1.58	,,	mark her).	,,	5	,,
2. 5.	,,	,,	2. 7	,,		,,	7	,,
2.15.	,,	,,	2.19	,,		,,	8	,,
2.27.*	,,	,,	2.32	,,		,,	8	,,
2.39.	,,	,,	2.42	,,		,,	7	,,
2.50.	,,	,,	2.54	,,		,,	8	,,
3. 2.	,,	,,	3. 6	,,		,,	8	,,
3.14.	,,	,,	3.17	,,		,,	8	,,
3.26.	,,	,,	3.29	,,		,,	9	,,
3.38.	,,	,,	3.42	,,		,,	9	,,
3.50.	,,	,,	3.58	,,		,,	8	,,
4. 7.	,,	,,	4.12	,,		,,	9	,,
4.20.	,,	,,	4.23	,,		,,	8	,,
4.32.	,,	,,	4.36	,,		,,	9	,,
4.46.	,,	,,	4.49	,,		,,	10	,,
5.	,,	,,	5. 3	,,		,,	11	,
5.13.	,,	,,	5.17	,,		,,	10	,,
5.26.	,,	,,	5.30	,,		,,	9	,,
5.40.	,,	,,	5.44	,,		,,	10	,,
5.54.	,,	,,	5.59	,,		,,	10	,,
6. 7.	,,	,,	6.11	,,		,,	8	,,
6.20.	,,	,,	6.25	,,		,,	9	,,

She did not come any more that day; but, as will be seen,

* She very often, however, throughout the day, in going away, flew to the other window first, and then, without alighting, returned to and went through the open one.

she had made forty-five visits to the honey in eleven hours. During the whole of this time no strange wasp, except the one above mentioned, came to this honey.

The following day, September 20th, this wasp made her appearance in my room at 6.55, when she flew straight to the honey.

At 6.55 came to the honey.	6.59 went away.	
7. 8 ,,	7.10 ,,	Absent 9 minutes.
7.18 ,,	7.22 ,,	,, 8 ,,
7.30 ,,	7.32 ,,	,, 8 ,,
7.41 ,,	7.45 ,,	,, 9 ,,
7.53 ,,	7.56 ,,	,, 8 ,,
8. 4 ,,	8. 7 ,,	,, 8 ,,
8.15 ,,	8.18 ,,	,, 8 ,,
8.27 ,,	8.30 ,,	,, 9 ,,
8.38 ,,	8.41 ,,	,, 8 ,,
8.50 ,,	8.53 ,,	,, 9 ,,
9. 1 ,,	9. 4 ,,	,, 8 ,,
9.12 ,,	9.15 ,,	,, 8 ,,
9.22 ,,	9.25 ,,	,, 7 ,,
9.34 ,,	9.36 ,,	,, 9 ,,
9.46 ,,	9.51 ,,	,, 10 ,,
10. 1 ,,	10. 3 ,,	,, 10 ,,
10.13 ,,	10.18 ,,	,, 10 ,,
10.28 ,,	10.30 ,,	,, 10 ,,
10.38 ,,	10.42 ,,	,, 8 ,,
10.53 ,,	10.56 ,,	,, 11 ,,
11. 7 ,,	11.11 ,,	,, 11 ,,
11.21 ,,	11.25 ,,	,, 10 ,,
11.32 ,,	11.36 ,,	,, 7 ,,
The wasp which came once yesterday returned and rather disturbed the first.		
At 11.49 came to the honey.	11.50 went away.	,, 13 ,,
11.57 ,,	12 ,,	,, 7 ,,
12. 8 ,,	12.11 ,,	,, 8 ,,
Here I was away for about two hours.		
2.42 came to the honey.	2.46 went away.	
2.58	3. 2 ,,	Interval 12 minutes.
3.15 ,,	3.17 ,,	,, 13 ,,
3.25 ,,	3.28 ,,	,, 8 ,,
Here I was called away.		
4.25 came to the honey.	4.28 ,,	
4.41 ,,	4.45 ,,	,, 13 ,,
5.15 ,,	5.19 ,,	,, 30 ,,
5.30 ,,	5.35 ,,	,, 11 ,,
5.45 ,,	5.50 ,,	,, 10 ,,
6. 2 ,,	6. 6 ,,	,, 12 ,,
6.15 ,,	6.17 ,,	,, 9 ,,

This was the last visit that day. She made therefore thirty-eight visits during the time she was watched, which was not quite eight hours. She was at work from 6.55 to 6.15; and assuming that she was occupied in the same manner during the three hours when she was not watched, as during the rest of the time, she would have made over fifty visits to the honey during the day.

Wishing, however to have a complete record of a day's work, I watched her the following day without intermission.

September 21. I began watching at ten minutes past six.

6.16.	She came to the honey.	6.19.	She went away.			
6.29.	„	6.32.	„	An interval of	10	minutes.
6.41.	„	6.44.	„	„	9	„
6.55.	„	7.	„	„	11	„
7.11.	„	7.15.	„	„	11	„
7.23.	„	7.26.	„	„	8	„
7.37.	„	7.42.	„	„	11	„
7.56.	„	8. 3.	„	„	14	„
	Was disturbed and seemed rather troubled.					
8.11.	She came to the honey.	8.14.	She went away.	An interval of	8	minutes.
8.20.	„	8.24.	„	„	6	„
8.31.	„	8.34.	„	„	7	„
8.40.	„	8.42.	„	„	6	„
8.50.	„	8.52.	„	„	8	„
8.58.	„	9.	„	„	6	„
9. 8.	„	9.11.	„	„	8	„
9.18.	„	9.22.	„	„	7	„
9.30.	„	9.32.	„	„	8	„
9.39.	„	9.40.	„	„	7	„
9.50.	„	9.54.	„	„	10	„
10. 1.	„	10. 5.	„	„	7	„
10.14.	„	10.17.	„	„	9	„
10.25.	„	10.28.	„	„	8	„
10.37.	„	10.40.	„	„	9	„
10.47.	„	10.51.	„	„	7	„
11.	„	11. 6.	„	„	9	„
11.17.	„	11.20.	„	„	11	„
11.34.	„	11.37.	„	„	14	„
11.50.	„	11.53.	„	„	13	„
12. 5.	„	12. 8.	„	„	12	„
12.20.	„	12.24.	„	„	12	„
12.36.	„	12.40.	„	„	12	„
1. 8.	„	1.11.	„	„	28	„
1.26.	„	1.28.	„	„	15	„
1.40.	„	1.42.	„	„	12	„
1.57.	„	2. 2.	„	„	15	„

2.10. She came to the honey.		2.13. She went away.		An interval of	8 minutes.
2.25.	,,	2.30.	,,	,,	12 ,,
2.45.	,,	2.56.	,,	,,	15 ,,

She buzzed about at the other window for a few minutes, which made the interval longer than usual.

3.13. She came to the honey.		3.18. She went away.		An interval of	17 minutes.
3.29.	,,	3.31.	,,	,,	11 ,,
3.41.	,,	3.45.	,,	,,	10 ,,
3.49.	,,	3.52.	,,	,,	4 ,,
4. 2.	,,	4. 6.	,,	,,	7 ,,
4.19.	,,	4.22.	,,	,,	13 ,,
4.29.	,,	4.33.	,,	,,	7 ,,
4.40.	,,	4.44.	,,	,,	7 ,,
4.51.	,,	4.53.	,,	,,	7 ,,
5. 4.	,,	5. 6.	,,	,,	11 ,,
5.16.	,,	5.20.	,,	,,	10 ,,
5.32.	,,	5.35.	,,	,,	12 ,,
5.45.	,,	5.50.	,,	,,	10 ,,

It will be seen that the intervals of her absence were remarkably regular. On one occasion, indeed, she was only away four minutes; but this time I think she had been disturbed and had not provided herself with a regular supply of food.

The number of visits was fifty-one in eleven hours and a half. I tried whether she would be in any way affected by a dead wasp, so I put one on the honey; but she took no notice whatever.

I observed with other wasps, that when the open window was not the shortest way to their nests, they had a great tendency to fly to that which was in the right direction, and to remain buzzing about there.

During the whole of this day, only four or five strange wasps came to the honey.

As regards the regularity of their visits, and the time occupied, other wasps which I observed agreed very closely with this one. For comparison, it may be worth while to give one or two other cases. I will commence with that of a worker, I believe *V. vulgaris*, observed on the 19th September.

10 A.M. I put her to the honey, she fed and then flew about the room and at last got into my bee-hive.

10.54. She came in again at the window. I again put her to the honey. She again flew all about the room.

11.41. She returned and this time came to the honey; but when she had fed again flew round and round the room, and did not seem able to find her way out. I therefore put her out.

12·11. She returned, and the same thing happened again.

12.28.	She came back to the honey.	12.31.	Flew straight away.	
12.45.	"			
12.53.	"	12.57.	"	
1.10.	"			
1.26.	"	1.29.	"	
				Interval
1.38.	"	1.41.	"	9 minutes.
1.50.	"	1.53.	"	9 "
2. 3.	"	2. 6.	"	10 "
2.12.	"	2.16.	"	6 "
		Was disturbed.		
2.20.	"	2.25.	"	4 "
2.40.	"	2.43.	"	15 "
2.51.	"	2.54.	"	8 "
3. 1.	"	3. 4.	"	7 "
3.13.	"	3.16.	"	9 "
3.25.	"	3.28.	"	9 "
3.35.	"	3.38.	"	7 "
3.46.	"	3.50.	"	8 "
3.58.	"	4. 1.	"	8 "
4 10.	"	4.14.	"	9 "
4.23.	"	4.25.	"	9 "
4.34.	"	4.38.	"	9 "
4.46.	"	4.50.	"	8 "
4.58.	"	5. 4.	"	8 "
5.14.	"	Was disturbed and flew about.		8 "

She did not return any more that evening, but made her appearance again at half-past six the next morning.

From twelve o'clock, when she had learnt her way, till five, she made twenty-five visits in five hours, or about five an hour, as in the previous cases.

It struck me as curious that on the following day this wasp seemed by no means so sure of her way, but over and over again went to the closed window.

I will give one other illustration:—

September 21. At 11.50 I fed a wasp.

11.56.	She returned to honey.		11.57.	Flew away.
12. 6.	"	"	12. 8.	"
1.25.	"	"	1.27.	"
1.37.	"	"	1.39.	"
1.57.	"	"	2. 0.	"

2.15. She returned to honey.	2.17. Flew away.
2.22. " "	2.25. "
2.32. " "	2.36. "
2.50. " "	2.55. "
3. 2. " "	3. 4. "
3.14. " "	3.18. "
3.28. " "	3.30. "
3.40. " "	3.44. "
3.51. " "	3.55. "
4. 4. " "	4. 8. "
4.16. " "	4.20. "
? " "	4.31. "
4.37. " "	4.41. "
4.46. " "	4.48. "
4.57. " "	5. "
5. 9. " "	5.12. "
5.22. " "	5.26. "
5.31. " "	5.36. "

After the above facts we may, I think, well say "How doth the little busy *wasp*." Even Mr. Ormerod seems hardly to have done justice to his favourites. He is very severe on those wasps which "take up their quarters on the wrong sides of our window." "I have nothing" he continues * "to say on behalf of these wasps; they are a nuisance and a terror to all who have little children. They are mere stragglers, who have lost all feeling of good fellowship, have deserted their nest, and are leading a freebooter's life." Many of them, on the contrary, I am satisfied, are perfectly respectable wasps which have unfortunately lost their way.

My experiments, then, in opposition to the statements of Huber and Dujardin, seem to show that wasps and bees do not convey to one another information as to food which they may have discovered. No doubt, when one wasp has discovered and is visiting a supply of syrup, others are apt to come too; but I believe that they merely follow one another. If they communicated the fact, considerable numbers would at once make their appearance; but I have never found this to be the case. The frequent and regular visits which my wasps paid to the honey put out for them proves that it was very much to their taste; yet few others made their appearance. For instance, on the 19th September, as recorded above, only one wasp came of herself to the honey; this wasp returned on the 20th, but not one other. The 21st was a hot day, and there were many wasps

* Natural History of Wasps, p. 245.

about the house; my honey was regularly visited by the two marked wasps; but during the whole day only five others came to it.

September 22. Again only only one strange wasp came up to one o'clock.

September 27. Only one strange wasp came.

October 2 and 3. These days were cold; a few marked bees and wasps came to my honey, but no strangers.

October 4. Two strangers.

October 6. Only one stranger.

On these days the honey was watched almost without intermission the whole day, and was more or less regularly visited by the marked bees and wasps.

These and other observations of the same tendency seem to show that, even if wasps have the power of informing one another when they discover a store of good food, at any rate they do not habitually do so.

On the whole, wasps seem to me more clever in finding their way than bees. I tried wasps with the glass mentioned on p. 124; but they had no difficulty in finding their way out.

Sounds.—My wasps, though courageous, were always on the alert, and easily startled. It was, for instance, much more difficult to paint them than the bees; nevertheless, though I tried them with a set of tuning-forks covering three octaves, with a shrill whistle, a pipe, a violin, and my own voice, making in each case the loudest and shrillest sounds in my power, I could see no symptoms in any case that they were conscious of the noise.

I made also a number of experiments with reference to colour, which have satisfied me that wasps, like bees, are capable of distinguishing colours. I am anxious, however, to repeat and extend these observations, and shall then hope to have the opportunity of laying them before the Society.

The following fact struck me as rather remarkable. The wasp already mentioned at the foot of p. 135 one day smeared her wings with syrup, so that she could not fly. When this happened to a bee, it was only necessary to carry her to the alighting-board, when she was soon cleaned by her comrades. But I did not know where this wasp's nest was, and therefore could not pursue a similar course with her. At first, then, I was afraid that she was doomed. I thought, however, that I would wash her, fully expecting, indeed, to terrify her so much that she would not return again. I therefore caught her, put her in a bottle half full of water and shook her up well till the honey was washed off. I then transferred her to a dry bottle and put her in the sun. When she was dry I let her out, and she at once flew to her nest. To my surprise, in 13 minutes she returned as if nothing had happened, and continued her visits to the honey all the afternoon.

This experiment interested me so much that I repeated it with another marked wasp, this time, however, keeping the wasp in the water till she was quite motionless and insensible. When taken out of the water she soon recovered; I fed her; she went quietly away to her nest as usual, and returned after the usual absence. The next morning this wasp was the first to visit the honey.

I was not able to watch any of the above-mentioned wasps for more than a few days; but I kept a specimen of *Polistes gallica* for no less than ~~three~~ months.

I took her, with her nest, in the Pyrenees early in May. The nest consisted of about twenty cells, the majority of which contained an egg; but as yet no grubs had been hatched out, and, of course, my wasp was as yet alone in the world.

I had no difficulty in inducing her to feed on my hand; but at first she was shy and nervous. She kept her sting in constant readiness; and once or twice in the train, when the railway officials came for tickets, and I was compelled to hurry her back into her bottle, she stung me slightly—I think, however, entirely from fright.

Gradually she became quite used to me, and when I took her on my hand apparently expected to be fed. She even allowed me to stroke her without any appearance of fear, and for some months I never saw her sting.

When the cold weather came on she fell into a drowsy state, and I began to hope she would hibernate and survive the winter. I kept her in a dark place, but watched her carefully, and fed her if ever she seemed at all restless.

She came out occasionally, and seemed as well as usual till near the end of February, when one day I observed she had nearly lost the use of her antennæ, though the rest of the body was as usual. She would take no food. Next day I tried again to feed her; but the head seemed dead, though she could still move her legs, wings, and abdomen. The following day I offered her food for the last time; but both head and thorax were dead or paralyzed; she could but wag her tail, a last token, as I could almost fancy, of gratitude and affection. As far as I could judge, her death was quite painless; and she now occupies a place in the British Museum.

Ants.

My experiments with ants have not been very succcessful; I may, however, just mention the following:—

On the 29th of December I took some red ants and placed them in a glass in my room. On the 4th of March following I put four of them back into their nest, but could not see any sign of joy on their part, or any evidence that they were recognized by their former companions. As, however, they soon went down into their nest and were out of sight, this observation was not very satisfactory. I therefore took some of the ants which had been left in the nest, and placed them in the glass. They joined the others, and crossed antennæ in the usual way; but I saw no special signs of satisfaction or recognition. For the sake of comparison, I put some other red ants with them, and I could observe no difference of behaviour.

On *Oniscigaster Wakefieldi*, the singular Insect from New Zealand, belonging to the Family Ephemeridæ; with Notes on its Aquatic Conditions. By ROBERT McLACHLAN, F.L.S.

[Read March 19, 1874.]

(Plate V.)

AT the Meeting of the British Association for the Advancement of Science held at Bradford in September of last year, I brought before the notice of Section D a very singular species of Ephemeridæ that I had just received from my friend C. M. Wakefield, Esq., of Christchurch, Canterbury Settlement, New Zealand, and which I proposed to name *Oniscigaster Wakefieldi*, the generic term being suggested by the formation of the terminal abdominal segments, they being provided on each side with wing-like corneous acute expansions strongly resembling a portion of an *Oniscus* or of some other Crustacean, and the true relationship of which, if examined only as a fragment, would scarcely be suspected. I had then received only female imagos; and an account of them (with a wood-cut) was published almost simultaneously in the Entomologist's Monthly Magazine for October 1874, vol. x. pp. 108–110. I have nothing to add to the generic diagnosis of the ♀ imago there given, excepting to indicate that instead of the 7th to the 9th abdominal segments only bearing the lateral corneous dilatations, the 6th to the 9th are really so furnished, a fact of which I was before doubtful, as indicated by a foot-note.

Recently I have received a further supply of the insect from Mr. Wakefield, and this time including males and the female subimago, before unknown to me. The male has, as I suspected, its eyes simple (as in the female), and very much longer anterior legs (a usual character in the family); but the abdomen is not much less robust than that of the female, and the middle tail is scarcely more abbreviated. The penultimate ventral segment carries a pair of 5-jointed forcipate appendages *.

I proceed to give an amended generic diagnosis of the female, and add thereto that of the male.

ONISCIGASTER.

(♀ *Imago.*) Corpus elongatum, valde robustum. Alæ quatuor; posticæ sat latæ, ovales; omnes venulis transversalibus ubique (anticæ apicem versus minus dense) regulariter reticulatæ. Pedes antici reliquis vix longiores; tarsi omnes 5-articulati, subæqualiter biunguiculati, posticorum articulo 4° brevi sed valde distincto. Abdomen valde elongatum et robustum; segmentis 6°–9° utrinque conspicue corneo-alatis, acute productis; ultimo parvo, elongato, obtuso-conicali: ovivalvula nulla: caudæ tres elongatæ, sed mediana cæteris gracilior et brevior.

(♂ *Imago.*) Oculi ut in ♀ integri. Pedes antici valde longiores. Cauda mediana paullo brevior. Abdomen infra segmentum nonum appendicibus forcipatis 5-articulatis instructum.

In its specific characters the male agrees with the female perfectly in coloration. The forcipate abdominal appendages are

* Five joints are unusual, four being the normal number; but it appears to me that the so-called second joint actually exists, and is defined by a suture.

slender and white, excepting the more robust basal joint, which is brownish.

The female subimago differs in the body being greyish rather than a decided brown; and the wings are uniformly smoky-grey (the anterior pair paler at the base), which coloration is caused by the subimaginal pellicle. I give here an extended specific diagnosis.

ONISCIGASTER WAKEFIELDI.

(♀ *Imago.*) O supra nigro-fusca; thorace nitido; abdomine indistincte pallido-vario, infra flavido, nigro-punctato, segmentis singulatim macula magna nigra utrinque signatis: caudæ flavo-albidæ. Pedes flavi, late nigro-annulati. Alæ vitreæ, anticarum dimidio basali et posticis omnino læte fuliginosis: venæ venulæque nigræ; his ad anticarum marginem costalem valde incrassatis, nigro-marginatis et suffusis: humeris nigris vel nigro-fuscis.

Long. corp. (sine caudis) 10''' (= 21 mill.); exp. alar. 19''' (= 40 mill.).

(♀ *Subimago.*) Corpus griseum vel fusco-griseum. Alæ subopacæ, griseo-infumatæ (anticæ ad basin pallidiores); venis ut in ♀ coloratis.

(♂ *Imago.*) Corpus paullo minus robustum; appendicibus albis, articulo primo robusto, paullo fusco-tincto, 2° parvo, 3° valde elongato, gracili, curvato, 4° et 5° brevissimis, æqualibus; peni elongato triangulari, fusco, ad apicem exciso. Long. corp. (sine caudis) $9\frac{1}{4}'''$ (= 19 mill.); long. caud. extern. circa 8''' (= 17 mill.); medianæ $2\frac{1}{2}'''$ (= 5 mill.); exp. alar. $16\frac{1}{2}'''$ (= 35 mill.).

The value of Mr. Wakefield's last consignment was greatly increased, inasmuch as accompanying it were two individuals of the aquatic conditions of the insects in spirits. These are so interesting that a somewhat detailed description is necessary. They are of different ages, and may be termed 'larva' and 'nymph' respectively, though, as is well known, these stages are defined in the Ephemeridæ by no abrupt line of demarcation such as exists in the life-history of insects with more complete metamorphosis. I use the terms as a matter of convenience, because the larger individual has strongly developed rudimentary wings, and is evidently nearly mature, whereas the smaller only possesses the thoracic lobes which indicate the position of the wings.

I proceed to consider the larger individual, or "nymph," first.

It is $12\frac{1}{2}'''$ (= 26 mill.) in length including the tails, and 9'''

(= 19 mill.) excluding those organs, which themselves are $3\frac{1}{2}'''$ (= 7 mill.) long. Probably it has arrived at its last stage, immediately before assuming the aërial condition of subimago, the rudimentary wings extending slightly over the suture between the third and fourth abdominal segments. The general colour (as is usual with many aquatic larvæ) is undecided, but may be termed greyish-olive. The *head* is small, with simple hemispherical *eyes*. The *antennæ* in this individual are mutilated, but probably they resembled those of the smaller specimen noticed below. The frontal portion of the disk, above, forms a slightly concave triangular space bordered by raised keels on either side; and these are continued as a single keel to the front margin, which is rounded; and when viewed from beneath, attached to it is seen the transversely subquadrate *clypeus*, and the large *labrum*, the front edge of which is very slightly rounded and raised and with obsolete angles, the margins being slightly ciliated. The *mandibles* are very broad; viewed from above there are two strong blackish teeth on the outer angle, each divided into two or more smaller teeth; and to these succeeds a concave edge; and the inner angle and edge possess what seems to be a pectinated fringe. Viewed from beneath the external teeth are still more prominent, and they are succeeded by a long moveable testaceous spine, the inner angle and margin being provided with a kind of cup-shaped sucker formed by the dense pectinated fringe (if such it really be) noticed above: the dentition &c., of the two mandibles is not quite symmetrical, that which frequently occurs in insects. The *maxillæ* are large and elongate, with strong teeth on the apical portion, and with a false suture, giving them the appearance of being divided into two longitudinal portions. The *maxillary palpi* are 3-jointed, stout, all the joints nearly equal in length, but each successively rather thinner. The *labium* is deeply divided into four palpiform lobes, the two on one side being curved in a direction opposed to those on the other, so that the two inner approach each other at base and apex. The *labial palpi* are 3-jointed, very stout, the apical joint obtuse and considerably shorter than the others. The *pronotum* is very narrowly transverse. The *mesonotum* and *metanotum* are consolidated into one large convex oval piece, with a median longitudinal suture and two semilunate foveæ posteriorly; the posterior margin produced into a lobe. The rudimentary *wings* are elongate, elliptical, and with strong indications of veins. The *abdomen* is somewhat depressed, broadest at the third segment, and gradually decreasing to the apex; each segment (excepting the tenth, and perhaps the first) is produced at the sides into an acute wing-like dilatation (similar to that on the terminal segments of the imago); and, in addition, there is a like-formed tooth, or dilatation, placed vertically on the middle of each segment, forming a serrated dorsal crest; on the dorsum of each segment, from (I think) the second to the sixth, is, on each side, a large rounded external gill or branchial lamina, very densely reticulated by a network of tracheal ramifications, most densely on the margins, because on the disk they form somewhat large cellules; each gill overlaps that on the succeeding segment, and is possibly double, for there appears to be an indication of a lower gill one half shorter than the upper; but I have been unable to separate them: these gills are only well-defined when the animal is floating free in the spirit; for they are so delicate that they disappear if it become at all dry: the tenth or terminal segment is somewhat conical: viewed from below the rudiments of the appendages are plainly discernible in the male nymph, proceeding from the margin of the penultimate segment and indistinctly 3-jointed, the middle joint being the longest; between them are two tubercles indicating the rudiments of the penis. The three *tails* are of nearly equal lengths, rather short, and each gradually attenuated to the end; the two outer are curved inwardly at the apex; each has a long dark space in the middle; the joints are short and indistinct, excepting under a high power, when the sutures are plainly visible, and seen to be furnished with minute blackish teeth; internally each of the outer tails has long ciliations; and the median is ciliated on both sides, all the cilia interlacing and giving to the tails when in the spirit the appearance of a single broad lamina. The *legs* are short and rather stout, without teeth; the trochanters small; the femora are the longest and stoutest joints, the tibiæ being shorter and less stout, and with a false suture near the base causing an appearance of a small intermediate joint; the monomerous tarsi are longer than the tibiæ, and articulated to them in a very oblique manner; the end claw is short and curved, acute at the apex.

The smaller individual or "larva" is 10‴ (= 21 mill.) long, including the tails, and $7\frac{1}{2}$‴ (= 16 mill.) without the tails; its greatest breadth is $2\frac{1}{3}$‴ (= 5 mill.). The *antennæ* are short, composed of twelve more or less moniliform joints, whereof the two at the base are much stouter than the others; they gradually diminish in stoutness from base to apex, the apical joint being subacute. (As these organs are wanting in the more mature individual, it is impossible to say if the number of joints varies according to age.) The thoracic lobes (whence the wings eventually proceed) only partially cover the sides of the second abdominal segment. In other respects this individual does not differ structurally from that above described, only that (supposing it to be also a male) there are no indications of the rudimentary appendages &c.

This remarkable insect would appear to be common at Christchurch; for Mr. Wakefield says the cast subimaginal skins are no rarities there, sticking on walls, windows, &c.; and he modestly accords the credit of its original discovery to his fellow townsman Mr. Fereday, who some years since sent an individual intended for me to this country, but which, by an accident, never came under my notice.

The Rev. A. E. Eaton (the author of the elaborate 'Monograph on the Ephemeridæ' in the Transactions of the Entomological Society of London, 1871, Part i.) remarks that the structure of the aquatic conditions shows that the creatures are of active habits, swimming freely among water-plants, &c. and not semi-fossorial, as is the case with some members of the family. He thinks the genus related to *Siphlurus* (which has an indication of lateral expansions of the abdominal segments), and through it distantly to *Cloëon*, but in the earlier states rather than in the imago; for *Cloëon* has double eyes in the male. With regard to my idea of there being a second smaller branchial plate under the large upper one, he rather inclines to the belief that it is only an illusory appearance caused by inflation with the spirits; but to my eyes the appearance became more marked in a plate I had detached, and which became dry from evaporation. I tender my warmest thanks to Mr. Eaton for information as to probable habits and affinities, which his critical knowledge of the group renders additionally valuable.

The great lateral expansion of the margins of the abdominal segments is without a parallel in any known perfect insect of the group. In the aquatic conditions there are occasional indications of it, especially in the extraordinary *Bætisca obesa* of Say, a North-American species, the nymph of which has been described by the late B. D. Walsh (from specimens found in Illinois).

But in this species there is an enormous development of the thoracic surface, this portion of the body forming a kind of carapace, covering all but the terminal segments of the abdomen, and concealing the rudiments of wings. And it must be noted that the formation of the abdominal segments in the aquatic conditions of *Bœtisca* disappear in the perfect and subimaginal conditions, which are only remarkable for the very obese thorax.

The formation is again seen in the terminal segments of the extraordinary animals described by Latreille as a genus of branchiopod *Crustacea* under the name of *Prosopistoma*, but which, I think, are now sufficiently proved by the French entomologists N. and E. Joly (father and son) to be the aquatic conditions of some unknown species of Ephemeridæ, although when they first expressed the idea of such a connexion I confess to having been sceptical. The typical examples of *Prosopistoma* may be regarded as belonging to an insect inhabiting Madagascar, and are now in the Hopeian collection at Oxford, in charge of Professor Westwood. But the form also occurs in France, and was figured and described by Geoffroy in the 'Histoire abrégée des Insectes de Paris' under the name of 'Binocle à queue en plumet.' It was re-found many years afterwards by Duméril in the Bois de Boulogne, but again disappeared until the Messieurs Joly found it in the Garonne, at Toulouse. It, like *Bœtisca*, has also an enormous carapace, but of a more rounded form. Latreille described it as *Prosopistoma punctifrons*, placing it, as before stated, among the branchiopod *Crustacea*; and though succeeding authors copied his description, its position among the *Crustacea* was never thoroughly admitted. I think we must accord to the Jolys the merit of having discovered its true position: but it is hard to imagine what the perfect insect can be like; for no European species yet known shows any approach towards the characters so prominent in these aquatic creatures *. That these are not Crustaceous is sufficiently proved by the fact that the Messieurs Joly have at length discovered five pairs of gills on the first five

* One is tempted to ask the questions:—Can there be minute *apterous Ephemeridæ*? and can the imago of *Prosopistoma* be in that condition? Such a thing is by no means impossible; for apterous exceptions exist in almost all groups of winged insects. If so, it would account for the absence of wing-rudiments in all the individuals dissected by the Jolys. The solution of the mystery surrounding *Prosopistoma* is waited for impatiently by all entomolologists who take an interest in the more philosophical branch of the science.

abdominal segments, hidden under the thoracic carapace, as detailed in their account given in the 'Annales des Sciences Naturelles' for 1872, article 7, sufficient to bear them out in their "preuves péremptoires" that the creatures are insects, and quite analogous to the branchial plates of Ephemeridæ. Having incidentally mentioned *Prosopistoma*, I thought it right to enter into the question of its relations according to the researches of the French entomologists, especially as, at one time, I had expressed myself uncertain as to the correctness of their deductions.

EXPLANATION OF PLATE V.

Fig. 1. Male imago; 1 *a*, underside of apex of abdomen; 1 *b*, appendages and penis, from beneath.

2. Female imago.
3. Female subimago.
4. Portion of "larva;" 4 *a*, antenna of the same.
5. "Nymph" nearly mature; 5 *a*, leg; 5 *b*, branchial plate; 5 *c*, labrum; 5 *d*, maxilla, with palpus and mandible, seen from above; 5 *e*, the same, seen from beneath; 5 *f*, labium and palpi; 5 *g*, apex of abdomen, from beneath.

A new Australian Sphæromid, *Cyclura venosa*; and notes on *Dynamene rubra* and *viridis*. By the Rev. T. R. R. Stebbing, M.A., of Tor-Crest Hall, Torquay. (Communicated by W. W. Saunders, Esq., F.R.S., V.P.L.S.)

[Read May 7, 1874.]

(Plates VI. & VII.)

The Sphæromid figured in the accompanying Plate appears to belong to a new genus of that family. It was "found under stones in Sidney harbour, in society, at the lowest ebb tides," by Mr. Stevenson, when collecting in Australia some years ago for W. Wilson Saunders, Esq., F.R.S., from whom I received the specimen.

The generic character consists in the attachment of the inner plate of the uropoda to a tooth which projects both forwards and upwards from the extremity of the tail, and in the extension of both plates of the uropoda beyond this projecting tooth, the outer plate folding partially beneath the inner, but extending beyond it.

It agrees with the Australian species *Cymodocea armata* in the prolongation of the seventh segment of the body over the tail. This process in the species now under description is not unlike that of the sixth segment of *Campecopea hirsuta*; but it does not extend over more than half the tail, and is rather thinner in the middle than at the end, which has a slightly nasal or trilobed appearance. On either side midway between this central trunk and the flanks, this seventh segment is armed with a small tooth on the hind border, both border and trunk being more or less scabrous. The pleon, or tail, is convex, with two curves—the first showing three lines of segmentation, the second, and larger, constituting the terminal tail-segment. This is granulated, and bears two small serrated elevations commencing at the base and scarcely extending beyond the process of the seventh body-segment above described, immediately under which they lie. Between these there is a shallow depression in the convexity of the tail, continuing, indeed, beyond them, but becoming shallower and almost imperceptible. At the base of the terminal tail-segment a deep socket receives the apparently immovable articulation of the inner tail-appendages. These lie close along the nearly straight and somewhat flattened margins of the terminal segment, free from, but fitted to, a very fine semicylindrical elevation upon the margin. The end of the tail presents a rather broad, but very shallow, excavation flanked by a small tooth on either side, while from its centre projects the tooth mentioned above in the generic description, to which the inner tail-appendages have every appearance of being firmly soldered. The tail-appendages themselves are curiously marked round their edges, the markings being below the surface. The closely set lines of this border-venation give off two or three branchlets apiece, which run quite to the margin. The outer plate is rather deeply concave above; and when the outer plates are folded as far as they will go beneath the inner, an appearance is presented of semicircle within semicircle, both the inner and the outer curve having a diameter greater than the width of the body, which tapers slightly towards the head. Having regard to this appearance, which makes the animal very unlike the other members of the Sphæromid family, the genus may be called *Cyclura*, with *venosa* for its specific designation, in allusion to the markings of the uropoda.

It remains only to mention that the length is about half an inch, and that the body-segments are armed on each side with a small projecting ridge which runs out into an angle or tooth towards the tail.

While introducing what appears to be a species of a new genus, I shall endeavour to keep down the number of divisions in this family by pointing out that what have been hitherto received as two species of *Dynamene* (or *Cymodocea*, Milne-Edwards), namely *rubra* and *viridis*, are in reality identical. If the colour of these creatures is to be taken as a specific distinction, instead of two species, we shall have to make a considerable group. Specimens are exceedingly abundant at Torquay, and the coloration is very variable. All are speckled, though to the unassisted eye many appear to be plain green or red. The greens and reds vary from very light to dark. Many of the green specimens have all the segments fringed with thin red lines. Some examples have a rich brown or deep purple aspect, which under the microscope is found to be produced by a close intermingling of small red and green patches with crowded black specks over the whole surface. Very frequently both on the red and green specimens there are two conspicuous patches of light green—one on the body near the head, the other on the tail. These look almost white against darker shades of the same colour. Occasionally a thin line of lighter colouring runs down the centre of the body, looking like a small fragment of bleached coralline, such as the net often takes up in sweeping for these creatures. Another variety has splashes of dark brown or red on each side of the first body-segment and of the tail, with smaller splashes on their segments.

What has been said of the colouring of *D. rubra* and *D. viridis* will apply equally well to that of *D. Montagui*. There are similar variations also in *Idotea tricuspidata*, of which Sir J. G. Dalyell, quoted by Spence Bate and Westwood, says, "their colour is dingy or brownish yellow, with three or four white specks down the centre of the back; or it is altogether of variegated hues, and some are mottled." Messrs. Bate and Westwood themselves say, "this species varies greatly in its colour and markings; generally it is of a dirty greenish grey, but often has a pale longitudinal line down the middle of the back or on each side of the body whilst other specimens are marked, often irregularly, with large pale yellow or orange-coloured patches on the body and tail. According to our own experience, the colour of the animal is dependent upon that of the weed on which it lives. Those that live on the black fucus are generally very dark purple, while those that we find on the green *Algæ* are brightly verdant." The Torquay specimens of *I. tricuspidata*, which are to be had in great numbers, fully bear out these details of colour-variation; and whatever the cause may be, it is very certain that many examples of *Idotea* and *Dynamene* correspond most closely in hue to the sea-weeds among which they are found. I have two small specimens of *Idotea* which are symmetrically banded with dark brown on a light ground. The smaller of the two has the extremity of the tail, or pleon, not quite so round as that of *I. parallela*, but without any apical tooth or cusp, indications of which are generally present even in very minute specimens of *tricuspidata*. The other (fig. 12) must be assigned to *Idotea pelagica*, unless that is itself only a variety of *tricuspidata*.

Among the Asellidæ, *Jæra albifrons* has many variations of hue. Messrs. Bate and Westwood say of it, " the general colour is ashy, but very much varied in its shades in dried specimens, with the front of the head whitish." In fact, however, the differences belong to living examples, which may be had ashen-grey, light brown, dark purplish brown, purple and green-banded, and plain green.

Among the Aerospirantia that which comes nearest in general resemblance to *Dynamene* is *Armadillo vulgaris*, a species " subject to great variation in the amount of its pale markings, which has led to the establishment of a great number of supposed species." To this remark it may be added that not only do the pale markings vary, but also the ground-colour, which may be dark steel-grey, or bright brownish red, or black, or even, though rarely, creamy white.

Colour, then, it will be seen, is an insufficient basis for specific distinction among crustaceans, at any rate in the groups to which allusion has here been made.

Passing on to the other differences which have been noted between *D. rubra* and *D. viridis*, we find the one said to be narrowly ovate and the other broadly ovate. This, however, is a character which seems to depend on the age and size of the individual. In *Idotea tricuspidata* the variations in the breadth of the body compared with that of the tail are very considerable ; but one would no more think of specifically separating the broad and the narrow examples than one would of making a fat man a distinct species from a thin one. There is, moreover, a peculiarity occasionally to be observed in *Dynamene*, whether red or green, and also in *D. Montagui*, which would seem decisive against the use of breadth as a specific character; for examples may be found of which the head and first four segments of the body are narrow, while the remainder of the body and the pleon, or tail, are broad (figs. 9 and 11). The effect to the eye of the perfectly abrupt transition is very curious. The animals exhibiting this formation appeared, when taken, if one may judge from their activity, to be perfectly healthy. It seems possible that these animals may now and then not shed the whole of their integumentary tissues at the same time, and that in consequence the hinder portion is able to expand while the front remains contracted. It is certainly the case that a *Ligia oceanica* in confinement thus parted with only a portion of its integuments, those, namely, of the pleon and the three hinder body-segments.

The only other point which seems to be depended on as differentiating *D. rubra* from *D. viridis* relates to the little longitudinal slit in the terminal tail-segment, which is said in *rubra* to be "of equal width throughout," or "nearly of equal width throughout its entire length," and in *viridis* to be "widest at its base," or "considerably widened at its base; the extremities of the sides of the slit sometimes closely approximating or touching each other," with the additional remark that "in the young states the sides of the terminal slit of the tail gape to a considerable width at their extremities." The small slit in question much resembles the slit in the leaf of the sweet-scented Coltsfoot, and probably varies in its proportions in different individuals, much as that proper to the plant in different leaves.

Neither separately nor together do the differences in colour, breadth of body, and width of the terminal slit seem to be of specific value. *Idotea tricuspidata*, so often referred to, would give a set of exactly parallel differences, in colour, breadth of body, and length of the apical termination; and the rule which is perforce admitted in regard to these, cannot fairly be withheld from applying to the case of *Dynamene*. I propose, therefore, to unite the two so-called species *D. rubra* and *D. viridis* under the name of *Dynamene varians*. There is, however, a Crimean *Dynamene* (= *Campecopea versicolor*, Rathke; *Cymodocea versicolor*, Milne-Edwards) which, for all that we can tell from the description in the great French work, may be the same as our English *D. varians*. The description is as follows:—"Corps ovulaire, bombé et lisse. Tête arrondie; fente du dernier article de l'abdomen un peu élargie à sa base. Habite les côtes de la Crimée." All the characters here given for the Russian apply equally to the English species; and, as habitat is no guide whatever, our only reason for thinking *varians* and *versicolor* distinct is, as far as the distinguished French author is concerned, that he gives them different names and separate notices in his valuable work.

EXPLANATION OF THE PLATES.

PLATE VI.

Fig. 1. *Cyclura venosa*, seen from above, natural size.
2. The same, enlarged.
3. The same, side view, natural size.
4. The same, enlarged.
5. Antennæ and mouth.
6. Hind leg.
7. Front leg.

PLATE VII.

8. *Dynamene Montagui*, normal form, enlarged.
9. *Dynamene Montagui*, showing constriction of front segments.
10. *Dynamene varians*, normal form, enlarged.
11. *Dynamene varians*, constricted form.
12. *Idotea pelagica*.

Descriptions of five new Species of *Gonyleptes*.

By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Read May 7, 1874.]

(PLATE VIII.)

SINCE the publication of my Monograph of the species of this interesting genus of Harvest-Spiders, the collection of the British Museum has been enriched by the presentation and purchase of several additional new species, which I now propose to describe.

1. GONYLEPTES TERRIBILIS, n. sp. (fig. 1).

In some respects similar to *G. armillatus*.

Colours: piceous; the sutures, prothoracic region, and sternal surface of cephalothorax dull testaceous; palpi and chelæ testaceous; three front pairs of legs luteous; coxæ and femora of hind legs black; tibiæ and tarsi piceous.

Male. Above, oculiferous tubercle slightly prominent, obtusely bispinose, with a minute granule in front of each little spine; behind the oculiferous tubercle and in front of the transverse suture are two series of minute granules, the anterior row composed of four, the posterior of two; central area of cephalothorax separated into four divisions by the sutures, and covered with minute granules; margined by a series of small irregular tubercles, gradually increasing in size towards hind margin, also an inner lateral series of minute irregular granules; hind margin bearing in the centre two slightly divergent, short, acute spines, and on either side a long, robust, slightly depressed, curved spine directed backwards over the coxæ of hind legs, and having a minute tubercle on its inferior surface near the base; a second, robust, short, incurved spine on the postero-inferior edge of the coxal sheath; abdominal segments margined with tubercles; legs rather long, femora of first three pairs minutely denticulate along their antero-inferior margin; third pair with three prominent denticles, tibial second joint also denticulate on its postero-inferior margin; hind legs with coxæ obtusely trispinose and denticulate; femora densely spinose; three curved spines on the interior surface of its proximal end prominent; tibiæ densely spinose, the spines on inferior surface very prominent, increasing in length towards the proximal end, which terminates internally in four short radiating spines; tarsi densely denticulate; palpi subcylindrical, with short slender spines; cheliceres smooth, cylindrical; pincers serrated internally; ventral surface of legs and cephalothorax minutely granulose.

Length of cephalothorax $3\frac{1}{2}$ lines, of entire body (including closed cheliceres) 5 lines; relative length of legs 1, 3, 2, 4, the fourth pair being the longest.

Huasampilla, Peru (*Whitely*). One example. B.M.

This species may at once be distinguished from all its allies by the densely spinose character of the hind pair of legs.

2. Gonyleptes defensus, n. sp. (fig. 4).

Colours: pitchy; the oculiferous tubercle, the coxæ of the first three pairs of legs, and the edges of abdominal segments yellow.

Male. Above, oculiferous tubercle scarcely prominent, with two central granules; prothoracic area transversely oblongo-ovate; central area subrotundate, smooth, separated into four divisions by the sutures; extreme edge of the margin minutely granulose; hind margin terminating on each side in a robust, oblique, slightly depressed spine; abdominal segments minutely granulose; three front pairs of legs nearly smooth, excepting the tibiæ of the third pair, which are strongly dentate externally; hind legs with coxæ coarsely trispinose on their external lateral margins; femora rugose, with four increasing denticles on their external inferior margin at the proximal end; tibiæ densely tuberculate and dentate-pectinate on both lateral margins; palpi subcylindrical, rather rugose, with short slender spines; cheliceres subcylindrical, pilose; ventral surface of cephalothorax coarsely rugose.

Length of cephalothorax $2\frac{1}{3}$ lines, of entire body 3 lines; relative length of legs 1, 3, 2, 4, the fourth pair being the longest.

Female differs from the male in the obsolete character of the posterior lateral spines of the cephalothorax and the much less robust and scarcely dentated hind legs.

Falkland islands (*T. Havers*). Four specimens. B.M.

This interesting little novelty is intermediate between the preceding species and *G. muticus* of Koch.

We have a second new species from the same locality, but, unfortunately, only of the female sex, so that it is hardly satisfactory to describe it.

3. Gonyleptes funestis, n. sp. (figs. 5, 5 *a*, profile).

Colours: piceous; streaked below with reddish testaceous; the tips of the tubercles and spines of cephalothorax orange; the legs at the terminations of the joints, the basal joints of palpi, a longitudinal streak on the femoral joint, the tips of the spines and the greater part of the chelæ of cheliceres testaceous; the spines and tubercles on the hind legs entirely orange; the tarsi clothed with silky pale testaceous pilosity; cheliceres and palpi olivaceous (excepting the basal joints).

Male. Above, oculiferous tubercle moderately prominent, with two slightly divergent short central spines; two series of minute granules in front of transverse suture, the anterior series composed of four, the posterior of three: central area of cephalothorax separated into five divisions by the sutures, and trisegmentate behind; the two front divisions bear an orange tubercle and three minute blackish granules, the third a series of four minute granules, the fourth two central orange tubercles and two minute granules, the fifth four minute granules; the margin is rugose, and its outer edge granulose; the three segmentations are granulose, the two central granulations on the second and third segmentations being lengthened into acute spines; hind margin bearing on each side a long, robust, curved, depressed spine directed backwards; legs granulose and denticulated, the denticles very minute in the first two pairs and confined to the antero-inferior margin of the femora, longer in the third pair, and extending along the tibiæ; coxæ of hind legs obtusely trispinose externally, the two lateral spinous processes projecting outwardly, the supero-terminal one almost perpendicularly, also a minute acute terminal spine on the infero-internal margin; femora and tibiæ prominently tuberculate, the lateral tubercles on both sides elongated into obtuse spinous processes, most developed at the proximal extremity of the femora; palpi subcylindrical, with long slender spines; cheliceres cylindrical, pilose, pincers serrated internally; ventral surface of cephalothorax smooth.

Length of cephalothorax $4\frac{1}{2}$ lines, of entire body (including closed cheliceres) 6 lines; relative length of legs 1, 3, 2, 4.

Chili (*Reed*). One specimen. B.M.

4. Gonyleptes Reedii, n. sp. (figs. 3, 3 *a*, hind leg).

Colours: cephalothorax dull reddish clay-coloured, spotted irregularly with black, its marginal ridge bright castaneous; the projecting border piceous, including the lateral spines and posterior segmentation; cheliceres pitchy; palpi dirty testaceous; three front pairs of legs testaceous, third pair varied with piceous; coxæ of fourth pair castaneous; femora piceous; tibiæ piceous, clouded with castaneous; tarsi bright ochraceous.

Male. Above, oculiferous tubercle tolerably prominent, with two short, acute, divergent, central spines; posterior area of cephalothorax trisegmentate, minutely and indistinctly granulated; ventral surface projecting laterally beyond margin, terminating in a long, robust, depressed spine; three front pairs of legs smooth; coxæ of hind legs externally obtusely bispinose; femora rugose, trispinose, the first at distal extremity projecting obliquely inwards from inferior surface, the second projecting laterally from first third of supero-internal margin, the third projecting obliquely downwards from supero-external margin close to proximal extremity; at the proximal extremity is also a short, obtuse, incurved denticle; tibiæ slightly curved, bearing seven to eight acute curved spines on the internal surface; palpi subcylindrical, nearly smooth, with short slender spines; cheliceres cylindrical, slightly rugose, the pincers minutely serrated internally; ventral surface of cephalothorax smooth, of last two or three segments of abdomen minutely granulated.

Length of cephalothorax 4 lines, of entire body (including closed cheliceres) 5 lines; relative length of legs 1, 3, 2, 4.

Chili (*Reed*). Two specimens. B.M.

Belongs to the *G. curvipes* group, and allied to *G. bicornis* of Nicolet.

5. Gonyleptes docilis, n. sp. (figs. 2, 2*a*, hind leg).

Same general form as preceding species.

Colours: cephalothorax greenish testaceous, spotted at the sides and behind with black; lateral spines and surrounding area black; posterior third of ventral surface dull castaneous; a central longitudinal orange band; three front pairs of legs and palpi bright ochreous; hind legs piceous at base above, dull castaneous below and at proximal extremity; tibiæ and tarsi dull castaneous; terminal joints of tarsi of third pair of legs green.

Male. Above, oculiferous tubercle slightly prominent and bifurcate above but not spined; central area of cephalothorax separated into four divisions by the sutures and trisegmentate behind, the segmentations indistinctly granulated; lateral ridge slightly rugose; projecting ventral area terminating on each side of the hind coxæ in a long, robust, depressed, bifid spine; three front pairs of legs smooth; coxæ of hind legs terminating externally above in an obtuse, nearly perpendicular spinose projection; femora rugose, much curved, with a strong irregular spine projecting obliquely upwards from the upper surface of the distal extremity, a second shorter spine projecting laterally from the internal surface at end of first third; also a number of obtuse pectinate denticles projecting from each side, but radiating at the proximal extremity; tibiæ rugose, with three long curved spines and several minute denticles projecting downwards and inwards from inferior surface, a space being left between the first two spines and the third; tarsi simple; palpi subcylindrical, nearly smooth, with short slender spines; cheliceres cylindrical, pilose, the pincers serrated internally; ventral surface of cephalothorax dull, but smooth; last two segments of abdomen minutely granulated.

Length of cephalothorax $3\frac{1}{2}$ lines, of entire body, including closed cheliceres, 4 lines; relative length of legs 1, 3, 2, 4.

Chili (*Reed*). One specimen. B.M.

Possibly the *G. bicornis* of Nicolet, but without the double spine on the oculiferous tubercles, and with a different distribution of spines on the hind legs, so that I suspect it to be distinct; it is evidently allied to *G. modestus* of Nicolet.

Resemblances between the Bones of Typical living Reptiles and the Bones of other animals. By Harry Govier Seeley, F.L.S., F.G.S., Professor of Physical Geography in Bedford College, London.

[Read June 18, 1874.]

PART I.

THE SIMILITUDES OF CROCODILE BONES.

§ 1. *The Mammalian Characters of the Crocodile.*

In the palate, Crocodiles are remarkable for the extent to which the posterior nares are carried backward by the closing over them of the palatine and pterygoid bones. This condition is paralleled in the great toothless ant-eater, *Myrmecophaga*, where the nares are carried back behind the pterygoid bones so as to make a flat uncleft palate. Nor is the resemblance less close in the fore part of the skull; for the immense toothless maxillary and small malar of the Ant-eater, essentially reproduce what obtains in the Crocodile, though the arch is entire in Crocodiles and the malar is not styloid : the nasal bones also conform to the Crocodilian type, and the premaxillary bones are relatively as small. From the absence of a transverse bone in mammals, there are no palatal pterygoid fossæ as in the Crocodile. But for the dicondyloid articulation, the back of the Ant-eater's skull is in many respects Avian.

The next nearest resemblance among mammals to the palate of the Crocodile is seen in the Cetacea, where the teeth are in some respects similar; yet the Crocodile is peculiar in having the posterior nares entirely embraced by the pterygoid bones. And the Porpoises diverge far from Crocodiles in the backward position of the anterior nares, by which the premaxillary bones, owing to their relation with the extremity of the snout and the nares, come to be developed to a great length. The scarcely divided occipital condyle is made by the exoccipital bones in Dolphins, and not chiefly by the basioccipital bone as in Crocodiles.

Perhaps the nearest resemblance among mammals to the external form of frontal bone of the Crocodile, is seen among Rodents like the Rabbit, in which the orbits are relatively large and approximate closely. But in Crocodiles the bone does not close in the brain, and is undivided laterally, which is rarely the case with mammals.

In the vertebral column Crocodiles have but little in common with mammals and are distinguished from them by many characters. Their vertebræ are procœlian; they have cervical ribs. Their dorsal ribs are attached by double heads to long transverse processes; only one or two of the vertebræ between the neck and back have the lower head of the rib attached to the centrum. This condition is characteristic of the dorsal vertebræ in *Myrmecophaga*, while in the majority of mammals the rib articulates with two vertebræ. And it is only among Cetacea, especially the true Whales, that the dorsal ribs are supported on long transverse processes as among Crocodiles. But the ribs of true Whales differ alike from those of mammals, birds, and Crocodiles in having but one head for the rib as among Lizards &c. The caudal vertebræ retain the neural arch to the end of the tail, which is not the case with mammals. Some of the chevron bones have the two articular facets connected by a transverse band, as figured by Wagler. This is also seen among certain of the Dinosauria, but not among mammals.

The dorsal rib of a Crocodile is divided on each side into four pieces, of which only the large proximal part is fully ossified. In most mammals the rib consists of two pieces, though a few (as some Dolphins) have one or more of the ribs consisting of three elements.

In Crocodiles the anterior part of the sternum widens, gives attachment to the pectoral girdle of bones, and is prolonged in front of them. In mammals the general aspect of the sternum is very like that of Crocodiles. The widening and forward prolongation of the anterior sternal part is quite equalled among true Whales (e. g. *Balænoptera*); and the Pig, Tapir, Rhinoceros, Lion, Seal, *Thylacinus*, for example, present anterior sternal elements similar in form to that of the Crocodile, but which are often compressed like the keel of the bird's sternum, and give attachment usually to the first pair of ribs instead of to the pectoral girdle; while the bones usually named coracoid and clavicle have but an uncertain existence in most mammals.

In the Crocodile the scapula unites with another bone usually named the coracoid, to form the glenoid cavity for the humerus to work in. In mammals the humerus usually articulates with the scapula only. In monotremes it articulates with scapula and coracoid; but then the coracoids underlap the episternum, and do not abut against the sternum as in Crocodiles. In the the Mole, among placental mammals, the humerus articulates with a scapula and coracoid, and, as in the Crocodile, that short strong bone abuts against the sternum.

In shape the coracoid bone in Crocodiles is very like the scapula, but differs from it in being perforated in front of the articulation. Its elongation precludes comparison with mammals; it is more like the bone in the *Echidna* than in the Mole. The scapula of the Crocodile, in its elongated flattened form, is not closely paralleled, the Mole and the Ox making the nearest approximations. It is wider from front to back at the humeral end than at the free end, and possesses a prearticular part, which are differences from mammals. In the small development and lateral position of the spine it resembles *Echidna*.

The humerus of the Crocodile differs from that of most mammals in not possessing a pit at the distal end for the olecranon-process of the ulna, and in having a crest at the proximal end on the radial side of the bone. These conditions are reproduced in Bats, where the humerus is proportionally much longer. Many pachyderms, like the Horse, have a radial crest; and the Walrus, Seal, Sloth, &c. have no marked olecranon-pit. The head of the mammalian humerus is never so much compressed from side to side as in the Crocodile, and usually has a trochanteroid process in front of the articular surface, though this is wanting in Whales and in Man.

The radius of the Crocodile offers no striking modification of its own, and is chiefly distinguished from mammals by its straight and more cylindrical shaft, and freedom from ridges, which are but faintly developed even when present. In proportion and form the ulna of the Crocodile is best matched by the African Ostrich, and is sufficiently distinguished from most mammals by wanting the olecranon-process, which, however, is sometimes but little developed, as in the Sloth; but the mammalian ulna has not often the stoutness found in the Crocodile.

The carpus of the Crocodile is peculiar in consisting of a large and elongated scapho-lunar, a smaller elongated cuneiform, and a pisiform in the proximal row. Distally there is a small subquadrate bone under the cuneiform. If it represents the bone in the same position in Chelonians, then the bones usually developed as a distal row of carpals have no existence *. In the Grampus (*Delphinus orca*) the proximal row of carpals similarly consists of two bones; but they are not elongated, and there is no pisiform bone; similarly there is a very small distal carpal. But most mammals have two rows of many-sided carpal bones.

The form and proportions of the metacarpal bones and phalanges is very similar to that of clawed mammals. Mammals, however, usually have the proximal end of the bone flatter and the distal end more globular; sometimes (*e. g.* the Lion) the metacarpals have a similar tendency to overlap each other at the proximal end. In number of phalanges in the long fingers Crocodiles do not equal the Cetacea.

The pelvis of the Crocodile is peculiar in the exclusion of the pubis from the acetabular articulation of the femur. In the Horse, Llama, and many mammals an approximation to such an arrangement may be detected; and in *Myrmecophaga* the pubis

* See, however, Gegenbaur's 'Vergleichenden Anatomie,' erstes Heft, 1864, pl. 3.

is almost, if not entirely, excluded, though not in the same way as in the Crocodile. In many mammals the articulation is chiefly formed by ilium and ischium, as in *Echidna* and the Orang. In the Crocodile the ilium and ischium almost meet again in front of the articulation so as to form an acetabular foramen. As a whole the Crocodilian pelvis most closely resembles that of the Seals, though it meets the sacrum more nearly at a right angle. The ilium of the Seal differs from that of the Crocodile in being anchylosed to the ischium and pubis, in the oblique way (mammalian way) in which it meets the sacrum, and in not being prolonged so far either backward or forward. As among the mammals, the pubis is the slender bone, while the ischium is larger. But in mammals the ischium usually has an osseous union with the pubis along the median abdominal line, which condition does not obtain in Crocodiles. Speaking generally, there is considerable resemblance in form respectively between the pubis and ischium of mammals, such as the Orang, and the Crocodile, though the bones in the Crocodile are intermediate in length between those of the Orang and the Seal.

The hind-limb bones of Crocodiles, like the bones of the fore limb, are distinguished from those of many mammals by wanting epiphyses. The femur, like the humerus, is distinguished by the proximal end wanting the external trochanter so characteristic of mammals, which latter usually have the proximal articular surface more convex. The external trochanter which marks the middle of the shaft in many mammals, such as Pachyderms like the Rhinoceros, is also moderately developed in the Crocodile; but there is no representative of the inner trochanter feebly developed in some mammals, such as Kangaroos, Tapir, Beaver, *Enhydra*, which is characteristic of the Dinosauria. The distal end is much more like the femur of mammals than is the proximal end, and may be compared to that of the Brown Bear, though in most mammals an antero-posterior thickening of the distal end constitutes a character which is not repeated in Crocodiles.

The Crocodile has no patella. The tibia is more cylindrical in its shaft than is the case with most mammals; and the cnemial crest, which many mammals have in common with birds, is not developed. Among placental mammals the Porcupine has a tibia of similar form and proportion; but its articular surfaces are better defined and somewhat different. A nearer resemblance is found in the marsupial *Phascolarctos*, where the form of the articulations, especially the distal articulation, and the form and position of the muscular attachments offer a close parallel to the Crocodile; but the epiphyses and side-to-side compression of the bone serve to distinguish it. The fibula of the Crocodile is also nearly paralleled by *Phascolarctos*, which has the Crocodilian form of distal end, and comes much nearer to the Crocodile in form than does the fibula of the Porcupine.

The tarsus of the Crocodile approximates closely to the mammal type. The os calcis is quite like that of a mammal, only shorter and stronger; the astragalus is comparable with that of some of the Marsupials, though it does not make a close resemblance to any genus in form. The distal row of the tarsus is formed by two bones, a cuboid and a smaller naviculare; this portion of the Crocodile's tarsus is, perhaps, best compared with that of a Kangaroo, in which, however, the three cuneiforms, which in some shape characterize the tarsus of mammals, are small and developed between the thread-like metatarsals and the astragalus: these cuneiform bones are wanting in the Crocodile. Some mammals, like Ox and Deer, have but one cuneiform bone; and then the naviculare and cuboid are united.

The metatarsal bones have a general resemblance to those in clawed mammals. As in man, the inner (great) toe is the stoutest. The metatarsal of the fifth digit is only represented in the Crocodile by a claw-shaped stump. The claw-phalanges are more like those of marsupials than placental mammals; but the marsupials do not appear to have the lateral furrows which mark the bones in the Crocodile.

Crocodile bones frequently have at their terminal margins a striated or wrinkled aspect, which is not seen in mammals.

§ 2. *The Avian Characters of Crocodiles.*

The Alligator, in its divided nostril, comes nearer to birds than do Crocodiles; and struthious birds, like the *Apteryx*, in the forward extension of the nares approximate nearer to the Crocodile type than do other birds. The palatal osseous perforation under the nares of Crocodiles is present in birds, but is often elongated, and extends far backward. The posterior nares in many birds are anterior to the pterygoid-malar fossæ, and margined by the vomer, malar, and palatine bones. In these features, as in some other parts of the skull, the Crocodile comes less near to birds than to mammals. A ligament extends from the post-frontal process to the malar bone in birds, and represents the osseous connexion between those bones which characterize Crocodiles and ruminant mammals. If a similar ligament united the distal end of the squamosal with the postfrontal in birds, it would enclose superior temporal fossæ, which in Crocodiles have osseous boundaries.

The lower jaw of the Crocodile is more like that of a bird than a mammal, being composite, perforated posteriorly, and having the articular element much developed on the inner side of the articulation, owing to the width of the articular end of the quadrate bone. In the Crocodile the bones are placed differently from the arrangement in birds, and the dentary rami remain separate. In view of some structures in fossil animals, it may be mentioned that in some birds the squamosal bone has a ligamentous, almost osseous, union with the quadrato-jugal.

The vertebral column in birds is in many respects unlike that of Crocodiles. Instead of the cup-shaped articular centrum, the bird has it merely concave from side to side, and never from above downward; while a few birds—Penguins—present the mammalian and chelonian type of having some vertebræ opisthocœlous. There are more vertebræ in the neck of birds than in that of Crocodiles, no bird being reported to have fewer than the Sparrow, in which Cuvier counted nine, and Prof. Owen twelve, while there may be twice that number; no bird has unanchylosed cervical ribs comparable to those of Crocodiles.

The dorsal vertebræ are fewer in number in birds than in the Crocodile; but the upper head of the rib is similarly supported on a transverse process, while the lower is uniformly attached to the centrum—an arrangement which only obtains in the Crocodile in the vertebræ which I name pectoral.

The sacral vertebræ of Crocodiles are unlike the sacrum of birds in never including more than two or three vertebræ which remain unanchylosed. In many birds the sacral elements similarly have transverse processes; but in Crocodiles they are separate bones, while in birds they are anchylosed with the centrums.

The caudal vertebræ of Crocodiles are much more numerous and much longer than in living birds. In birds the articular face of the centrum is usually flat or slightly concave in front and convex behind, while, where they exist, the anterior zygapophyses look *downward* and the posterior zygapophyses look *upward*, and in every respect the posterior end of the vertebra has the characters which usually occur at the anterior end. To the majority of caudal vertebræ in Crocodiles hæmapophyses are developed; while scarcely an indication of such a structure is seen among birds.

The sternum of the Crocodile is unlike that of birds in form: it never has the keel which characterizes the majority of birds; and it never has the breadth and basin-form which characterize adult struthious birds. But similarly it gives attachment to several pairs of ribs and to the coracoid bones, which have a similar elongated compressed form, though they have not the synovial and close osseous connexion with the sternum which characterizes the Avian type, and are directed more outward.

In some birds, as the Penguin, a precoracoid portion of the coracoid bone grows down and encloses a coracoid foramen comparable to that of the Crocodile.

The scapula meets the coracoid at a similar angle to form the shoulder-joint in struthious birds and Crocodiles; and the bone has much the same general form in those birds that it has in Crocodiles, differing chiefly in being much narrower from side to side. The Crocodile scapula has not the tubercle which in birds and the lower mammals usually gives attachment to the clavicle. In birds with a carinate sternum the scapula meets the coracoid at about a right angle.

The humerus in Crocodile has about the same proportional stoutness and form which characterize Parrots. The proximal articulation is more convex in birds, where the head has a process on its ulnar side not seen in Crocodiles; the radial crest is similar in the two. At the distal end, in carinate birds, the condyles, especially on the radial side, are more developed; in this point the Crocodile is better paralleled by struthious birds like the Ostrich.

The ulna of the Crocodile is most nearly paralleled among birds in stoutness and form by the African Ostrich; but in the Ostrich the proximal end does not curve so much inwards towards the radius, nor is it so massive; the distal end is directed further inward.

The radius of the Crocodile is similarly comparable to that of the Ostrich, with a like difference at the distal end. The two bones have much the same relative proportion to each other in the two groups of animals.

The long carpal bones of the Crocodile are not comparable to the short carpals of birds, which have the distal carpal row anchylosed to the metacarpus.

The five free metacarpal bones of the Crocodile are different from the three anchylosed metacarpals of birds; and the phalanges are very different, though in the Crocodile the three fingers most developed are those on the inner or radial side, which represent the digits of the bird.

The Crocodile's os innominatum is made up by elements comparable to those of birds, but differently proportioned. They remain unanchylosed with regard to each other, and are not anchylosed to the sacral vertebræ, as they usually are in birds, though they remain separate from the sacrum in the Penguin. In birds the ilia are always much more prolonged both anteriorly and posteriorly, and have the long axis of the bone identical with that of the sacrum, which is not the case in the Crocodile; in the bird the ilia approximate dorsally, in the Crocodile they approximate ventrally. The ischium and pubis are much more slender in birds than in Crocodiles, and less elongated; they are directed backward and are close together, while in Crocodiles the bones are rather directed forward, and expand considerably at their distal ends; and the pubis does not meet the ilium, but is supported on the anterior process of the ischium; hence in Crocodiles there is no obturator foramen. The articulation in the Crocodile's pelvis would be perforated as in birds, if the forward process of the ischium met the ilium, which it does not quite do. The bird in which these bones are best comparable to the Crocodile's is the Emu.

The femur in the Crocodile differs chiefly from that of the bird in the proximal end not being in the same plane with the distal end, owing to which, the bone has a twisted aspect. The proximal articulation in birds is not so globular, nor the end so massive; nor is the ridge, which looks outward and backward at the proximal end, so much developed. The bird is wanting in the powerful muscular attachments which make a sort of trochanter on the inner side of the upper half of the femur of the Crocodile. At the distal end the femur of the Crocodile resembles the bird's in having the outer condyle the larger; there is a similar small process on the outer side ; but the distal articulation is not so pulley-like, nor so deeply cut, in Crocodiles.

The tibia of the Crocodile is unlike that of the bird at both the proximal and distal ends. The proximal end in birds develops a considerable forward cnemial process; and at the distal end the Crocodile has no condyles like those of the bird.

At its proximal end the bird's fibula is usually very similar to that of the Crocodile, while it very rarely happens that the bird's fibula is prolonged to the distal end of the tibia (as in certain fowl), and then it is so attenuated that the shaft and distal end are not comparable to those of the Crocodile.

The tarsus of the Crocodile is in no way comparable with that of birds.

Even in the Penguin, where the bones usually named metatarsals are applied to the ground, they are still anchylosed together, and three in number, instead of four as in Crocodiles. The outside toe is the largest in birds and has most phalanges in the digit, while in Crocodiles the inside metacarpal is the stoutest, and has fewest phalanges.

The claw-phalanges are very similar in form in birds and Crocodiles; and a similar groove runs along each side of the bone.

Birds differ from Crocodiles in not having cervical ribs ; the dorsal ribs of birds consist of only two pieces, both ossified, between the sternum and vertebræ, while in the Crocodile there are four elements, of which the proximal one only is fully ossified. The lateral ossifications of the bird's ribs are represented in Crocodiles by small cartilaginous processes. In birds the anterior head of the rib always articulates with the centrum, while in the true dorsal ribs of the Crocodile both heads articulate with the transverse process.

§ 3. *The Chameleon-characters of the Crocodile.*

The bones of the skull in the Chameleon are thin or represented by membranes, and thus are generally unlike the massive bones of the Crocodile ; moreover the difference in size probably obscures some similitudes as well as some differences.

From the prolongation backward of the parietal and squamosals the skull has enormous perforations to represent the small temporal fossæ of the Crocodile. On the muscular mechanism which produces this modification may be presumed to depend the high form of the head, the vertical quadrate bone, the absence of a quadrato-jugal (if it be absent), the lateral aspect and large size of the orbits and nares. The external nostril in *Chamæleon* is not enclosed by the premaxillary as in a Crocodile, but has that bone and the nasal dividing it, so that the nares look outward and are double. To bring the premaxillaries into harmony with the Crocodile's, it would be necessary to suppose that the Crocodilian bones had been turned round through nearly half a circle by having their anterior termination drawn backwards through the nares. This view would account for their narrowness in the dental border, the few premaxillary teeth (which do not exceed two, and those obliterated in old age), the divided nostril, &c.

The teeth, instead of being conical and in sockets, are flattened, serrated, and anchylosed with the jaw. Neither the maxillaries, palatines, nor pterygoids meet mesially on the palate, but are divided by a groove. The middle holes of the skull, covered by membrane, are large, between the orbits and nares, look upward, and are divided by the premaxillary and frontal bones; in living Crocodiles these perforations have no representative. The occipital condyle is chiefly made by the exoccipital bones, which meet mesially, as in Chelonians; in Crocodiles the condyle is chiefly made by the basioccipital. In the Chameleon the lower jaw does not extend backward behind the articulation with the quadrate bone.

Throughout the vertebral column there runs a transverse platform, which is made by the zygapophyses extending outward, beyond and above the small flat single facet on the lower part of the side of the centrum to which the rib is attached; in Crocodiles the wide platform is made by the transverse process which carries the rib.

The cervical vertebræ are short from front to back, and have a hypapophysis. The last two of the five have long ribs, which are free at their distal ends. The dorsal vertebræ have the centrum somewhat elongated; and the neural arch is long, especially in the early part of the back. All the vertebræ, except the last two, appear to have ribs, which, relatively are enormously long, cylindrical, and in the dry state only consist of a dorsal and sternal part, though in a fresh specimen the latter joints into four parts. In the tail, though transverse processes are developed, they are directed downward and outward from the hinder corners of the centrum. After the first three vertebræ a hypapophysis is developed, and the neural spine becomes short, and stands between the posterior zygapophyses. So that the vertebral column has little in common with the Crocodile's beyond a short neck, a long tail, a sacrum of two vertebræ, and a procœlous centrum. The transverse processes in the tail of the Crocodile are directed outward and not downward, and the zygapophysial facets in the tail of Crocodiles look upward and not inward. In the Chameleon the neural spines are relatively small, and the chevron bones are small and short.

The principal part of the sternum has its lateral portions inclined to each other like the sides of a boat. The anterior pair of the four sides (which make it diamond-shaped) give attachment to the coracoids; and there is no episternal part prolonged between those bones and anterior to them, as in a Crocodile. Only one pair of sternal ribs are attached to the first part of the sternum, two pairs to the second part, and one pair to the third part. These characters, with the keel running down the sternum, are the chief differences of this region from that of the Crocodile.

The scapular arch similarly consists of scapula and coracoid; but the bones are not inclined to each other at the great angle observable in the Crocodile.

The coracoid is a compressed subquadrate bone, with the anterior margin convex, and a posterior margin made by two concavities, of which the superior one is completed above by the scapula, and so forms the articulation for the humerus, which, instead of looking outward and backward as in the Crocodile, looks directly backward. The bone only resembles that of the Crocodile in being similarly perforate in front of the articulation. The scapula differs from that of the Crocodile more in proportion than in plan, being twice as long as the coracoid; for the part of the bone which in a Crocodile is thin, flattened, and expanded, is here prolonged with the ribs as a flattened cylindrical bone, slightly widening as it becomes more compressed towards the free end. The Chameleon has no spine to the scapula like that in the Crocodile.

The humerus in the Chameleon is relatively longer, straiter, more slender in the shaft, and more massive at the proximal and distal ends; the radial crest is more massive than in the Crocodile. The distal end has two well-marked condyles, of which the outer one is hemispherical; immediately above the condyle is a depression in which a large vessel enters the bone. These features are unlike those of the Crocodile, and approximate to those of claviculate Lizards.

The ulna and radius are relatively longer than in the Crocodile. The ulna is a straight cylindrical bone enlarging at the proximal end on the anterior and outer sides; the subquadrate articulation has two oblique facets, one looking upward and forward, the other upward and outward toward the radius. The distal end in the Crocodile is relatively smaller, and has not the same convex lizard-like articulation. The proximal end of the radius is subcircular and cupped; the distal articulation appears to be obliquely truncated and to look backward.

The carpal bones have nothing in common.

The metacarpals of Chameleon are short broad bones, not unlike in form to the proximal carpals of Crocodile. The phalanges of Chameleon are all of great length and strength, and so far unlike the short small phalanges of the Crocodile. The digits of the Crocodile are arranged in a group of three, in which their metacarpal bones overlap each other proximally, and have no distal carpal ossified, and a group of two smaller outer digits articulated to one distal carpal bone. If we suppose the proximal ends of the metacarpals of the Crocodile to enlarge so as to thrust these groups away from each other, an arrangement might be produced like the hand of the Chameleon.

The pelvis of the Chameleon is unlike that of Crocodiles. The ilium is an elongated compressed narrow bone, shorter than the scapula, and more expanded at the free end; it descends from the transverse processes of two vertebræ almost vertically, but slightly forward, in a straight line with the os pubis, than which it is slightly wider from back to front. The pubis is a short straight bone almost equally expanded at both ends, entering into the acetabulum for the femur and perforated in its upper third for the obturator nerve, like the pubic bone in Lizards. The pubes are inclined to each other, and meet along the whole ventral margin of the bone, which is not the case in Crocodiles. The ischium is more like that of a Crocodile in outline, differing in wanting the process which gives attachment to the pubis, and in being longer from back to front, chiefly owing to the development forward of the anterior distal angles.

The Chameleon femur is about as long as the humerus, and similarly has a straight cylindrical shaft more enlarged at the distal and proximal ends than is the case with Crocodiles. The proximal articulation is more nearly hemispherical, and has the inner side of the head more developed. In front is a transverse and vertical triradiate notch for the ligamentum teres; behind, the proximal end of the shaft is compressed. The bone terminates distally in a well-rounded trochlear articulation, above which, on the posterior aspect, is a deep depression.

The tibia and fibula are shorter than the femur—the tibia straight, but the fibula curved like an ulna upside down. The tibia is massive at the proximal end, with a transverse concave articulation adapted to the femur; its distal end is subcylindrical and obliquely truncated. The fibula is compressed behind; and a sharp ridge runs posteriorly down its length.

The tarsals are entirely different.

The metatarsals are short, like the metacarpals, the elongation of the foot being made by the phalanges; there is nothing analogous to the arrangement of the digits in the Crocodilian hind foot to be seen in the Chameleon.

§ 4. *The Lacertian Characters of Crocodiles.*

Iguana is like the Alligator in having the nostril double, but unlike that animal in having its outer margin made by the maxillary bone, and its inner division by a single premaxillary. The frontal and parietal are similarly single; and the bones generally correspond in their connexions; only a small quadrato-jugal appears to be placed in front of the squamosal at the proximal end of the quadrate bone, so that the malar arch is not prolonged, as in the Crocodile, to the distal end of the os quadratum. And the temporal fossæ, which are small in Crocodiles, are here so enormously enlarged that they prolong outward and backward, in a V-shape, diverging processes of the parietal bone. The high position of the quadrato-jugal would seem attributable to the great development of the postfrontal in making the outer margin of the temporal fossa.

There is nothing in common in the arrangement of the bones on the palate, owing seemingly to the elevated shape of the Lizard's head, by which the maxillaries are withdrawn from the palate and the palatine bones go forward to take their places.

The lower jaw in the Lizard is not perforated behind like that of the Crocodile; it has the articular bone developed inward to even a greater extent than in Crocodiles, and has the coronoid developed into a strong erect process, of which there is no trace in the Crocodile.

It is probably due to the vertical position of the maxillary bone that the teeth of Lizards are not in sockets, the inner alveolar border being drawn away from them in the elevation of the bone from a horizontal to a vertical position. The teeth of Crocodiles differ but little from front to back; but in the *Draco volans* there are kinds which might represent incisors, canines, and molars; and in many Lizards the premaxillary teeth are sharper, or of different form from the others, and the hinder maxillary teeth undergo a change in the form of the crown quite analogous to what is seen in mammals.

The fewer neck-vertebræ of Lizards are not usually furnished with ribs; and when, as in the Skink, ribs are attached to all the vertebræ except the first two, they have only one articular head. The centrum never has the cylindrical form seen in the Crocodile; and the dorsal vertebræ never have transverse processes, except in the first few vertebræ of the Dragon, which give off the first ribs to the parachute, where in form they are very unlike those of the Crocodile. The dorsal vertebræ rarely have the vertical, flat, oblong neural spines of the Crocodile; the neural spines are suppressed in the Dragon, small in the Skink, compressed in front, and oblique in *Iguana*. In the Monitor, however, the neural spine is very like the Crocodile's throughout the vertebral column. The cup-and-ball articular vertebral surfaces are usually transversely depressed and oblique, which is not the case with the Crocodile's.

Between the dorsal vertebræ which are united with the sternum, and the neck, are the ribs (with massive ovate heads slightly concave at the articulation) which assist in supporting the shoulder-girdle. The dorsal ribs never include more than three ossified parts, though in *Iguana* a short unossified cartilage intervenes between the middle and sternal elements, assimilating the rib to that of a Crocodile.

The caudal vertebræ of *Monitor*, though far more numerous, are very similar in form to those of the Crocodile, differing chiefly in the centrum having a cup-and-ball articulation and in its obliquity. In Skinks the neural spine is suppressed; and in Dragons the vertebra is elongated, and its processes scarcely noticeable.

The sacrum similarly consists of two vertebræ.

The pectoral arch includes, besides the elements met with in

Crocodiles, a T-shaped or +-shaped episternum, and clavicles. The coracoid is more like the Chameleon's than the Crocodile's in form, but differs from both in its anterior emargination and processes directed towards the episternum. The scapula is most like that of the Dragon. *Stellio* and *Polychrus* approximate in having the bone narrow; but in most Lizards the bone has an expanded and emarginate form, or even unites along its anterior side with the coracoid.

The humerus is broader at both ends than a Crocodile's. The radial process is thick and blunt, and does not make an angle with the upper surface of the bone, as it does in Chameleon and Crocodile, though in the limbs the Chameleon is less closely approached by the adult Alligator than by the young animal.

The distal end of the humerus in Lizards has three condyles, of which the middle one is usually most developed. The humerus of the Dragon seems more like the Chameleon's than the Crocodile's, but has the radial crest smaller.

The ulna resembles the Crocodile's in being compressed from side to side, though it is even more compressed; but it differs in the development of an oblique olecranon ossicle, which gives to the bone a testudinate form. The distal end is expanded, with the articulation subhemispherical and convex from side to side as in the Chameleon, and not convex from front to back as in the Crocodile. The ulna is not so long as the humerus; but, owing to the development of the olecranon, the disproportion is not usually so marked as in the Crocodile. In the Skink the proportion of the forearm is most Crocodilian.

The radius is a not dissimilar bone to that of the Crocodile; only in Crocodile the proximal end is concave, and the part of the distal articulation which is most prolonged becomes a prominent boss.

The carpal bones are not conformable.

The metacarpals and phalanges are not dissimilar, and differ chiefly in Lizards having the claw-phalanges compressed from side to side.

The pelvis of Lizards is very uniform, and, both in its entirety and in the forms of the constituent bones, is very unlike that of the Crocodile. The pubis, like the coracoid, is usually perforated; it enters into the acetabulum for the femur, and develops a prepubic process. The posterior end of the ilium is more prolonged backward, and the anterior ventral angle of the ischium more prolonged forward, than is the case with Crocodiles.

In *Monitor* the femur is straighter than in Crocodiles; and behind the proximal articulation the bone is compressed, and terminates in a strong inner trochanter, of which condition there is hardly a trace in Crocodiles. The distal ends are similar; but the fibula articulates with the outer side of the distal end in Lizards.

The tibia and fibula are not unlike those bones in Crocodiles, except that the Lizard fibula is somewhat compressed, so as to have a ridge down each side; and the tibia, instead of being subquadrate at its distal end, is compressed from back to front, and more expanded from side to side.

The proximal row of tarsal bones is usually anchylosed together; and the part corresponding to the heel of the os calcis is much less developed than in a Crocodile. The distal row seems to similarly consist of one or two small bones.

Except that the phalanges of the fifth digit are suppressed, the arrangement of the other bones of the hind foot is similar in the two. In Lizards the proportions of the bones are different, the fourth metacarpal being the longest and strongest; the claw-phalanges are similarly compressed from side to side. The bones of Lizards and Chameleons are much thinner than those of Crocodiles; and all the limb-bones differ from those of Crocodiles in having epiphyses.

The Blindworms have no special resemblance to Crocodiles. Their ribs throw off a tubercle just behind the articular head, which looks as though it might foreshadow double-headed ribs; but the process has no attachment. Between the dorsal vertebræ which bear ribs, and the caudal vertebræ with anchylosed chevron bones, are two or three sacral vertebræ, which have the transverse processes specially modified, sometimes double, as in *Python*, but in no respect like the Crocodile's.

§ 5. *On the Rhynchocephalian Characters of Crocodiles.*

Hatteria resembles Crocodiles in having the quadrate bone firmly wedged in the skull, but differs in the relations of the bone; for although a malar arch extends from the maxillary to the base of the quadrate, as in Crocodiles, the quadrato-jugal bone does not intervene between the quadrate and the malar. The quadrate, too, is nearly vertical, and sends a long straight wing inward overlapping the pterygoid in front, much after the manner of the

Dinosaur *Scelidosaurus*. The palate, though flat and closed, as in Crocodiles, would seem rather to be constructed after the plan of *Chamæleon* and of those Emydian Chelonians from which that plan is modified; for the pterygoids, according to Dr. Günther, entirely divide the palatine bones extending between them to meet the vomera, with which they form the middle of the osseous palate; in Crocodile they only advance a little way between the palatines, and the vomer does not come into the palate.

The parietals diverge behind as in Lizards; and the diverging processes are overlapped by the squamosal. Yet parietal, frontal, nasal, and premaxillary are all double; and between the parietal and frontal is a foramen parietale.

The vertebral column (since the vertebræ are biconcave, devoid of transverse processes in the back, with oblique neural spines and, in the caudal region, with small chevron bones) has little in common with the Crocodile's. Still the articulation of the centrum is vertical; the first three vertebræ in the neck have no ribs; the fourth has a double head, but rather after the plan of *Pliosaurus* than of *Crocodilus*. The dorsal ribs have epipleura which in the early vertebræ are cartilaginous as in Crocodiles, and the middle ones ossified as in birds, but remaining unanchylosed as Dr. Günther found them to be in the mature egg of the Pheasant. The sternal and hæmal ribs are very unlike the Crocodile's. The caudal vertebræ divide into anterior and posterior parts, as in Lizards.

The sternum, episternum, and clavicles are after the plan of Lizards'. The perforated coracoid more nearly resembles that of the Chameleon, while the flattened ossified portion of the scapula, which has a slight spine, is in the main Crocodilian.

The pelvis is about intermediate between *Chamæleon* and *Testudo*, and in no respect Crocodilian. The limbs are essentially Lacertian.

§ 6. *The Chelonian Characters of Crocodiles.*

In Chelonians the quadrate bone is wedged into the skull much as in Crocodiles, though it is usually vertical, with a tendency to incline forward rather than backward. It is similarly united to the malar by a squamous quadrato-jugal, though in the Testudine family, owing to enormous excavation of the quadrate and squamosal bones, the squamosal has a tendency to retreat up the side of the quadrate after the plan of Lizards. The malar bone in both types similarly forms the back of the orbit; but in Chelonians it does not similarly exclude the maxillary bone from entering into the orbital circle, seemingly owing to the large size and forward position of the eyes. And for this reason, though the nostril is single as in Crocodile, it is surrounded by the premaxillary, maxillary, and prefronto-nasal bones. The upper surface of the Chelonian skull is very unlike that of the Crocodile, owing to the serpent-like and Chameleonoid prolongation backward of the parietal and supraoccipital bones, the enormous temporal fossæ, the double parietal and frontal bones, the general absence of distinct prefrontal and lachrymal bones, and the vertical Lacertian position of the maxillary. The palate is similarly closed in the median line; but the nostrils are not carried back in a tube, the Testudine arrangement in this respect reminding us as much of Chameleon as of Crocodile. And the palatal resemblance is not so close as it seems at first sight to be, since, from the presence of a transverse bone and downward prolongation of the pterygoid bone to meet it, the lateral palatal vacuity of the Crocodile is of a different nature from that of the Tortoise. In the vertebral column there is scarcely any thing in common. In the tail only of Emysaura (*Chelydra serpentina*) there is a superficial resemblance to Crocodiles, the centrum being elongated and compressed, having transverse processes, a vertical articulation, and chevron bones; but the articulation is opisthocœlous, and the neural spine is suppressed.

The scapula and coracoid in both groups are the only bones in the pectoral arch. But the Chelonian scapula is a cylindrical rod; and though in the Emydian and Testudine families the coracoids have a sub-Crocodilian expansion of their distal ends, they do not articulate with the sternum as in Crocodiles, or even with each other.

The Chelonian humerus is the stronger. Its radial process is like that of the Crocodile, but is prolonged nearer to the hemispherical articular head; while on the other side a strong ulnar process is prolonged beyond the articulation, and to this the Crocodile has nothing analogous.

The compressed ulna of clawed Chelonians is unlike the bone in Crocodiles. The radius is better comparable; but in Chelonians it never has so cylindrical a shaft, and the distal end has a more simple articular surface.

The carpal bones are not comparable. The metacarpals and phalanges in Emydians are not dissimilar; only with them all the digits terminate in claws, and the metacarpal bone of the fifth finger is the stoutest.

There is very little in common in the pelvis, which in Chelonians is more like Lizards' than Crocodiles'.

The femur is a stronger bone in Chelonians, with a large hemispherical instead of a compressed subovate articular head. It might be considered to diverge from the Crocodile's more than Lizards', since the trochanteroid ridge which is developed behind the head of the bone in Lizards may here be regarded as greatly expanded from side to side, so as to produce an enormous trochanter; and to this modification the Crocodile offers no analogy.

The tibia and fibula have a general resemblance, except that in Chelonians they are stouter, and differ a little in their distal articulations.

The os calcis and astragalus of Testudines are anchylosed together, and show nothing like the Crocodilian form. The distal row of bones is more numerous than in Crocodiles.

In reducing the digits of the hind foot to four, *Testudo* becomes Crocodilian; and, as in Crocodiles, the hind foot is more elongated than the fore foot, though not to the same extent.

§ 7. *The Ophidian Characters of Crocodiles.*

The resemblances of Serpents to Crocodiles are necessarily limited to the skull and vertebral column. Like Alligators, serpents have the nostril divided by the nasal and premaxillary bones; but the premaxillary is single and toothless. Almost every other character gives matter for distinction; in the poisonous group the divergence is least, from both frontal and parietal bones being single.

In the vertebral column the resemblance is limited to the procœlous articulation of the centrum and the compressed subquadrate neural spine.

§ 8. *The Urodelan Characters of Crocodiles.*

No skull of a living Amphibian is likely to be mistaken for that of a Crocodile. The nasal sac is surrounded by premaxillary, maxillary, nasal, and vomerine bones. As in *Monitor*, neither orbit nor orbital fossa is circumscribed by bone. As in fishes, an enormous parasphenoid covers much of the base of the skull, and it divides the pterygoid from the palatine bones. The nares do not open upon the palate.

The dorsal and caudal vertebræ of the Menopome resemble the Crocodile's in having the ribs supported on transverse processes; and in some types the articulation of the rib's head is divided. The ribs never encircle the viscera; and there are never neural spines. In the tail the chevron bones are anchylosed to the centrum. The centrum appears to be biconcave.

The scapula is very like that of the Crocodile, but widens at the acetabulum for the humerus, so as to become ⊥-shaped. In the Menopome epiphyses to the limb-bones are not ossified.

The humerus is twisted, and expands widely at the distal end. At the proximal end the radial crest is greatly developed, but, from the twist in the bone, does not make an angle with the shaft.

The ulna and radius, though stouter in the Menopome, have sufficient resemblance to make a detailed comparison necessary with both Crocodilia and Testudinata.

The carpus in the Menopome is unossified, and so far resembles the condition of the Crocodilian distal carpal series, though in other Urodelans all the elements are changed to bone. The metacarpals and phalanges are compressed from above downward, like those of some Dolphins.

In the pelvis there is no near resemblance; and the hind limbs are formed more on the Lacertian than on the Crocodilian plan.

PART II.

THE SIMILITUDES OF CHELONIAN BONES.

§ 1. *The Mammalian Characters of Chelonians.*

There is in Chelonians a nearer resemblance than in Crocodiles to the usual plan of the mammalian posterior nares, since they are divided by the vomer, and have their anterior lateral border made by the palatine. And in mammals the anterior nares are similarly single at their termination, except in the Porpoises and Armadillo. Except, however, with the Porpoises and Man, a mammal rarely admits the maxillary bone into the border of the anterior nares, as do Chelonians.

Except in certain Rodents, some Monkeys, and Man, those mammals which have the orbit for the eye surrounded with bones do not admit the maxillary bone into its border, as is usual with Chelonians. The lateral eyes and terminal nostril are mammalian; but only in Man are the similarly placed premaxillaries so small.

Certain Carnivora have the parietal and supraoccipital bones elevated into a median crest, but it is never prolonged so far backward as among Chelonia.

The essential difference between the mode of union of the skull with the vertebral column is made by the forward recession among mammals of the basioccipital element.

The forms of Chelonian ribless cervical vertebræ may be paralleled in mammals. The testudinate group has its analogues in such long-necked forms as the Giraffe and Llama. The marine group has more the proportion of the neck-vertebræ in the Sheep; but there is a stronger hypapophysis, and only an indication of the transverse process characteristic of short-necked mammals. The opisthocœlous feature of the earlier vertebræ is a character of ruminant mammals.

The dorsal ribs have a mammalian character in articulating between the bodies of two vertebræ, though they usually differ in appearing to have no union with the neural arch. When, as with the Armadillo, a mammal is covered with an osseous sheath, it is not homologous with that of Chelonians, being merely dermal, and having no osseous union with the skeleton.

The tail in the marine and testudinate groups agrees with most mammals in wanting the chevron bones; but all Chelonians differ from mammals in having the neural arch prolonged to the end of the tail.

The pectoral arches are dissimilar.

The curves in the mammalian humerus appear at first sight to be the reverse of those in the Testudinata, owing to the bone being directed forward instead of backward, so that the left humerus of one type resembles the right humerus of the other. The bone corresponds most closely in form with that of Seals, which in common with many Carnivora, have a similar hemispherical head and a similar foramen on the inner and lower border of the shaft, though in Chelonians it is usually a groove. And some mammals, like the Walrus, have a trochanteroid ulnar process prolonged beyond the articulation, after the manner of Chelonians. The distal end of the bone is not more thickened than in those mammals which show least trace of an olecranon-pit.

The mammalian ulna—which is usually behind the radius, and when external to it, as in Carnivora, is external only at the distal end—reminds one of the testudinates in the way in which the bone is compressed from side to side. The young Elephant is comparable to the old Tortoise in the extent to which the olecranon process of the ulna is developed. But the best parallel to the bone as a whole is seen in the *Manatus australis*, if we neglect the combined distal epiphyses, on which both ulna and radius abut. After the plan of the Beaver, the radius is the smaller bone of the two. Perhaps its nearest general resemblance in form is to the Manatee, where, however, the bone is relatively stouter, and is suturally united to the ulna at the proximal end: at the distal ends the bones similarly touch each other on the inner side.

The carpus in its two rows reproduces all the elements usually found in the mammal; and in the Testudines the scaphoid and lunar bones are usually anchylosed as in some Carnivores.

The metacarpal bones are shorter than in any mammal; the phalanges are as short as those of the Rhinoceros; and the terminal claws resemble those of marsupials in wanting the lateral groove, but differ in being depressed.

The pelvis is entirly mammalian in the forms and grouping of the bones. The ilium is an elongated massive bone rather less expanded antero-posteriorly at the sacral end than in the Tiger. It contributes, with the pubis and ischium, to form an imperforate acetabulum for the femur, as in mammals; and its articular surface similarly looks downward. The bone differs from the ilium of mammals in being directed according to the reptilian plan, upward and backward from the acetabulum, instead of forward; in the Testudines its direction is more vertical than in the Chelonian type. And it differs from mammals' in not having the sacral end produced beyond the bones with which it articulates.

The pubes and ischia meet mesially in *Testudo* as in mammals, so as to enclose two large obturator foramina. The ischia are massive behind, transversely truncated, and directed a little downward, with an angular process behind, after the plan seen in the Elephant. The pubis is proportionally larger than in any mammal, the expanded flattened bones of Chelonians differing in having a mesial angular prolongation forward, of which there is a faint indication in the Camel, but which, if transversely truncated and ossified separately, would have made prepubic bones after the pattern of those seen in the Monotremes. External to this is a strong digit-like process directed outward, of which only a faint trace is seen in *Echidna*. In the marine Chelonia the pubis is much larger than the ischium, which bone, as well as the ilium, is small, the ischium being a simple flattened dicebox-shaped bone.

The femur has much the proportion seen in the Sea-otter (*Enhydra*), and is mammal-like in its hemispherical articular head. The great trochanter is rather less developed than in most mammals. The obturator pit is moderate; but, the inner lesser trochanter being prolonged up the bone almost as far as the great trochanter, the proximal end has a character unlike that of any mammal's. The distal end, expanded from side to side, is not more thickened from before backward than in the Walrus and Seal; in those animals, however, the shaft is not cylindrical, and the articulation is deeply divided into two parts.

There is no patella. The tibia in old Testudines is a massive bone, with almost the heavy proportions of the tibia in a Rhinoceros. It wants, however, the cnemial crest, of which all mammals have some indication at the proximal end in front. In the form of the distal end it approximates to that of mammals, being intermediate between that in the Kangaroo and the usual placental type. The proximal end is not expanded so much from front to back as in most mammals; but the articulation has two ill-defined facets for the femur.

The fibula is relatively stronger than in the Rhinoceros, and differs from most mammals' in its cylindrical shaft, and in articulating proximally with the femur. Distally it articulates with the os calcis, as in Marsupials and, it may be, some Carnivores.

The tarsus consists, as in mammals, of two rows of bones, but wants the naviculare, and differs, moreover, in having the astragalus and os calcis anchylosed together side by side, so that neither bone has the characteristic mammalian characters.

In the Testudine hind foot there are four digits. The metacarpals are short, obliquely overlap each other at their proximal ends, and are expanded from side to side distally, shorter and stronger bones than are usual with mammals. The claw-phalanges are proportionally longer than in *Orycteropus*; but in that animal they are compressed from side to side, and not from above downward.

§ 2. *The Avian Characters of Chelonians.*

There is no resemblance between the Avian and Chelonian crania, except in the immaterial point that both are toothless, and both, in an immature condition, have members which show transitional indications of teeth. In the lower jaw both have the dentary bone similarly single [typically]. And the number of elements in the lower jaw is seemingly often the same, though, from the obliteration of sutures in birds, the number of bones is not always easily determined in the mature animal.

In the marine Chelonia the length of the neck-vertebræ is like that in the Penguin. In *Testudo* there is an approximation, both in length and in form, to the anterior vertebræ of long-necked birds, such as the Heron or Swan; but the bird never has the centrum so free from lateral processes as *Testudo*, never has the zygapophyses prolonged so far forward, and never departs in the neck from the Avian articulation. The dorsal region of Chelonians is so much modified in relation to the immovable carapace that detailed comparison is impossible. It may be noticed that the underside of the dorsal centrum is often smooth and rounded as in such birds as the Heron.

The sacrum has nothing in common. The tail is similar in such birds as the Swan and in *Testudo*, correspondence being seen in the short centrum flat on the underside, the depressed neural arch devoid of neural spine, in the transverse process coming off from the base of the centrum. In place of the chevron bones seen in some freshwater Chelonians, birds rarely have more than a mere ossicle between the vertebræ, approximating to the intervertebral ossicle of Lizards, or a few vertebræ have long double hypapophyses after the manner of Serpents.

The form of the Chelonian pectoral arch, consisting of scapula and coracoid, is closely paralleled by Struthious birds. The elongated coracoid in the young bird is about intermediate in length between that of the marine and land types; but in Chelonians the bones have no distal articular surface, not meeting any sternum. The scapula in Chelonians is straighter and more cylindrical; it gives off near the articulation with the coracoid a digital process which Mr. Parker names the precoracoid, and which in

Struthious birds is an ossified prolongation of the scapula along the side of the coracoid. In old age this element in the bird unites again with the distal end of the coracoid so as to enclose a foramen.

The sternum and clavicle of ordinary birds are not to be compared with those of the Chelonia.

The testudine humerus is massive and stout, as in Parrots, from which that of *Testudo* differs chiefly in being more curved, in having the head hemispherical, and in having the ulnar process prolonged beyond the articulation instead of being reflected over on the posterior side of the bone as in Lizards. In the Ostrich the radial crest of the humerus is suppressed. At the distal end of the bone birds have the condyles much more developed than Chelonians, and in this respect are more Lizard-like; so that distally the resemblance is better in the Ostrich than in other birds.

The proportions of the ulna and radius of Chelonians are perhaps best matched in the Penguins, in which, however, the bones are even more compressed. As in birds, the ulna is the larger bone; but the majority of birds differ in having it cylindrical and long. Both bones are best paralleled in the Ostrich; and the comparison is better made with a middle-aged *Testudo* than with an old animal.

The carpus, metacarpus, and phalanges are incomparable.

The dorsal ribs are comparable in that the epipleuron in such birds as the Parrot grows so as to cover the interspace between the ribs, and so shows a faint approximation to the condition of the same element in the young Chelonian, though in the bird the epipleural parts overlap instead of abutting one against the other.

The pelvis has no common character in birds and Chelonians.

The femur is similar to that of a bird, but differs chiefly in the proximal end being twisted at right angles with the distal end, the twist being more perfect than in many mammals, while the proximal articulation is smaller in birds, and a sharp ridge runs from the great trochanter some distance down the front of the bone. The distal end in birds is thicker from front to back, and has the condyles much better defined. In its proportions the femur might be compared to that of the Ostrich and many carinate birds.

Birds often have a patella, which Chelonians have not.

The fibula of the bird is unlike the Chelonian's in having no distal end; but the proximal end similarly articulates with a facet on the outside of the femur. The tibia of the bird would only approximate to that of the Chelonian before its proximal and distal epiphyses were anchylosed. As it is, there is no close resemblance; and no resemblance at all is found in the tarsus, metatarsus, and phalanges.

§ 3. *The Crocodilian Characters of Chelonians.*

[See also the Chelonian characters of Crocodiles, p. 172.]

These characters, properly so called, may in the cranium be regarded as the growing together of the squamosal, parietal, and postfrontal bones, which in the Crocodilia leave only a small temporal fossa between them, while in the marine Chelonia the growth has extended till the foramen is obliterated. Similarly there may be supposed in Crocodiles a tendency of the squamosal and postfrontal bones to grow down to meet the quadrato-jugal and malar, which growth is seen perfected in *Chelone,* though the quadrato-jugal bone is vertical. On the other hand, by enlarging the temporal fossa in the Crocodile so as to divide the postfrontal from the squamosal bone (towards which there may be supposed a tendency in Crocodiles with the temporal fossa largest, such as the great Gavial), the postorbital features of the Crocodilian head would approximate towards the Testudinata. In the vertebral column there is no character which can be considered to be Crocodilian, the long tail and chevron bones of *Emysaura* being associated with an opisthocœlous centrum, which hitherto has not been found in a Crocodile: though occurring in the tail and neck, it may be considered eminently Chelonian, and is probably only obscured in the back by the formation of the carapace.

What the pectoral arch would have been but for the peculiar envelope of the Chelonian it is difficult to judge; but as it stands, no Crocodilian characters can be recognized. The only Crocodilian feature of the humerus is the radial crest, which it shares with birds, the Chameleon, and a few mammals.

The elongation of the proximal carpal bones under the ulna in *Chelone* is paralleled in Crocodiles. And the elongation of the metacarpals and phalanges of Crocodiles is better matched in the marine than the land Chelonia.

In the pelvis the shortness of the ilium in marine Chelonia is a character which is approximately Crocodilian, but it is rather like a less distant removal than a mark of affinity: the form of the ischium, too, is least dissimilar in marine Chelonians.

The approximation of the tibia in *Emysaura* and *Chelone* to the triangular form is Crocodilian.

There is a general resemblance in the character of the articular surfaces at the joints, and in the absence of epiphyses; but in the Chelonia the sharpness of definition increases considerably with old age, probably more than in Crocodiles.

§ 4. *Lacertian Characters of Chelonians.*

I do not recognize in the head any community of character beyond such generalities as the vertical orbits in *Iguana* with temporal fossæ behind them.

The pelvis is comparable both in the arrangement of the bones and in their form. The ilium, however, is attached to the sacrum by the middle of its inner surface, and not by its free end as in Chelonians. As in *Emysaura*, the Lacertian pubes and ischia do not meet each other mesially so as to define obturator foramina. The os pubis of Lizards differs chiefly in being perforated by the obturator nerve, and in having the anterior digital process connected by intervening bone with the anterior margin, so as to make the form of the pubis roughly triangular, and not triradiate as in *Testudo*. The ischium is like that in *Emysaura*; so that when the two bones meet mesially their ventral margins form a Y-shape in *Iguana*, the cleft part being behind.

The resemblance does not cease with the hind limbs, though they are usually larger than the fore limbs in Lizards, while in Chelonians the inequality is much less marked, and only with Emydians are the hind limbs visibly the longer.

To make the femur of *Emysaura* comparable to that of *Iguana*, it would only require that the bone should be straightened, and that the trochanter on the fibular side (the great trochanter of mammals) be entirely suppressed.

There is a general resemblance of proportion and form between the subtriangular tibia and fibula. The latter bone is usually more slender. The comparison is best made between the Nilotic *Monitor* and *Emysaura serpentina*.

The proximal tarsals with the bones anchylosed into one row are so similar in *Iguana* and *Emysaura* that they might be easily confounded. The distal tarsal bones of Lizards differ in being limited to two. The metatarsals and phalanges of Lizards differ in being elongated, but approximate best to *Emysaura* and the marine Chelonia, which latter similarly have five digits.

§ 5. *The Chameleon-characters of Chelonians.*

The Chameleon-characters are few. In the head they are seen in the backward prolongation of the supraoccipital and parietal bones, coupled with the high form of the cranium. The premaxillaries are similarly narrow in front; but they do not enter into the lateral perforation of the anterior nares, but into the superior membrane-covered vacuity which I have already spoken of as the middle hole of the skull.

The palatine bone appears similarly to form the inner floor of the orbit. It may be worth consideration whether the Chelonian terminal hole in the head does not represent the middle hole rather than the true nares, and whether by the prolongation forward of the prefronto-nasal, maxillary, and premaxillary bones, nares in front of these might not be circumscribed which should be more analogous to the nares of *Chamæleon*—a view which is not unsupported by the existence of long fleshy snouts in some Trionychidæ.

The elongated scapula of the Chameleon approximates to that of the Tortoise; but the resemblance would seem to be accidental.

§ 6. *The Rhynchocephalian Characters of Chelonians.*

The Rhynchocephalian palate has only a resemblance of form to the Chelonian; for the maxillary and premaxillary only margin it, there is no similar aperture for the posterior nares, and, although the palatines are parted from each other as in many Chelonians, it is by the pterygoid bones and not by the vomer, which bone is here double and makes the anterior part of the palate. The basioccipital and basisphenoid are exhibited on the underside of the head; but in the adult they form one bone. The pterygoid gives off a strong lateral process into the lateral pterygoid fossa, as in *Podocnemis*; and the bones diverge against the basisphenoid to reach the quadrate, as in *Chelone midas*; but there the resemblance ends.

The oblique orbit is surrounded by much the same bones as in a

Chelonian, the maxillary and malar below, the postfrontal and quadrate behind, though in *Testudo* the bone which represents the quadrato-jugal, while penetrating the suture between the postfrontal and malar, does not reach the orbit; above are the postfrontal, frontal, and prefrontal, the latter bone in Chelonians rarely being distinct; and in front is a small lachrymal, which is not found in Chelonians.

The nostril differs from that of a Chelonian in having the premaxillaries prolonged upwards to be embraced by the front of the nasal bones.

There is a resemblance to Chelonians in the median bones of the roof of the skull all being double.

The quadrate bone is vertical in *Hatteria*, and suturally wedged in the skull; but it has a form of its own and a peculiar antero-posterior perforation; and the back of the skull has little in common with Chelonians.

The pelvis is very like that of *Emysaura*, and in old animals would probably approach near to *Testudo*.

The ischium has the Chelonian shape, with a not dissimilar posterior tuberosity; it is, however, united to the pubis only by a strip of cartilage as in *Iguana*. The pubes have between them a diamond-shaped cartilage in front, which, fully ossified, would give the pubic bones a form like that of the old *Testudo*. The bones are perforated, as in Lizards, by the obturator nerve. The ilium inclines a little backward, is flattened, has the sides subparallel, but, as in Lizards, extends beyond the point of attachment to the sacrum.

§ 7. *The Serpent-characters of Chelonians.*

In the Boa there is a similar prolongation of the parietal and occipital bones backward into a crest and spine. The maxillary bone is similarly introduced into the base of the orbit; and, as in *Testudo*, the posterior boundary is made by the postfrontal bone, the upper boundary by the frontal, and the front boundary by the prefrontal. In the Boa and in the poisonous group the small premaxillary is similarly toothless. And though the anterior nares are double in Serpents, they are bordered by the nasal, maxillary, and premaxillary bones as in Chelonians.

The method of articulation in the vertebral column, and the double hypapophysis in the tail preclude further comparison.

§ 8. *The Urodelan Characters of Chelonians.*

There is a general resemblance of form between the crania of *Chelys mammata* and the Menopome. The quadrate and squamosal bones are as firmly fixed in the skull as in Chelonians, and in the Mammata are similarly directed more outward than downward. The maxillary and prefrontal make the front and base of the orbit; in Salamanders its hinder part is not circumscribed with bone. The pterygoid in the Menopome is a large bone like that of the Mammata, and the bones are mesially parted from each other as in *Trionyx*; only the separation is made by the basi-temporal in the Menopome, and not by the basisphenoid. The pterygoid in both similarly meets the quadrate. In Tritons the quadrate bone is directed forward as in the extinct Ornithosauria.

The humerus of the German Salamander has a digital process at the proximal end, which is not likely to recall the ulnar process in a Chelonian. The radius is proportionally a very large bone, and is greatly expanded at the distal end. The ulna is sufficiently similar to that of marine and freshwater Chelonia to suggest comparison.

The carpals in *Menopoma* have no existence; in the Salamander they are well ossified, and, though very different, are more suggestive of the marine Chelonia than of the other types.

The pubis is unossified in the Urodela; and the ischia are large reniform bones unlike those of any Chelonian; but the ilium appears to be similar.

The femur, though having a hemispherical proximal articulation and a widened distal end, has proximally a digital trochanter unlike that of a Chelonian and more suggestive of an Iguanodont Dinosaur's.

The tarsals differ in the same way as the carpals; and the compressed dicebox-shaped metacarpals and phalanges are intermediate in elongation between the marine and land types of Chelonians.

Usually Batrachian bones differ from those of Chelonians in being hollow, and in having epiphyses.

PART III.

THE SIMILITUDES OF LIZARD BONES.

§ 1. *The Mammalian Characters of Lizards.*

THE nearest approximation to the diverging V-shaped parietal crest of Lizards is the faint V-crest of certain Seals, like the Grey Seal. The few mammals which have the external nostrils double never have the division made by the nasal and premaxillary bones meeting mesially, but by a jutting forward of the ethmoid. The maxillary bone is similarly excluded in Ruminants and Pachyderms from a circumscribed orbit, by development of the malar and lachrymal bones.

A change in the forms of the teeth, like that of many Lizards, is seen in many mammals in the transition of incisors to canine, and to premolars and molars; only the molar teeth of Lizards never have a divided fang.

The ribless neck-vertebræ in the Monitor are six; in other Lizards there are usually fewer. Oxen have a strong neural spine and a well-developed hypapophysis; but neither is relatively ever so long as in the Monitor; and mammals never have a long intervertebral ossicle as in *Iguana*, or a procœlous cup-and-ball articulation; in many of the long-necked mammals the transverse process is as little developed as in Lizards. The axis of *Iguana*, with its large forward-reaching neural spine, and large odontoid process placed immediately under the neural canal, might well be compared to a mammal's. In long-necked mammals like the Giraffe there is a similar obliquity in the articulation in the centrum, its upper part leaning forward.

The dorsal vertebræ agree with those of all mammals except Cetaceans in not having the ribs supported on transverse processes, though a few early vertebræ in the Dragon have a short massive lateral process to which the large head of the rib articulates. They resemble *Myrmecophaga* and Cetacea in having the rib attached only to its own proper vertebra. They resemble true Whales in the articulation being strictly single, but differ in the expanded cup-shaped articular head, which is sometimes vertical. This single-headed condition is seen in the hinder ribs of many mammals and in *Ornithorhynchus*.

The dorsal region has the visceral surface of the centrum generally rounded and smooth. The neural arch in the early part of the back is usually directed forward in mammals, as it is in the back of *Iguana*; and in the lumbar region of mammals the neural spine is usually quadrate and erect as in the back of *Monitor*.

The tail in long-tailed mammals like the Marsupials and Monotremes rarely includes more than twenty vertebræ, except in *Paradoxurus*, while in *Monitor* there may be more than 100. The transverse process is more persistently developed in the mammalian caudal region than in Lizards; in Lizards the neural arch is the persistent part.

The ribs of Lizards appear to consist of a variable number of parts determined by the state of the specimen as fresh or dry. Taking three as the normal number in *Iguana*, the same number of parts may be seen in a few ribs of some Porpoises; and in *Ornithorhynchus* there is a long unossified element between the dorsal and sternal ribs.

The pectoral girdle resembles that of a Monotreme in consisting of scapula, coracoid, clavicle and interclavicle, while the mammal differs in the coracoids not meeting the sternum, and in those bones being divided by two others not seen in Lizards, which are named the epicoracoids. The episternum or interclavicle is a T-shaped bone in both, which carries the clavicles [often] on its cross bar in front, and in the mammal meets the proximal end of the sternum behind, while in the Lizards it extends mesially down the front of the large lozenge-shaped sternum. The ends of the cross bar in some Lizards unite with a process of the coracoid; in the mammal they extend along the clavicle nearly to the acromion process of the scapula. The scapula of the Monotreme, with its anterior lateral acromion-process, situate as in Cetaceans, is like the scapula of *Iguana*, where, however, the process is much longer—though in *Monitor* the coracoid unites with the whole side of the scapula, so that there is no true acromion. In the Monotreme the clavicle extends to this process; in the Lizard it extends beyond it to the suprascapula. The massive coracoid of *Chamæleon* or *Hatteria* is more like that of Monotremes than the emarginate bones of ordinary Lizards.

The diamond-shaped sternum of the Pike-Whale is relatively smaller than in Lizards, and has different relations; and, except in Chameleons, it is not usual for Lacertians to have the sternum formed of elements placed one behind the other, as in mammals.

The limb-bones with their epiphyses remind us of mammals' and Salamanders', though in the larger bones the resemblance of form is small. Bears, like Lizards, have the ulna larger than the radius: mammals have the bone compressed from side to side as it is in Lizards; but in mammals the proximal end is usually prolonged beyond the articulation. The carpus, metacarpus, and phalanges are very like in form to those of mammals, except that in Lizards the phalangeal bones are more elongated.

There is considerable resemblance in the pelvis to that of a mammal, so that if the pelvis were turned round about the sacrum so that the ilia were directed forward, little would be needed to make the pelvis mammalian, beyond the prolongation mesially backward of the pubes to meet the ischia and so form obturator-foramina, a suppression of the prepubic angle of the pubis, and an expansion of the free end of the ilium.

The femur is unlike that of any mammal in having the inner or tibial trochanter of the proximal end greatly developed, and the outer or great trochanter suppressed—as well as in having the articular head compressed, which is also a feature of the humerus. The inner trochanter of the femur of *Ornithorhynchus* is similar; but the bone in no other respect is like that of Lizards.

There is no patella in Lizards. The tibia differs from most mammals' in being, at the proximal end, compressed from front to back; in *Dasyurus* it is subcylindrical. The fibula differs from mammals' in articulating with the side of the femur. The tarsus is not mammalian; and the other bones of the foot differ from mammals' chiefly in their great length.

§ 2. *The Avian Characters of Lizards.*

The single premaxillary extends between the nares and between the termination of the nasal bones, after the manner of birds; but in birds the lateral rays of the bone diverge backward, and form that part of the palatal border which in Lizards is made by the maxillary bones; and in Struthious birds the premaxillaries make a conspicuous part of the palate.

The free motion of the quadrate bone is avian; but the bone does not articulate with the wall of the brain-case as in birds. The basisphenoid in Struthious birds gives off similar lateral processes to articulate with the pterygoid; and the presphenoid is similarly prolonged forward between the pterygoids. These bones, though smaller in the bird and of different form, similarly diverge behind, and unite with the inner sides of the quadrate bones, lapping behind the process which the quadrate of the bird, in common with that of the Rhynchocephalian, sends forward and inward.

There is a general resemblance between the form of the dorsal vertebræ in *Monitor* and in birds, so far as concerns the shape of the neural spine, the length of the centrum, and the concave side-to-side outline of the articulation seen on the under surface; but Lizards, unlike birds, Crocodiles, and Salamanders, have no transverse process, which in the neural arch of birds forms a platform down the back, to which the second head of the rib articulates. The elongation of the neck, the shortness of the tail, and the anchylosis of the sacral vertebræ in birds are unlizardlike.

The pectoral arch of Struthious birds may be compared to that of *Chamæleon.* The sternum is similar, and gives attachment to short broad coracoids, which make the acetabulum for the humerus, with an elongated unexpanded scapula.

Carinate birds have the clavicles as well developed as in ordinary Lizards; and then, as in Monotremes, they similarly articulate with the small acromial process of the scapula, but do not reach beyond it as in Lizards. In the Penguin the scapula is almost as much expanded as in Lizards; but the acromion is short and not given off from the middle of the front margin, but from near the union of the bone with the coracoid. If the keel of the bird's sternum represents the interclavicle of Lizards, it is not often that it preserves, as it does in the Shrike, the transverse bar of the T-shape; the interclavicle of *Iguana* has an incipient keel; and, in general, the interclavicle of the bird may be supposed to be formed, like that of the Skink, in a +, if it exists at all.

The ribs of true Lizards never show the epipleura characteristic of birds, which are well developed in *Hatteria*; nor do the ribs usually consist of so few as two elements, though often as many sternal ribs articulate with the sternum in Lizards as in birds.

The humerus corresponds closely with that of carinate birds, and from the Parrot differs chiefly in not having the radial crest so much compressed, in not having the ulnar process excavated for a pneumatic foramen, and in having the distal end more expanded from side to side.

The ulna and radius rather resemble those of Struthious than carinate birds, since carinate birds have not the proximal end of the ulna so large, or the whole bone so much compressed, and they usually have the distal end impressed mesially so as to make the articulation pulley-shaped. In Struthious birds, too, the distal end of the bone is more expanded from side to side. The radius corresponds with the Ostrich better in proportion than in the form of the articular ends.

The resemblances in the remainder of the skeleton are very slight. Even the femur, though similar in proportion, differs in wanting the external trochanter, and in having an internal trochanter (which in birds is not developed), in having the proximal articulation large and terminal instead of at right angles with the shaft as in birds, and in having the condyles of the distal end less divided in those few Lizards which, like the Monitor, show indications of a dividing groove.

The phalanges are often similar, and the claws are compressed from side to side.

§ 3. *The Crocodilian Characters of Lizards.*

Uromastix and *Iguana* are Crocodilian in having the frontal and parietal bones single and the nasals double. The frontal bone similarly divides the orbits. The downward direction of a process of the pterygoid and of the transverse bone, so that they fall within the lower jaw, is Crocodilian.

Those Lizards (like the white Skink) which after the first two vertebræ have cervical ribs, never have them of the ⊥-shape with double heads which characterizes Crocodiles.

Only in the earlier dorsal vertebræ of the Dragon are there short transverse processes to the vertebræ; but they are given off from the centrum, and are never notched for ribs after the manner of Crocodiles, but are single-headed and shorter and stronger. In the tails of many Lizards, however, the transverse processes are even more developed than in the Crocodile, especially in *Uromastix*; and in Lizards the vertebræ are more numerous. They usually have the articulation of the centrum oblique, while in Crocodiles it is vertical; and in Crocodiles the centrum is more compressed from side to side. In the young Crocodile the articular faces of the caudal centrum are flat or slightly convex as in mammals, and so far unlike Lizards'.

The pectoral arch of the Crocodile differs from that of true

Lizards in wanting an episternum and clavicles, as well as in the forms of the coracoids and the scapulæ. The shapes of the pectoral bones are points in which the different Lizards differ greatly among themselves—the Skink having the episternum +-shaped, with expanded clavicles. In *Monitor* the scapula adjoins the coracoid along its whole length; in *Uromastix* the scapula has no acromion process; in *Stellio* the clavicles are brought down to the anterior margin of the sternum; and in the Dragon the scapula is like that of the Crocodile.

The humerus similarly has a compressed proximal articulation; but the bone in Lizards puts on many other characters not seen in Crocodiles, such as the twist in the bone, the widening of the distal end, the development of the distal condyles, the thickening of the radial crest, and the formation of an ulnar tuberosity. With a general resemblance, the ulna has scarcely a Crocodilian character beyond a compression of the bone from side to side; for though the inner outline of the bone in Lizards is concave, its outer outline is straight, and not convex as in Crocodiles, so that the proximal end of the bone in Lizards becomes more massive, is more prolonged on the outer side, and a concave articulation is made in it for the humerus.

The radius has a straight Crocodilian cylindrical shaft, but develops characters of its own in the concave proximal end, and in the process of the distal articulation, which, like that of the mammalian tibia, is directed inward.

The carpus is very unlike; but the metacarpals and phalanges differ but little.

There are no Crocodilian characters in the pelvis.

The Lizard femur is less unlike the Crocodile than the humerus, being similar in proportion, and having a similarly compressed articular head; but while in Crocodiles the articular head is so directed as to give a convex outline to the hinder side of the proximal end of the bone, in Lizards the corresponding surface is concave; and the tuberosity, which on the inner side of the shaft in Crocodiles is scarcely a prominence, in Lizards becomes the large inner trochanter, which is especially prominent in Skinks, and but slightly prominent in the Dragon.

There is much resemblance in the proportions of the tibia and the fibula: but in Lizards the distal end of the tibia sends a process downward and inward as in mammals, and the proximal end of the bone is compressed on the inside; in Lizards the fibula is more compressed from side to side at the distal end, and its proximal end usually curves backward.

There are many points of difference in detail (in the metatarsals and phalanges), but nothing inconsistent with both having had a primitive plan in common.

§ 4. *The Chelonian Characters of Lizards.*

There is no community of character in the skull, or vertebral column, or pectoral girdle, beyond such features as all reptiles have in common.

In the humerus of *Emysaura*, however, are found all the points of the lacertian humerus; only they are exaggerated to an extent which might be considered grotesque.

In the os pubis of *Uromastix* and the Dragon the prepubic angle is prolonged into a digital process similar to that of a Chelonian. The ischium of *Emysaura* is similar to that of *Iguana*. But there seems to be in the ilium of Lizards always an angular process in front above the acetabulum, of which Chelonians give no indication.

The characters of the Lizard femur, like those of the humerus, are burlesqued by *Emysaura*; and a new character is added by the development of a great trochanter.

The tibia and fibula would correspond very well with *Emysaura* but for the greater stoutness of the bones in the Chelonian.

The tarsus corresponds generally; and the bones of the Emydian digits may be matched by those of the White Skink.

§ 5. *The Serpent-characters of Lizards.*

The parietal in *Iguana* sometimes has a median ridge approximating to that of *Python*. The squamosals in Serpents are always prolonged backward; but in Lizards the parietals are prolonged with them and over them. The nares of both are divided by a single premaxillary. The orbits are similarly vertical. The pterygoid bones are very similar in their forms and in their connexions with the quadrate, transverse, basisphenoid, and palatine bones; and in *Iguana* they are similarly divided from each other mesially. The palatine bones of Serpents, like those of *Hatteria*, carry teeth, and similarly abut against the maxillary, and similarly are divided by the vomer; but in the Boa the palatine is a narrow bone

The vertebral column of Serpents resembles that of *Iguana* in the form of articulation of the neural arch by addition of a zygosphene; but the *Iguana* has the neural spine inclined backward and thickened posteriorly, which is not the case in Serpents; also in transverse section the part of the arch at the base of the neural spine which is convex in Serpents, in Lizards is concave. The articulation for the rib is more elongated vertically in Serpents than is usual in Lizards.

§ 6. *The Urodelan Characters of Lizards.*

As in Rhynchocephalia and Ophidia the palatine abuts against the maxillary and carries a second row of teeth, the pterygoid and palatine are more expanded than in Lizards (in this rather recalling *Chamæleon*), and, with the parasphenoid between the pterygoids, in the Hell-bender, make a closed palate.

The nasal sacs are double, and in the Hell-bender appear to be surrounded by a similar set of bones to those which margin the anterior nares in *Monitor*.

As in *Monitor*, the Hell-bender does not prolong the maxillary arch backward, and the orbit has no margin of bones behind; the animal is unlike *Monitor* in having all the median roof-bones of the skull double.

Supraoccipital and basioccipital in the Hell-bender would seem not to exist, though the posterior part of the basitemporal looks as though it might well become a basioccipital bone like that of mammals.

The atlas of the Hell-bender has a strong resemblance to the axis of mammals and Lizards, what would be called the odontoid process fitting into the vacuity where the basioccipital is usually found, while the flattened lateral facets of the centrum fit on to the exoccipital bones. And this would raise the question whether if a vertebra with the characters of an ordinary atlas came to be developed between this vertebra and the skull, its centrum would not go to form a basioccipital bone. The outline of a vertebra in Hell-bender is very similar to that in Skink, differing in more perfect suppression of the neural spine, and in the development of transverse processes from the centrum, which in many Salamanders are double-headed. These processes are long in the Hell-bender; in *Triton* they are short, and give attachment to double-headed ribs, which have in the middle of their hinder margin an epipleural element, also seen in the earlier ribs of the

German Salamander. The transverse processes are directed backward; and the chevron bones of the tail are anchylosed to the centrum.

The scapula and coracoid are the only elements of the pectoral girdle ossified in Salamanders; the coracoids are widely divided by cartilage. There is a general correspondence of this part of the pectoral arch to that of Skink, except that the acromion in Salamander is a very wide short process which unites along its length with the coracoid. The latter bone has much the form seen in *Hatteria*.

The humerus and femur are both distinguished by the curious digital trochanters of their proximal ends. With regard to the other bones, along with a general resemblance of form, which from the absence of epiphyses cannot be traced in the articulations, there is a greater tendency in the bones to enlarge at the distal end than is the case with Lizards.

The ilium has the Lizard-direction upward and backward; but, as in Chelonians, it does not extend beyond its transverse process.

PART IV.

THE SIMILITUDES OF SERPENTS' BONES.

The absence of limbs and pectoral and pelvic arches limits comparisons to the head and vertebral column, which latter is so unlike what is characteristic of other types that the similitudes of Serpents' bones are necessarily few. Little in common with mammals will be noticed beyond the large development of the parietal and frontal bones, and the parietal crest seen in the Boa and Python, of which an analogue may be noticed in *Dasyurus*, *Thylacinus*, and the Spotted Hyæna. An analogous form of the neural arch, but with the zygapophysial characters which are anterior in Serpents developed at the posterior end of the arch, occurs in the lumbar vertebræ of Armadillos and *Myrmecophaga*; but the centrum in those animals is unlike that of a serpent's vertebra.

The resemblances to the bird are chiefly in the large share which the parietals take in covering the brain, and in the function of the frontals in completing the covering in front, in the basisphenoid having articular facets for the pterygoid bones, as in Lizards, and in the similar prolongation of the presphenoid bone forward. The pterygoid bones, as well as the palatines, are similarly divided from each other mesially: in birds, however, they are toothless and small, and have attachments only with the quadrate, palatine, and presphenoid. The quadrate bone is free in Serpents, but of of more typically lacertian than avian form; and in birds the squamosal bone enters into the wall of the brain-case, while in Serpents it has not even osseous union with the brain-case, though more closely applied to it than is the case with the bone in Lizards.

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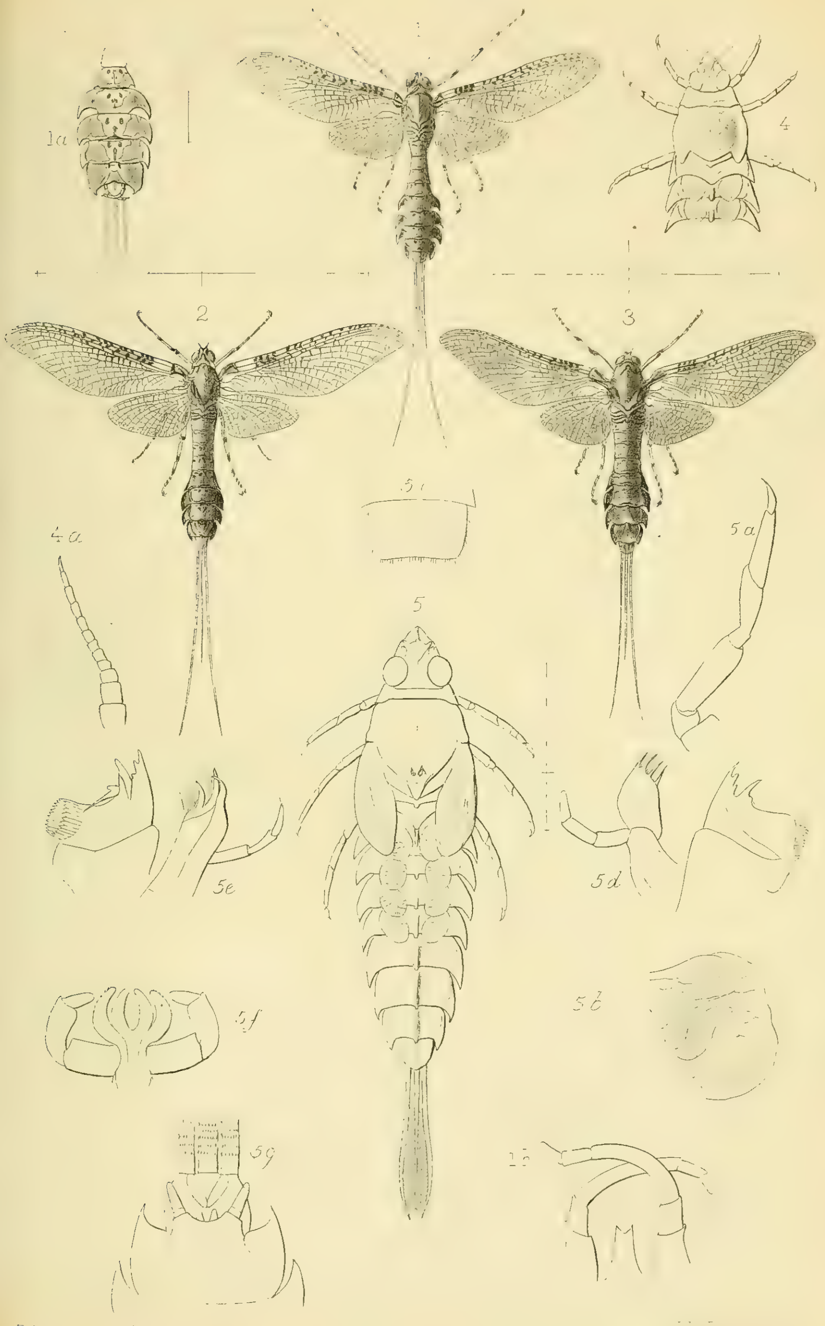

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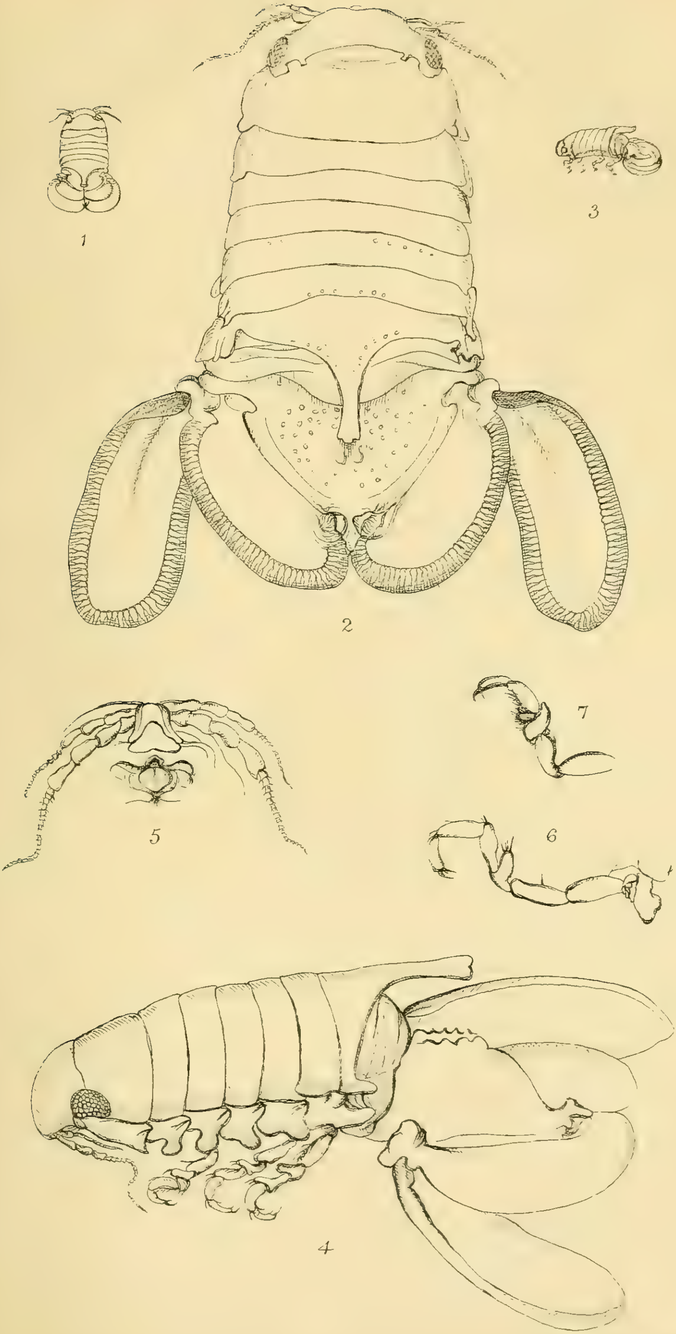

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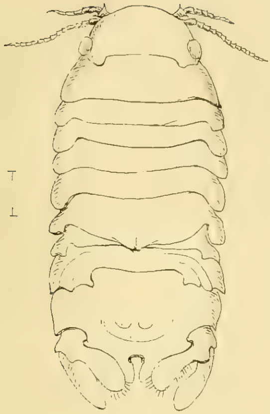

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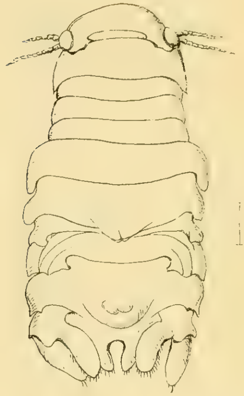

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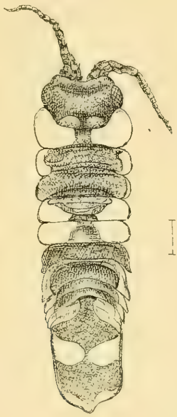

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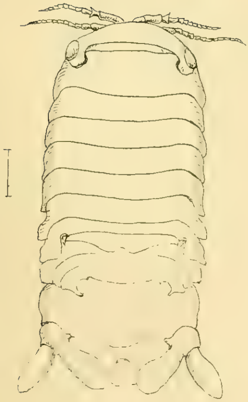

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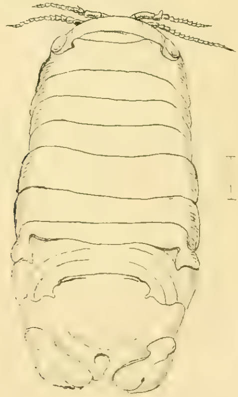

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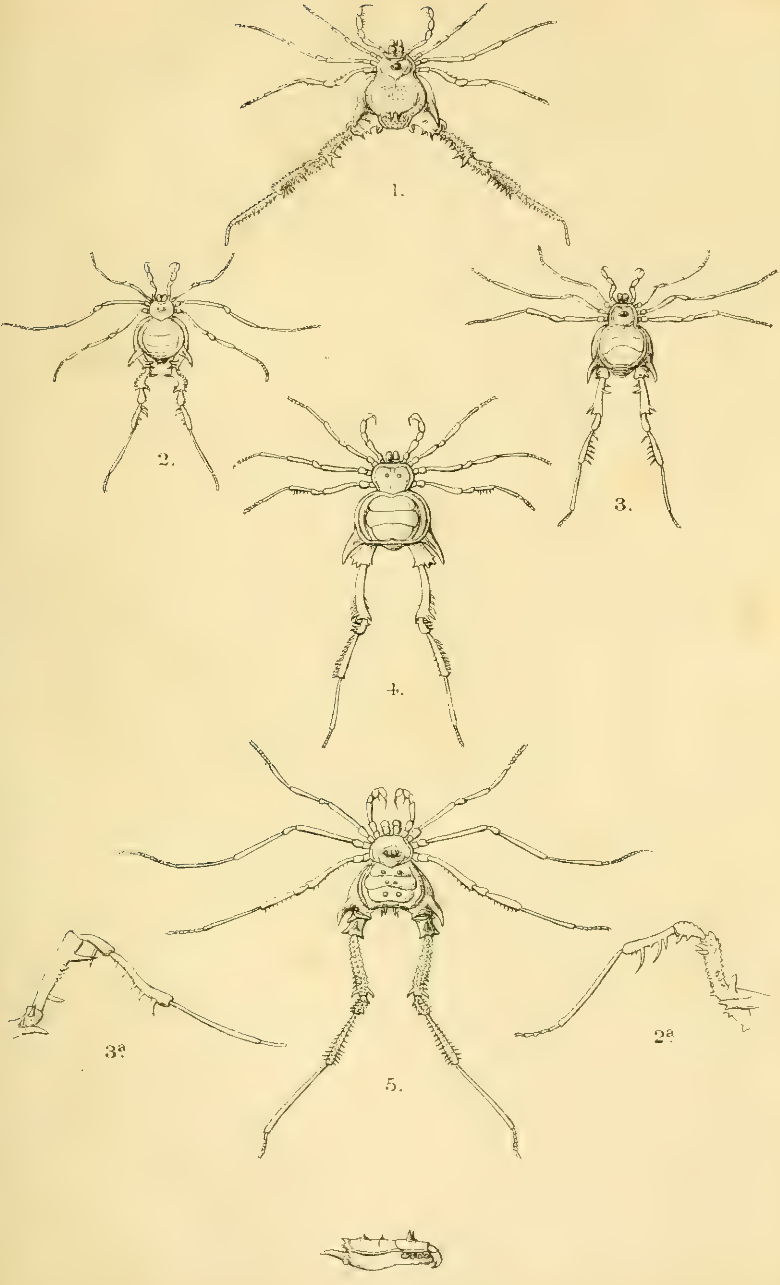

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Each volume will consist of Eight numbers, instead of Four.

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CONTENTS.

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Notes on the Letters from Danish and Norwegian Naturalists contained in the Linnean Correspondence. By Professor J. C. Schiödte, of Copenhagen.

[Read June 18, 1874.]

Amongst the treasures preserved by the Linnean Society, one of the most important is the correspondence of the King of Naturalists. It is true that for the appreciation of his own works and genius this vast collection is of minor value, because the letters are those of his correspondents and not his own. But Linnæus was the centre of the scientific world at his time and in his own department, such as no other man of science ever was to a similar degree; and this enormous mass of communications sent to him by contemporary naturalists of every nation and every class, through a series of years, give in their totality a most interesting and unique picture of that whole period in the history of science, and throw so much light on many points in it, that this history certainly never can be properly written without a most ample use of this correspondence, such as has not yet been made.

It was therefore a great satisfaction to me to be enabled, by the kind permission of the Linnean Society, to copy those letters to Linnæus, preserved in its library, which had been written by naturalists in Denmark and Norway. As many of these letters as seemed to have any interest have now been printed, exactly transcribed (a few only in extracts) in the seventh volume of the 'Naturhistorisk Tidsskrift,' pp. 333–509; and their historical value has been amply demonstrated by the quantity of new information which Mr. Gosch has derived from them and embodied in his work on the Zoological Literature of Denmark *. In order to explain fully the importance of these documents for the history of natural science in Denmark, I should have to trespass too far on the indulgence of my readers; but a few short observations on the principal authors of them may perhaps not be unacceptable.

The letters printed in the 'Naturhistorisk Tidsskrift' are 130 in number, including a very few to the younger Linné. The following are the principal writers.

1. *Balth. Joh. de Buchwald*, Professor of Medicine at Copenhagen (five letters).

* 'Udsigt over Danmarks Zoologiske Literatur,' Pt. II. vol. i. pp. 293–302, 321, 335, 339, 355, 360, 414, 417, 438–440, 451, 461.

2. *G. T. Holm*, a favourite pupil of Linnæus, who had great expectations of him. He died very young; and hitherto but little was known of his life. His letters (three) give very valuable information on the efforts made by the Danish Government in order to resuscitate the study of natural history, which had lain dormant in Denmark since the time of Bartholinus and Steno.

3. *G. C. Oeder*, the founder of the Botanical Garden at Copenhagen, and the first editor of the well-known work published by the Danish Government, the 'Flora Danica.' (Six letters.)

4. *P. Ascanius*, the First Professor of Zoology at Copenhagen. (Six letters.)

5. *C. G. Kratzenstein*, Professor of Medicine and author of the original text to the splendid work on shells by Regenfuss ('Choix de Coquillages') published at the expense of the King of Denmark. This text was withdrawn and another substituted for it, a very curious and hitherto but imperfectly understood episode in literary history *. Also with regard to the great expedition to Arabia sent out by the Danish Government, which resulted in the well-known works of Niebuhr and Forskåhl, many new and interesting details are contained in the letters of Kratzenstein (six in number), Oeder, and Holm.

6. *C. F. Rottböll*, afterwards Professor of Botany, author of several works in that department. (Five letters.)

7. *M. Th. Brünnich*, Professor of Zoology and Mineralogy at Copenhagen, author of 'Ichthyologia Massiliensis,' 'Ornithologia Borealis;' a friend of Jos. Banks, E. Tennant, Solander, &c. (Sixteen letters.)

After my return from London with the copies of these letters, I had occasion to examine the papers and manuscripts formerly belonging to Brünnich, and now preserved at the University library at Copenhagen. I had the great pleasure of finding amongst them nine autograph letters from Linnæus, answers to a corresponding number of those from Brünnich. They have been printed in the 'Naturhistorisk Tidsskrift,' vii. pp. 510–521. The two savants had never met; but they understood and appreciated

* It was originally intended to publish this work by subscription; and a specimen of the circular issued by Regenfuss, probably the only one existing, is bound up with Linnæus's copy of the work in the library of the Society.

each other thoroughly; and their correspondence bears strong testimony of their mutual esteem and sympathy.

8. *Lorenz Spengler*, the widely known collector of shells, whose collection, containing a great number of types, is still preserved at Copenhagen. (Four letters.)

9 and 10. *Hans Ström* and *I. E. Gunnerus*, Bishop of Throndhjem, able and industrious observers of nature in Norway and authors of many, for their time, valuable papers. (One and five letters.)

11. *O. F. Müller*, the author of 'Zoologia Danica' and so many other distinguished works. Like Brünnich, he knew Linnæus only by correspondence; but it is noticeable that the latter never entered into so cordial relations with him as with Brünnich. (Fifteen letters.)

12. *Joh. Chr. Fabricius*, the great entomologist and the ablest of Linnæus's personal disciples. Amongst the twelve letters in this collection is also the one (without date, but from other sources known to have been written in 1766) in which he submits to Linnæus his new method of analyzing and classifying insects.

13. *Johan Zoëga*, a botanist of great ability, but who unfortunately was compelled from various circumstances to abandon natural science and enter on an administrative career. In this he distinguished himself greatly; but natural history sustained a severe loss. He studied at Upsala together with his cousin, Joh. Chr. Fabricius; and it is recorded that Linnæus once said, "When I see Fabricius with an insect, and Zoëga with a moss, I take off my hat and salute my masters." The twenty-six letters from his pen contain a great mass of valuable personal and scientific details.

14. *Martin Vahl*, the celebrated author of the 'Symbolæ Botanicæ,' 'Eclogæ Americanæ,' &c., himself a devoted personal disciple of Linnæus. (One letter.) Besides these, there are letters from the statesman J. H. E. Bernstorff, the historian Suhm, and other men of fame.

The correspondents of Linnæus very frequently sent him descriptions and annotations of plants and animals; and many entries and alterations in the various editions of the 'Systema

Naturæ' may doubtless be traced to this correspondence. The often voluminous descriptions, sometimes accompanied by drawings, which form enclosures or parts of the letters in question, have not been reproduced in the 'Naturhistorisk Tidsskrift,' as not having sufficient value in proportion to the space they would occupy. But as an instance of how the correspondence illustrates the systematic works of Linnæus, we may mention the following. In the second edition of 'Fauna Suecica' we find under the genus *Hydra* a species called *triticea*; but in the twelfth edition of the 'Systema Naturæ' this is omitted, and rightly so. From one of the letters of Fabricius we gather in what way Linnæus was led to correct the error; for Fabricius here communicates to him that a certain Schun (whose name is probably misspelt), minister at Bamf, had informed him that these supposed Hydras, which occur frequently on the coast, were only the ova of *Buccinum lapillus*, L. This letter is written from Edinburgh, 17 September, 1767 (Naturhistorisk Tidssrkrift, vii. p. 459).

But as I have already said, it is for the appreciation of Linnæus's contemporaries and his influence on them (in short, of the Linnæan period in natural history) that this correspondence is principally valuable; and I may perhaps, in conclusion, be permitted to express a hope that some writer thoroughly qualified for the task may be found inclined to work up in an exhaustive manner the vast store of material for the history of science which I feel sure must be contained in this remarkable collection of letters.

Copenhagen, April 1874.

On the Classification of the Animal Kingdom. By T. H. Huxley, LL.D., Sec. R.S., F.L.S., &c.

[Read December 3rd, 1874.]

In the twelfth edition of the 'Systema Naturæ' Linnæus gives the following definition of the object of classification:—

"Methodus, anima scientiæ, indigitat primo intuitu, quodcunque corpus naturale, ut hoc corpus dicat proprium suum nomen, et hoc nomen quæcumque de nominato corpore beneficio seculi innotuere, ut sic in summa confusione rerum apparenti, summus conspiciatur Naturæ ordo" (*l. c.* p. 13).

While entertaining the same general conception of classificatory method, Cuvier saw the importance of an exhaustive analysis of the adult structure of animals. The most complete investigation of the kind ever made under the direction of a single mind, and far surpassing all previous attempts in extent and thoroughness, is contained in the 'Leçons d'Anatomie Comparée' and the 'Règne Animal.' Cuvier's classification is purely morphological; it is an attempt to enunciate the facts of structure determined in his time, and largely by his own efforts, in a series of propositions of which the most general are the definitions of the largest groups, and are connected by a series of subordinate, differential propositions with those which constitute the definition of the species.

In his great work, the 'Entwickelungs-Geschichte der Thiere,' Von Baer, among other contributions to science of first-rate importance, showed that our knowledge of an animal's true structure must be imperfect, unless we are acquainted with those developmental stages (which are successive structural conditions) through which the animal has passed in its way from the ovum to the adult state; and, since 1828, no philosophical naturalist has neglected embryological data in forming a classification.

In 1859, Darwin, in the 'Origin of Species,' laid a new and firm foundation for the theory of the evolution of living beings, which had been hypothetically sketched out by Lamarck, and thereby introduced a new element into Taxonomy. If a species, like an individual, is the product of a process of development, the character of that process must be taken into account when we attempt to determine its likeness or unlikeness to other species; and Phylogeny, or the history of the evolution of the species, becomes no less important an element than Embryogeny in the determination of the systematic place of an animal. The logical value of phylogeny, therefore, is unquestionable; but the misfortune is, that we have so little real knowledge of the phylogeny even of small groups, while of that of the larger groups of animals we are absolutely ignorant. To my mind there is full and satisfactory proof of the derivation of *Equus* from *Hipparion*, and of this from an Anchitherioid ancestor; and there is much to be said in favour of the derivation of other genera of existing Mammals from their Tertiary predecessors. There are also pretty clear indications of the series of changes by which the Ornithic arose out of the Reptilian type, and the Amphibian from the Fish; but I do not know that as much can be said of other large groups. We are reduced to speculation—to the formation of more or less probable hypotheses; and, though I believe that phylogenetic speculations are of great interest and importance, and are to be reckoned among the most valuable suggestors of, and guides to, investigation, I think it is well to recollect, not only that they are at present, for the most part, incapable of being submitted to any objective test, but that they are likely long to remain in that condition. For the ultimate test of the truth of a phylogenetic hypothesis is the historic record of the succession of living forms contained in the fossiliferous rocks; and the present state of geology gives no encouragement to the supposition that even the whole series of fossiliferous rocks represents a period coextensive with the existence of life on the earth. In speculating on these subjects, it is constantly needful to remind oneself, even now, that there is every reason to believe that all the leading modifications of animal form were existent at least as early as the close of the Palæozoic epoch; and though it is true that the fossiliferous Palæozoic rocks are thicker than all the rest put together, yet the amount of progress in evolution from a moner to the fully differentiated Vertebrata of the Trias bears an enormously larger ratio to the amount of progress from the Triassic vertebrates to those of the present day. All such comparative measurements as these are but rough aids to the imagination; but the Invertebrata yield even stronger evidence in the same direction. The larger divisions of the Arthropoda were completely differentiated in the Carboniferous epoch; so were those of the Mollusks and those of the Echinoderms. The great desideratum is the discovery of estuarine and freshwater formations of Silurian, Cambrian, and Laurentian date. At the present moment, I do not think that any one is in a position to form even a probable guess as to what will be found in such deposits.

Taxonomy should be a precise and logical arrangement of verifiable facts; and there is no little danger of throwing science into confusion if the taxonomist allows himself to be influenced by merely speculative considerations. The present essay is an attempt to set a good example, and, without reference to phylogeny, to draw up a classification of the animal kingdom, which, as a fair statement of what, at present, appear to be well-established facts, may have some chance of permanence, in principle, if not in detail, while the successive phylogenetic schemes come and go. No doubt the increase of our knowledge of embryology will largely modify any conclusions which may be based upon our present imperfect acquaintance with the facts of development; and, in many cases, it is impossible to do more than suggest the conclusions towards which these incomplete data tend.

Among those animals which are lowest in the scale of organization there is a large assemblage, which either present no differentiation of the protoplasm of the body into structural elements; or, if they possess one or more nuclei, or even exhibit distinct cells, these cells do not become metamorphosed into tissues—are not histogenetic. In all other animals, the first stage of development is the differentiation of the vitellus into division-masses, or *blastomeres*, which become converted into cells, and are eventually metamorphosed into the elements of the tissues. For the former the name PROTOZOA may be retained; the latter are coextensive with the METAZOA of Haeckel.

I. THE PROTOZOA.

The movements of the body are effected either by pseudopodia or by cilia, which latter may either be small and numerous, or long and single, and at most two. When pseudopodia are the only instruments of progression, the animal may be termed a *myxopod*; when numerous cilia, a *trichopod*; when single or double flagelliform cilia, a *mastigopod.*

Among the Protozoa, two groups are distinguishable:—1. The *Monera*; 2. The *Endoplastica.*

1. *The Monera.*—There is no "nucleus." Our knowledge of these forms and of their relations is largely due to Haeckel, who has shown that several of them present a remarkable alternation of conditions. Thus, *Protamœba* is a myxopod which may become encysted, and, in that condition, divides into several portions which are set free and resemble the parent, or are myxopods. *Protomonas* is a *mastigopod* which becomes encysted, divides, and gives rise to myxopods, which subsequently become converted into mastigopods. *Myxastrum* is a myxopod which becomes encysted, divides, and the products of division become enclosed in ovoid cases, whence they emerge as myxopods. *Vampyrella* is a myxopod which devours *Gomphonema* and other stalked Diatoms, encysts itself on their stalks, divides, and gives rise to new myxopods. In *Protomyxa*, the primitively independent myxopods unite into plasmodia. Although our knowledge of the structure of the soft parts of the *Foraminifera* is imperfect, and the case of *Gromia* sug-

gests caution in assuming that they are all devoid of nuclei, it is probable that the great majority of the Foraminifera resemble *Protogenes* and belong to this division, the extent of which will doubtless be greatly enlarged by the discovery of new forms.

2. *The Endoplastica.*—The application of the term "nucleus" to the structure commonly so called in this division of the Protozoa, to a certain extent implies a belief in its being homologous with the histological element to which the same name is applied; and I prefer to revive a term I once proposed for the latter, and to call the body at present in question "endoplast." It may or may not be the homologue of the histological nucleus; and without expressing any definite opinion on that subject, I wish to leave it open for further consideration.

It is remarkable that among these Endoplastica there is a series of forms which run parallel with the Monera. Thus *Amœba* is like a *Protamœba* with a nucleus and, commonly, a contractile vesicle. The Infusoria Flagellata are comparable to *Protomonas* with the same additions, and attaining a considerable degree of complexity in *Noctiluca*.

The Gregarinidæ repeat the series of forms of *Myxastrum*, though some become divided into several segments, and, as E. Van Beneden has shown, acquire muscular fibres.

The Acinetidæ and the Radiolaria apparently have their moneral representative in *Actinophrys sol*, though the conversion of the pseudopodia into suckers in the Acinetidæ distinguishes them remarkably.

On the other hand, while no moneral trichopod seems yet to have been discovered, the trichopod type is richly represented, in this division, by the Catallacta of Haeckel, and by the Infusoria Ciliata, of which I think the Catallacta should form only a subdivision.

It is among the Ciliata that the Endoplastica attain their greatest degree of complexity, by a process of direct differentiation of their protoplasmic substance into tissues and organs, without the intervention of cell-formation.

I have recently examined several genera of Infusoria (*Paramecium, Balantidium, Nyctotherus, Spirostomum*) with great care—using very high microscopic powers (1200–2000 diameters), employing osmic acid (which at once kills and preserves unchanged the tissues of the Infusoria) and other reagents, and comparing them with such truly cellular organisms of similar size as *Opalina*; and I must express my entire agreement with Von Siebold and with Haeckel in their conclusion, that the protoplasm of these animals is not differentiated into cells.

At most there is an excessively minute, and sometimes regular, granular structure, which is found in the endoplast, as well as elsewhere, and appears to me to be altogether similar to that of the protoplasm between the nuclei of *Opalina*. But although the bodies of the Infusoria contain no cells, they may be differentiated into very definite tissues. In the genera mentioned, the so-called "cuticula" is, I believe, simply the transparent outermost layer of the protoplasm, and the cilia are directly continuous with it. Beneath this is a well-marked cortical layer, in which the "trichocysts" of *Paramecium* are situated, and which, in *Spirostomum*, *Balantidium*, and *Nyctotherus*, presents the distinct muscular fibres described by Stein and others. The inner substance is, in some (*Balantidium, e. g.*), semifluid, and undergoes an obvious rotation; but in *Nyctotherus*, not only is there no movement of this substance, but the long curved œsophagus is succeeded by an ill-defined region, which lies between it and the anus, is permanently filled with ingested matter, and is, in one sense, an alimentary tract. Even in *Paramecium*, the complex water-vessels, which lie, for the most part, not in the cortical layer, but beneath it, show, by the permanence of their disposition, that a great part of the inner substance is fixed. The constancy of position of the endoplast *, which also lies beneath, and not in, the cortical layer, is evidence to the same effect.

In comparing the Ciliated Infusoria with nucleated cells, the existence of the so-called "nucleolus," which assuredly can have nothing to do with the histological element so named, and which I propose to term the *endoplastula*, is an important fact, often left out of sight.

I have no observation to offer upon the vexed question of the nature of the endoplastula, as none of the numerous individuals of the different species named, which I have examined, showed the changes described by so many observers. That the endoplast itself is a reproductive organ is clear; but the development of embryos by its fission is an argument rather against, than in favour of, identifying it with the nucleus of a cell. No cell is known to multiply by fission of its nucleus alone.

* The membranous investment of the endoplast, so often described and figured, certainly has no existence in the unaltered state of the Infusoria I have mentioned.

On the whole, while I hesitate to absolutely identify the endoplast of an Infusorian with the nucleus of a histological cell, and can find no analogue for the endoplastula in the latter, I think that Von Siebold's view holds good, and that the higher Infusoria are unicellular animals, in the sense that *Mucor*, *Vaucheria*, and *Caulerpa* are unicellular plants.

Nevertheless it must be admitted, on the other hand, that though the view for which Ehrenberg has so long contended, that the *Infusoria* possess, in miniature, an organization, in a broad sense, as complex as that of the higher animals, is not tenable, the great majority of them are far more highly organized than was suspected before that indefatigable observer commenced his long and remarkable series of investigations.

II. The Metazoa.

The germ undergoes differentiation into histogenetic cells; and these cells become arranged into two sets, the one constituting the outer wall of the body, while the other lies internal to the foregoing, and forms the lining of the alimentary cavity, when, as is usually the case, a distinct alimentary cavity exists. In the embryo, the representatives of these two layers are the *epiblast* and *hypoblast*. In the adult, they are the *ectoderm* and the *endoderm*, which answer to the *epidermis*, and the *epithelium* of the alimentary canal, in the higher animals.

All the Metazoa, in fact, commence their existence in the form of an ovum, which is essentially a nucleated cell, supplemented by more or less nutritive material, or *food-yelk*. The ovum, after impregnation, divides into blastomeres, giving rise to a *Morula* (Hæckel), in the midst of which arises a cavity, the *blastocœle* (*cleavage-cavity*, "*Furchungshöhle*" of the Germans), which may be larger or smaller, filled only with fluid, or occupied by food-yelk. When it is largest, the blastomeres, united into a single layer, form a spheroidal vesicle, enclosing a correspondingly shaped blastocœle. When it is reduced to a minimum, the *Morula* is an almost solid aggregation of blastomeres, which may be nearly equal in size, or some much larger than others, in consequence of having undergone less rapid division. The next stage in the development of the embryo of a Metazoon consists (in all cases except a few parasitic anenterous forms) in the conversion of the *Morula* into a body having a digestive cavity, or a *Gastrula*.

The conversion of the *Morula* into the *Gastrula* may take place in several ways.

In the simplest, the *Morula*, being composed of equal or nearly equal blastomeres, these, undergoing conversion into cells, differentiate themselves into an epiblast, which invests the remaining cells, constituting the hypoblast. The central cells of the hypoblast next diverge and leave a space filled with fluid, the alimentary cavity, which opens at one end, and thus gives rise to the *Gastrula*. This is the process generally observed in Porifera, Cœlenterata, Turbellaria, Trematoda, and Nematoidea.

In a second class of cases, the *Morula* becomes converted into blastomeres of unequal sizes, a small and a large set. The smaller are rapidly metamorphosed into cells, and invest the larger (with any remains of the food-yelk) as a blastoderm. The hypoblast arises either from the blastoderm thus formed, or from the subjacent larger blastomeres. This is the process observed in certain Turbellaria, in the Ctenophora, in most of the Oligochæta and Hirudinea, in the Arthropoda, and in most Vertebrata.

In a third group of instances, the *Morula*, whether consisting of equal or unequal blastomeres, becomes spheroidal, and encloses a correspondingly shaped blastocœle. One part of the wall of this vesicular *Morula* then becomes invaginated, and is converted into the hypoblast, which encloses the alimentary cavity, the latter communicating with the exterior by the aperture of invagination. This process has been observed in the Chætognatha, Echinodermata, and some Gephyrea, in *Lumbricus* and *Hirudo*—in polychætous Annelida, Enteropneusta, Brachiopoda, and most Mollusca—and in *Amphioxus*, *Petromyzon*, and the Amphibia among the Vertebrata.

The various modes in which the two primary layers of the germ may be developed shade off into one another, and do not affect the essence of the process, which is the segregation of one set of cells to form the external covering of the body, and of another to constitute the lining of the alimentary canal. We may, with Haeckel, term those animals which pass through the Gastrula stage, *Gastreæ*. The *Gastrula* may be deeply cup-shaped, or flattened out into a disk, slightly concave on one side; but in whatever manner the *Gastrula* is formed, and whatever be its shape when its alimentary cavity is complete, one of two things happens to it. It becomes provided with many ingestive apertures distinct from that first formed (polystomatous), or with one only, which may or may not be distinct from the first aperture of the *Gastrula* (monostomatous).

Metazoa polystomata.—The former division comprises only the Sponges (Porifera or Spongida), in which, as the remarkable researches of Haeckel (" Monographie der Kalk-Schwämme ") have shown, the walls of the deeply cup-shaped *Gastrula* become perforated by the numerous inhalant ostioles, while the primitive opening serves as the exhalant aperture.

The latter division includes all the remaining forms, which may be grouped together as *Metazoa monostomata.* Among these, two primary groups are distinguishable, of which the second exhibits an advance in organization upon the first. In the first, the primitive aperture of the *Gastrula* becomes the permanent mouth (Archæostomata). In the second, the permanent mouth is a secondary perforation of the body-wall (Deuterostomata).

1. *The Archæostomata.*—It is now well established that the aperture of the *Gastrula* becomes the oral aperture of the adult in the Cœlenterata, which group includes animals differing much in grade of organization, from the simple *Hydra* to the complex *Ctenophore*, but all manifestly exhibiting variations of one fundamental type.

In most of the Hydrozoa, the ovum passes into a solid *Morula*, which, as in the Porifera, becomes differentiated into an epiblast and a hypoblast. The central cavity of the latter opens at one end, and thus far the *Gastrula* of the Hydrozoa is very like that of the sponges ; but the aperture produced in this manner becomes the mouth ; and if, as not unfrequently happens, apertures are formed elsewhere, they do not serve the purpose of taking in food. In such Hydrozoa as have thickened body-walls, hollow prolongations of the hypoblast extend into the blastocœle, and are surrounded by a mesoblastic tissue. These prolongations may become branched and anastomose, resembling vascular canals ; but they remain permanently in connexion with the alimentary cavity. The reproductive elements are developed in the body-wall, and usually in cæcal outwardly projecting processes of that wall, which dehisce and set free the ova and spermatozoa upon the outer surface of the body.

The Actinozoa, while presenting the same continuity of the cavity of the body with the alimentary cavity which is exhibited by the Hydrozoa, differ from them in two respects. The commencement of the alimentary canal is, as it were, sunk in the body; and the reproductive elements are developed in the walls of the gastrovascular canals, and pass into them on their way outwards.

The development of the coralligenous Actinozoa has not yet been thoroughly worked out; but Lacaze-Duthiers has shown that, in *Corallium rubrum* and other Gorgonidæ, the *Morula* passes into an elongated, almost vermiform, ciliated *Gastrula*, which becomes fixed by one end, and then develops the intermesenteric chambers. It can hardly be doubted that these are formed as diverticula from the basal end of the primitive alimentary canal, in which case the developmental process differs but little, essentially, from that of such a Hydrozoon as *Carmarina hastata*; and the line of demarcation between the Actinozoa and the Hydrozoa becomes very narrow.

The Ctenophora, on the other hand, differ somewhat in development, as in other respects, from the Coralligena. Their development has been carefully worked out by Kowalewsky and more recently by Agassiz.

The laid egg is contained in a spacious capsule, and consists of an external thin layer of protoplasm, which, in some cases, is contractile, investing an inner vesicular substauce. The vitellus thus constituted divides into two, four, and, finally, eight masses; on one face of each of these the protoplasm-layer accumulates, and is divided off as a blastomere of much smaller size than that from which it arises. By repeated division, each of these gives rise to smaller blastomeres, which become nucleated when they have reached the number of 32, and form a layer of cells, which gradually spreads round the large blastomeres, and invests them in a complete blastodermic sac. At the pole of this sac, on the face opposite to that on which these blastoderm-cells begin to make their appearance, an ingrowth or involution of the blastoderm takes place, which, extending through the middle of the large yelk-masses towards the opposite pole, gives rise to the alimentary canal. This, at first, ends by a rounded blind termination; but from it, at a later period, prolongations are given off, which become the gastrovascular canals.

At the opposite pole, in the centre of the region corresponding with that in which the blastoderm-cells first make their appearance, the nervous ganglion is developed by metamorphosis of some of these cells.

It is clear that the invaginated portion of the blastoderm, which gives rise to the alimentary canal, answers to the hypoblast, while the rest corresponds with the epiblast.

The large blastomeres which become enclosed between the epiblast and hypoblast in the manner described, appear to serve the purpose of a food-yelk; and the space which they originally occupied is eventually filled by a gelatinous connective tissue, which possibly derives its origin from wandering cells of the epiblast.

The Actinozoa and the Hydrozoa constitute the Cœlenterata, which are definitely characterized by the fact that, in all the higher forms, the mesoblast is traversed by canals formed by diverticula of the hypoblast, which permanently remain in continuity with the alimentary cavity, and that, in the lower forms, the alimentary cavity is prolonged into the cœnosarc. They are usually said to have a radiate symmetry; but, even in the *Actiniæ*, there are traces of bilaterality; and in the Ctenophora the bilateral symmetry of the adult is obvious.

Parallel with these may be ranged an assemblage composed of the Turbellaria, Rotifera, and Trematoda, the Nematoidea, Oligochæta, and Hirudinea, to which the name of 'Scolecimorpha' may be applied. They are associated together by the closest resemblances of structure, and present an even greater range in grade of organization than the Cœlenterata. The lower Rhabdocœla come very close to the Infusoria (as close as the multicellular to the unicellular Algæ), and are but little superior to *Hydra* in the degree of their organic differentiation, while in the land-Planariæ, the Trematoda, and the Nemertidæ we have animals which attain a considerable complexity and, in the case of many Trematoda and of *Lineus* (*Pilidium*), undergo remarkable metamorphoses. Such forms as *Dinophilus* appear to connect the rhabdocœle Turbellaria with the Rotifera. The lower Nematoidea are extremely simple, while the higher are considerably differentiated; and, as Schneider has shown, they are connected with the Turbellaria by such forms as *Polygordius*. The Oligochæta and the Hirudinea either belong to this division, or constitute a transitional group between it and the Deuterostomata. In *Lumbricus* (and apparently in *Hirudo*) there seems to be no doubt that the aperture of invagination of the *Gastrula* becomes the mouth. According to Kowalewsky, the mouth in *Euaxes* and *Tubifex* is of secondary origin; but its close resemblance to that of the earthworm and of the leech embryos leads me to suspect that there must be some error of interpretation here. On the other hand, it may be that these are transitional forms, such as we may expect to find bridging over the intervals between all groups, as knowledge widens. In any case, they differ from the foregoing in the development of a segmented mesoblast. In the Cœlenterata, Nematoidea, Turbellaria, Trematoda, and Rotifera, the mode of origin of the cells which lie between the epiblast and the hypoblast, constitute the mesoblast, and give rise to the connective tissues and muscles of the body-wall and of that of the intestine, is not precisely known. They may take their origin in the epiblast or in the hypoblast, or in both. But, in the Earthworm and Leech, after the epiblast and hypoblast are differentiated, the cells of the latter give rise, by division, to two bands of cells which lie one on each side of the long axis of the ventral face of the worm, and constitute the mesoblast. This becomes marked out by transverse constrictions into segments, and, in each segment, gives rise to all the tissues which lie between the epiblast and hypoblast. The mouth corresponds with the primitive involution of the *Morula*; the anal aperture is a new formation.

In the Nematoidea and in the lower rhabdocœle Turbellaria, the intestinal canal is a simple tube or sac. But, in some Turbellaria and Trematoda the alimentary canal gives off diverticula, which ramify through the mesoblast and even unite together, giving rise to a gastrovascular canal-system like that of the Cœlenterata. These animals, therefore, have what may be termed an *enterocœle*, more or less distinct from the proper digestive cavity, but connected with it, ramifying through the mesoblast.

Whether the remarkable group of worms termed Gephyrea by De Quatrefages (and including *Sipunculus*, *Sternaspis*, *Bonellia*, &c.) belong to the Archæostomata, or not, is uncertain, too little being known of the early stages of their development. They appear to me to be closely allied to the Rotifera (compare *Bonellia*, for example), to the Enteropneusta, and to the Echinodermata; while Schneider, by his very ingenious comparison of the *Phoronis*-larva *Actinotrocha* with *Cyphonautes*, affords even stronger grounds than those furnished by the structure of *Phoronis* itself, for suspecting that the Gephyrea and the Polyzoa are more intimately connected than has been supposed to be the case.

It will be observed that the Scolecimorpha present a series of modifications from the unsegmented Turbellaria and Nematoidea, through the imperfectly segmented Rotifera, to the polymerous Oligochæta and Hirudinea, and that the segmentation primarily occurs in the mesoblast.

2. The *Deuterostomata.*—In the remaining Gastreæ the embryo develops a secondary mouth as a perforation of the body-wall, the primary aperture sometimes becoming the anus and sometimes disappearing.

The *Schizocœla.*—Of these Metazoa Deuterostomata there are some which follow the mode of development of the Oligochæta and Hirudinea very closely, so far as the formation and segmentation of the mesoblast is concerned; though the question whether this segmented mesoblast arises from the epiblast or the hypoblast, has not been exhaustively worked out. These are the Annelida Polychæta.

It is a very general, if not universal, rule among these animals, that the *Gastrula* is formed by invagination, and that the aperture of invagination persists as the anus of the adult. Almost universally, again, the outer surface of the *Gastrula* is provided with cilia, by the working of which it is actively propelled through the water in which it lives; and these cilia usually become restricted to certain areas of the body, in the form of zones transverse to its long diameter. In this respect the larvæ of some Gephyrea present similar features. Moreover setæ, developed in involutions of the ectoderm, are very generally present, especially on the limbs, when such exist. Some are apodal; some possess symmetrically disposed setæ in each segment of the body; and in many, true though rudimentary limbs (*parapodia*), one pair for each segment of the body, occur. In a few of the highest forms (e. g. *Polynoë*) some of the anterior limbs are turned forwards, and lie at the sides of the mouth, foreshadowing the jaws of the Arthropoda. In some, a process of the ectoderm, in the region of the head, gives rise to a cephalic hood or mantle. A perivisceral cavity occupies the space between the wall of the body and that of the alimentary canal, and, so far as is known, is invariably formed in the substance of the mesoblast, by a sort of splitting or divarication of its constituent cells, whence it would seem to be a rehabilitation of the primitive blastocœle. The great majority of the *Polychæta* possess the so-called "segmental organs"—variously formed tubes, which open on the surface of the body, on the one hand, and, usually, into the perivisceral cavity on the other. Not unfrequently these, or some of them, play the part of conduits of the generative products.

The lower Arthropoda closely resemble the Polychæta in their development, except that the food-yelk is usually large, the alimentary cavity is rarely formed by invagination, and cilia are never met with in any part of the body*. The mesoblast is developed and becomes segmented precisely in the same way. Limbs are formed and rarely remain rudimentary; usually they become jointed; and, in almost all cases, more or fewer of those which lie in the neighbourhood of the mouth are converted into jaws. The perivisceral cavity is formed in the same way as in the foregoing group; so that the Arthropoda, like the Polychæta, are "schizocœlous." In the higher Insecta, the embryogenetic process is complicated by the development of an amnion, which singularly resembles that met with in the higher Vertebrata. Mr. Moseley's recently published careful examination of *Peripatus* tends to show that this animal, formerly regarded as an Annelid, is really a low and primitive form of Arthropod, and thus affords evidence of the highest significance as to the relations of the Annelida with the Arthropoda.

The true position of the Polyzoa is as yet, as I have already said, a matter of doubt; but the arguments of Morse, and still more the recent investigation of Kowalewsky into the development of the Brachiopoda, place the close affinity of the latter with the Annelida in a clear light. The free larva of *Argiope*, for example, is wonderfully similar to those of *Spio* and of *Spirorbis*; and the mantle of the Brachiopoda appears to correspond with the cephalic hood of these Annelids. When it first becomes fixed, on the other hand, the young Brachiopod has many resemblances to *Loxomma* and *Pedicellina* among the Polyzoa.

As regards the Mollusca proper†, the larvæ of the Lamellibranchiata, and of the majority of the Odontophora, have their parallel in the larva of the Annelidan *Phyllodoce*, while the young of *Dentalium* and of the Pteropods correspond with the larvæ of other Annelids. A Mollusk appears to me to be essentially an Annelid which is only dimerous, or trimerous, instead of polymerous.

The development of the perivisceral cavity in the Molluscan series stands much in need of elucidation. There seems to be little reason to doubt that the higher Mollusks are Schizocœlous;

* The like absence of cilia is a notable peculiarity of *Hirudo*, among the Leeches.

† See Mr. Lankester's valuable paper "On the Development of *Lymnæus*," Quarterly Journal of Microscopical Science.

but it is possible that the lower forms are Enterocœlous, like the members of the next division*.

The *Enterocœla.*—Kowalewsky has shown that in the Chætognatha, represented by the strange and apparently anomalous *Sagitta*, the vitellus undergoes complete segmentation, and is converted into a vesicular *Morula*, on one side of which invagination takes place, and gives rise to the primitive alimentary canal, of which the opening of invagination becomes the permanent anus, the mouth being formed, by perforation, at the opposite end of the body. Before the mouth is formed, however, the primitive alimentary cavity throws out, on each side, a cæcal pouch, which extend as far forward as its central continuation; while posteriorly these pouches stretch behind the anus, meeting, but remaining separated by their applied walls, in the median plane of the body. These lateral sacs are next shut off from the median portion of the primitive alimentary cavity, which becomes the permanent alimentary canal; and they are converted into closed sacs, the cavity of each of which forms one half of the perivisceral cavity, while the inner wall, applied to the hypoblast, gives rise to the muscular wall of the intestine, and the outer wall, applied to the epiblast, becomes the muscular wall of the body, and gives rise to the generative organs. The great ganglia and nerves are developed from the cells of the epiblast. We have thus an animal which is temporarily cœlenterate, but in which the two gastrovascular sacs, enclosing what may be termed an "enterocœle," become shut off and metamorphosed into parts of exactly the same order as those which arise from the mesoblast of an Annelid. But it is not altogether clear whether the cells of the enterocœle in this case give rise only to the lining of the perivisceral cavity, and whether the muscles and connective tissue are in fact derived from the

* When I wrote this paragraph, I had been for some time in possession of the recent important memoir on the development of the Brachiopoda by M. Kowalewsky, as that distinguished embryologist had been good enough to send it to me. But it is written in Russian, and I could only judge from the figures that the perivisceral cavity of *Argiope* is developed in the same way as that of *Sagitta*. Some little time ago, however, my friend Mr. W. F. Ralston kindly took the trouble to translate so much of the text as referred to these figures for me, and I found that my interpretation of them was correct. The Brachiopoda, or some of them, therefore, are Enterocœla; and their relations with the schizocœle Annelida and Mollusca bring up anew the question suggested by the frequent origin of the mesoblast from the hypoblast (as in the Sharks for example), May not the schizocœle be derivable from a primitive enterocœle condition?

epiblast or not. Kowalewsky's evidence, however, is in favour of the origin of the muscles directly from the cells of the mesoblastic diverticula.

The brilliant investigations of Johannes Müller upon the development of the Echinodermata, confirmed in their general features by all subsequent observers, have proved, first, that the ciliated embryonic *Gastræa* (the primitive alimentary canal of which is formed by involution of a vesicular blastoderm), to which the egg of all ordinary Echinoderms gives rise, acquires a mouth by the formation of an aperture in the body-wall distinct from the primitive aperture of the *Gastræa*, so that, in this respect, it differs from all Cœlenterata; secondly, that the embryo thus provided with mouth, stomach, intestine, and anus acquires a completely bilateral symmetry; thirdly, that the cilia with which it is primitively covered become restricted to one or more circlets, some of which encircle the axis of the body, or a line drawn from the oral to the anal apertures; and, fourthly, that within this bilaterally symmetrical larva or *Echinopædium*, as it may be called, the more or less completely radiate Echinoderm is developed by a process of internal modification.

Müller believed that the first step in this process was the ingrowth of a diverticulum of the integument, as a hollow process, out of which the ambulacral vascular system of the Echinoderm took its rise. He did not attempt to explain the origin of the so-called blood-vascular system (or pseudhæmal vessels), nor of the perivisceral cavity. Müller's conclusions remained unchallenged until 1864, when Prof. Alexander Agassiz took up the question afresh, and, in a remarkable paper on the development of the genus *Asteracanthion*, detailed the observations which led him to believe that the ambulacral vessels do not arise by involution of the external integument, but that they commence as two primitively symmetrical diverticula of the stomach (the "würstformige Körper" of Müller), one of which becomes connected with the exterior by an opening (the "dorsal pore" observed by Müller, and considered by him to be the origin of the ambulacral vessels), and gives rise to the ambulacral vessels, the ambulacral region of the body of the Echinoderm being modelled upon it; while, upon the other gastric sac, the antambulacral wall of the starfish-body is similarly modelled. Both gastric sacs early become completely separated from the stomach of the *Echinopædium*, and open into one another, so as to form a single horseshoe-shaped sac connected with the exterior by a tube which is converted into the madreporic canal. Agassiz does not explain the mode of formation of the perivisceral cavity of the starfish, and has nothing to say concerning the origin of the pseudhæmal vessels.

Recently Metschnikoff has confirmed the observations of Agassiz, so far as the development of the ambulacral system from one of the diverticula of the alimentary canal of the starfish larva is concerned; and he has added the important discovery that the perivisceral cavity of the Echinoderm is the product of the rest of these diverticula. Moreover his observations on other Echinodermata show that essentially the same process of development of the peritoneal cavity occurs in Ophiuridea, Echinidea, and Holothuridea.

The precise mode of origin of the pseudhæmal system, or so-called blood-vessels, of the Echinoderms is not yet made out. But it is known that the cavity of these vessels contains corpuscles similar to those which are found in the perivisceral cavity and in the ambulacral vessels, and that all of these communicate together.

Agassiz and Metschnikoff alike, justly insist upon the correspondence in development of the lateral gastric diverticula of the *Echinopædium* with that of the trunks of the gastrovascular system of the Ctenophora; and, on the ground of this resemblance, the former refers the Echinoderms to the Radiata, retaining under that Cuvierian denomination the Acalephæ (Cœlenterata) and the Echinodermata. But this arrangement surely ignores the great value of his own discovery, which shows that the Echinoderms have made a great and remarkable progress in passing from their primarily cœlenterate stage of organization to their adult condition. And it further ignores the unquestionable fact, admirably brought out by the same able naturalist's investigations into the development of *Balanoglossus*, that the *Echinopædium* is almost identical in structure with the young of animals, such as the Gephyrea and Enteropneusta, which are in no sense radiate, but are eminently bilaterally symmetrical. In fact, the larva of *Balanoglossus*, the sole representative of the Enteropneusta, was originally described by Müller under the name of *Tornaria*, as an Echinoderm larva, and was subsequently more fully examined by Prof. Alex. Agassiz, who also regarded it as an unquestionable Echinoderm larva; and it is only recently that it has been proved, partly by Metschnikoff and partly by Agassiz himself, to be the larval form of *Balanoglossus*. In *Balanoglossus*, as in the Echinoderms, saccular diverticula of the intestine appear to give rise to the perivisceral cavity and its walls. In the Chætognatha, Echinodermata, and Enteropneusta, therefore, the perivisceral cavity is a portion of the alimentary cavity shut off from the rest; and in contradistinction to the Schizocœla, in which the perivisceral cavity is produced by a splitting of the mesoblast, they may be said to be Enterocœla.

The *Epicœla*.—In the Ascidians, the investigations of Kowalewsky, now confirmed in all essential points by Kupffer, have shown that the alimentary cavity is formed by the invagination of the vesicular *Morula*, that the blood-channels answer to the blastocœle, that the central nervous system is produced by invagination of the epiblast, as in the Vertebrata, and that, in most, the mesoblast of a caudal prolongation gives rise to an axial column flanked by paired myotomes, which are comparable to the notochord and myotomes of the vertebrate embryo*.

In the simplest Ascidians (the *Appendicularia*) the modified pharynx, which constitutes the branchial sac, is perforated by only two apertures, which open on the hæmal or ventral face of the body, and there is no atrial chamber. But in all other Ascidians an invagination of the epiblast takes place on each side of the anus, and, extending alongside the branchial sac nearly as far as the endostyle, give rise to a spacious chamber, lined by the so-called atrial or "third" tunic. In many Ascidians the chamber extends much further, so that even the alimentary canal and the generative organs are situated between the atrial tunic and the ectoderm. In this manner a kind of "perivisceral cavity" is formed, which is of a totally different nature from the "schizocœle" of the Annelid, and from the "enterocœle" of the Echinoderm, and which may be termed an epicœle.

The resemblance of the simplest of vertebrated animals, the Lancelet (*Amphioxus lanceolatus*), to the Tunicata was first indicated, though, it must be admitted, very vaguely, by Goodsir†.

* It is with great diffidence that I venture to express my dissent from the views of my venerated friend Von Baer, from whose works I first gathered sound principles of morphological science, and whose authority in such a matter as this has no equal; but I cannot think that the doubts he has expressed respecting the fundamental similarity between the Ascidians and the Vertebrata are warranted.

† "On the Anatomy of *Amphioxus lanceolatus*." Read before the Royal

In 1852 I gave full reasons for believing that the branchial sac of the Ascidian "represents, not the gill of the Mollusk, but the perforated pharynx of *Amphioxus*" *; and I described the development of the muscles of the tail in the larval Ascidian as "closely resembling that of the muscles of the Tadpole;" but in the absence of any sufficiently detailed knowledge of the development of the embryo of either the Ascidian or of *Amphioxus*, it was impossible to know what weight ought to be attached to these resemblances; and it was not until the publication of the memoir of Kowalewsky on the development of *Amphioxus* that their real significance became manifest.

In this animal, in fact, yelk-division gives rise to a vesicular *Morula*, which becomes provided with an alimentary cavity by invagination, and with a cerebrospinal axis by the development of laminæ dorsales and the invagination of the corresponding portion of the epiblast, as in other Vertebrata.

The branchial clefts are secondary perforations of the body-wall and pharynx; and the protovertebræ and notochord are developed, as in Annelids and Arthropods, out of a mesoblastic layer situated between the epiblast and hypoblast, and therefore in the blastocœle. But one of the most important points made out by Kowalewsky is, that the branchial clefts at first open externally—and that they only acquire their anomalous position in the adult by the growth over them of two laminæ of the body-wall, which

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Society of Edinburgh, May 3rd, 1841, and published in vol. xv. of the 'Transactions' of that Society. "Viewed as an entire animal, the Lancelet is the most aberrant in the vertebrate subkingdom. It connects the Vertebrata, not only to the Annulose animals, but also, through the medium of certain symmetrical Ascidiæ (lately described by Mr. Forbes and myself), to the Molluscs. We have only to suppose the Lancelet to have been developed from the dorsal aspect, the seat of its respiration to be transferred from the intestinal tube to a corresponding portion of its skin, and ganglia to be developed at the points of junction of one or more of its anterior spinal nerves and inferior branch of its second pair, to have a true annulose animal, with its peculiar circulation, respiration, generative organs, and nervous system, with supra-œsophageal ganglia, and dorsal ganglionic recurrent nerve."

With every desire to give credit for sagacity where it is due, I think it is obvious from this passage, and from the fact that Goodsir denied the existence of the branchial clefts, or even of the abdominal pore, in *Amphioxus*, that he had no conception of its true morphological relations, and no valid grounds for the hint which he throws out.

* Report of the Belfast Meeting of the British Association, 1852. Transactions of the Sections, pp. 76, 77.

unite in the median ventral line for the greater part of their length, leaving only the abdominal pore open.

Although the structure of *Amphioxus* has been investigated by many able observers * during the last forty years, a reexamination of this singular animal, with which I first made acquaintance in 1846, has convinced me that some of its most remarkable morphological features have hitherto escaped notice; and I will take this occasion of laying a summary of the chief results at which I have arrived before the Linnean Society.

Amphioxus has hitherto been generally assumed to be a vertebrated animal, which differs from all others in possessing a mere rudiment of brain and of skull, and in being devoid of renal organs.

It is quite true that *Amphioxus* has neither brain nor skull, if we restrict the application of these terms to those particular forms under which the brain and skull are met with in the higher Vertebrata; but if we ask whether those regions of the cerebrospinal axis, and of the axial endoskeleton, which are metamorphosed into the brain and skull in the higher Vertebrata are, or are not, represented in *Amphioxus,* the answer must be, that these regions are not only present, but that, in relation to the size of the body, they are much longer than in any other Vertebrate, and that, in this respect, as in so many others, *Amphioxus* is the counterpart of the embryo of the higher Vertebrate.

The oral aperture of *Amphioxus* is surrounded by a series of tentacula; and the spacious buccal chamber is divided from the branchial one by a curiously arranged valvular "velum" (the "Franzen" of Müller). Close to the anterior end of the cerebrospinal axis is the ciliated olfactory sac discovered by Kölliker; and the pigment-spot, which represents the eye, coats the extremity of the same part of the cerobrospinal axis.

On comparing *Amphioxus* with the Lamprey, in its larval or *Ammocœtes* condition, the cerebrospinal axis of the latter is seen to be a mere rod, somewhat enlarged at its anterior end, where it bears a mass of pigment representing the eye, and connected, by a very short cord, with a single ciliated olfactory sac. The oral aperture of the *Ammocœtes* is also surrounded by tentacles; and, as in *Amphioxus,* leads into a wide buccal cavity, which is separated from the branchial sac by two remarkable folds, originally

* I need only mention the names of Retzius, Rathke, Müller, Goodsir, and Quatrefages. Within the last two years Stieda has published an elaborate paper on *Amphioxus* in the Transactions of the Academy of St. Petersburg.

described by Rathke, which answer to the velum of *Amphioxus*. But the dorsal ends of the attached edges of these folds are situated immediately under the middle of each auditory capsule; and, in the adult Lamprey, they can be proved to correspond with the position of the hyoidean arch. In the *Amphioxus* their dorsal attachment corresponds with the anterior angulation of the intermuscular septum between the sixth and seventh myotomes, counting from the anterior end of the body. Hence, it follows that this septum answers to the hyoidean arch of the higher Vertebrata, and that the six myotomes in front of it represent six primary segments of the body, or somatomes. But the first of these lies behind the eye, whence it also follows that the region occupied by these somatomes answers to the region included between the optic foramen and that for the seventh nerve in the skull of an ordinary vertebrated animal, and that so much of the head of *Amphioxus* as lies in front of the hyoid region answers to the præauditory moiety of the skull in other Vertebrata.

In *Amphioxus*, a nerve leaves the cerebrospinal axis in correspondence with the interval between each pair of myotomes, and then divides into a dorsal and a ventral branch, like an ordinary spinal nerve. And, in front of the first myotome, two nerves, or perhaps one nerve in two divisions, are given off. The more anterior of these two passes above the eye, and is distributed to the end of the body in front of the mouth, while the second and the other nerves pass to the side walls of the oral cavity.

These nerves, arising as they do between the homologue of the optic nerve and that of the *portio dura*, must represent the third, fourth, fifth, and sixth pairs of cranial nerves of the ordinary Vertebrata; while the myotomes between which five of them pass must represent the muscles of the nose, eye, and jaws. In fact, the course of the most anterior nerve is exactly that of the orbito-nasal nerve (the so-called ophthalmic, or first, division of the trigeminal), as is conspicuous when this nerve in *Amphioxus* is compared with the undoubted orbito-nasal of the Lamprey.

In the embryo Lamprey, at the most advanced stage described by Schulze, the portion of the centro-spinal axis which lies between the ear and the eye is relatively very long; but the cerebral hemispheres are beginning to grow out beyond the primitive anterior end of the cerebro-spinal axis, and project beyond the eye. In the young *Ammocœtes* of 1·5 inch long the length is still great, though it has not increased in proportion to the body; but the cerebral hemispheres are relatively larger, and the eyes are fully formed and have moved backwards, dividing the series of myotomes into a supraocular and a subocular bundle of muscles. And, in the adult Lamprey, changes in the same direction have gone still further.

It is clear, therefore, that the region occupied by the six most anterior myotomes of the body of *Amphioxus* answers to the præauditory region of the skull in the higher Vertebrata. The question next arises, How many of the succeeding myotomes are included in the region which corresponds with the postauditory or parachordal region of the skull in the higher Vertebrates?

The Lamprey has seven branchial sacs, with as many external clefts; and no Vertebrate ever possesses more. To each of these sacs nerves pass which undoubtedly correspond with the branchial branches of the glossopharyngeal and pneumogastric nerves; and strong grounds for thinking that the pneumogastric trunk contains the representatives of, at fewest, six primary distinct nerves, answering to the six posterior branchial sacs, have been given by by Gegenbaur and myself. If this be so, then the seven pairs of nerves behind the representative of the portio dura in *Amphioxus* will answer to the glossopharyngeal and pneumogastric, and the eighth somatome will correspond with the occipital segment of the Ichthyopsida. Thus the skull of a Lamprey or of an Elasmobranch fish is represented by the anterior region of the body of the *Amphioxus* as far back as the fourteenth myotome. As there are from sixty to seventy myotomes, this estimate makes the head of *Amphioxus* to occupy, morphologically, one fifth of the whole body.

With respect to the renal organs, Müller thought he had observed some rounded bodies which might have a renal character in the posterior part of the abdominal cavity of living specimens of *Amphioxus*; but as he could not find them by dissection, and as no other anatomist has been more successful, they need not now be discussed.

Rathke described two canals situated in the ridges which are developed at the junction of the ventral with the lateral faces of the body. He states that these canals open, behind, at the abdominal pore, and in front at the mouth. Müller and, more recently, Stieda confirm Rathke's account, which appeared to be strengthened by Kowalewsky's statement that he had seen the ova pass out by the mouth. Nevertheless there are no such canals. The ventro-lateral folds in question begin on each side of the front part of the mouth, and are continued along-side it, as Goodsir rightly states, becoming deeper as they pass back. At the sides of the abdominal pore, they terminate without uniting, one on each side of the præanal fin. In the living state, as well as in spirit specimens, these ventro-lateral laminæ are strongly curved inwards; and they meet, or nearly meet, in the middle line, more or less covering the proper ventral aspect of the body, between the mouth and the respiratory pore. And it is simply the semicanals enclosed by these infolded ventro-lateral laminæ which Rathke took for abdominal canals, open only in front and behind. The superficial layer of the integument, with its epiderm, is continued from the outer margin of each ventro-lateral lamina, over its edge, on to the inner surface of the lamina, and, in the normal state, is closely adherent to the greater part of that surface, becoming detached, to be reflected on to the proper ventral face of the body, only at the reentering angle between the ventro-lateral lamina and the ventral face. But, in spirit specimens, this superficial layer, which coats the inner face of the ventro-lateral lamina, sometimes becomes detached, along with more or less of its continuation on to the ventral surface of the body, and leaves a wide space, which is the abdominal canal described by Stieda, and erroneously supposed by him to be Rathke's canal. The floor of the respiratory chamber is formed by a layer of transversely disposed fibres, chiefly composed of muscular tissue and coated on the dorsal face by a layer of cells, forming part of the epithelium of the chamber. In the middle line these fibres are more or less interrupted by the raphe described by Stieda; the dorsal aspect of the floor is longitudinally grooved in correspondence with the raphe; and, not unfrequently, the epithelial cells dip down into this groove for a greater or less distance.

On the ventral face of the thick floor of the respiratory chamber the superficial layer of the integument is naturally separated by a narrow interspace from the transverse fibres of the floor, except in the middle line, where it is attached along a depression or groove corresponding with the raphe, like that of the dorsal aspect of the floor. This layer of integument is thrown into regular and close-set longitudinal plaits, which have been described as muscular fibres by Rathke, Müller, Goodsir, and Quatrefages. Stieda discovered the true nature of these longitudinal fibres; but his figures give no idea of the regularity of the plaits, or of the manner in which the cells of the epidermis line the sides of the folds, which in transverse sections, have the appearance of glandular cæca. It is this organ which I conceive to be the renal organ, functionally, and to represent the Wolffian ducts, morphologically. These ducts are now known to be formed in the higher Vertebrates by involutions of the lining of that part of the peritoneal cavity which lies external to the generative area. Taking the raphe in *Amphioxus* to represent the line of union of the lateral laminæ, the development of which into the walls of the "perivisceral" cavity has been observed by Kowalewsky, the space between each lateral half of the plaited integument and the ventro-lateral fold of its side, will answer to an involution of the epithelium of the somatopleure, such as that by which the Wolffian duct of osseous fishes * commences; and the position of the reproductive gland low down on the wall of the somatopleure is in accordance with this interpretation.

On this view, the wall of the respiratory chamber of *Amphioxus* is strictly comparable to the somatopleure of a higher Vertebrate embryo. On the other hand, the cells which line it and represent the peritoneal epithelium must, from the mode of formation of the cavity, occupy the place of the epiblast, and represent a continuation of the epidermis. Thus the respiratory chamber of the *Amphioxus* is an *epicœle*, a cavity of the same fundamental nature as the atrium of the Tunicata; and this circumstance constitutes another curious point of resemblance between the Tunicata and *Amphioxus*.

On the other hand, it is such a cavity as would be formed by the growth and extensive union in the middle line of the lateral prolongations of the wall of the body in *Balanoglossus*.

To what does the respiratory chamber of *Amphioxus* answer in the higher Vertebrata? In the manner of its formation it corresponds, as I have elsewhere † suggested, very closely with the respiratory chamber into which the gill-clefts open in the Tadpole, and which, in most Anura, communicate with the exterior by only a single external opening on the left side of the body, though there are two symmetrical apertures in the Tadpole of *Dactylethra*. But, in its relations to the alimentary canal, and to

* Rosenberg, "Untersuchungen über die Entwickelung der Teleostier-Niere," 1867.

† Manual of the Anatomy of Vertebrated Animals, p. 121.

the generative and urinary organs, it is obvious that it no less closely answers to the "pleuroperitoneal"* chamber of the higher Vertebrates. The opercular fold which constitutes the outer wall of the branchial chamber in the Tadpole is formed by an outgrowth of the body-wall, as Kowalewsky states the wall of the respiratory chamber in *Amphioxus* to be. On the other hand, in all the higher Vertebrata, the somatopleure which bounds the "pleuroperitoneal cavity" seems to be formed by a sort of splitting by the mesoblast, apparently very similar to the process which gives rise to the perivisceral cavity of Annelida and Arthropoda. And the discovery of the free communication of the great serous cavities with the lymphatic system, has removed the objection that might have been urged that the serous cavities of the Vertebrata are not parts of the vascular system.

But it has been seen that it is only by the most careful study of development that the "enterocœlous" "perivisceral cavity" of the Echinoderm has been shown to be morphologically distinct from the "schizocœlous" "perivisceral cavity" of an Annelid; and I think it probable that renewed investigation will prove that the "splitting of the mesoblast" in the Vertebrata represents the invagination of the epiblast in the Ascidian, and the formation of an epicœle by outgrowth of a ridge in *Amphioxus*. Provisionally, at any rate, this hypothesis may be adopted, and the Vertebrata in general, as well as *Amphioxus*, ranked among the Epicœla.

The discovery of the true head, brain, and renal organs of *Amphioxus* removes the chief supposed anomalies of the structure of this animal, and to so great an extent bridges over the supposed hiatus between it and the Marsipobranchii, with which the development of the latter shows it to be very closely related, that I see no reason for separating it from the class Pisces, in which, however, it may properly rank as the type of a distinct order, which may be termed *Entomocrania*, in contradistinction to the rest, in which, as in all the higher Vertebrates, the skull, even in the embryonic state, exhibits no indication of its primitive segmentation†, and which may be termed *Holocrania*.

* More accurately "pericardio-pleuroperitoneal" chamber, as the pericardium is only part of it, and, indeed, is only incompletely shut off in the Rays and Myxinoid fishes.

† See the proof of this position in my Croonian Lecture, 'Proceedings of the Royal Society,' 1858.

The eye-spots of *Amphioxus* were single in all the specimens I have examined; in the very young *Ammocœtes*, described by Schulze, there are two such pigment-spots, separated by the very short representatives of the cerebral hemispheres and olfactory lobes. This suggests that the eye, like the nose, was primitively simple in the Vertebrata, and that it has become divided in the same way as the nose. In this case the involution of the epiblast, out of which the cornea and the crystalline lens are developed, should have been primitively a median sac; and it is a curious circumstance that, in the very young tadpole, Mr. W. K. Parker, F.R.S., has described and figured a transverse groove connecting the eye-sacs.

I am unable to find any thing in the structure or mode of development of the Marsipobranchii which gives this group more than an ordinal value in the class Pisces. Their great peculiarities are the structure of the skull, the presence of a naso-palatine passage which opens posteriorly in the Myxinoids, and the existence of a large superior median brain-lobe.

As respects the first point, the skull is strictly comparable with that of the embryo of any higher Vertebrate, being composed of a parachordal occipital portion, of largely developed trabeculæ, and of auditory capsules. In the Lampreys the cartilaginous hyoidean and mandibular arches are represented, and the curious facial cartilages appear to me to be reducible to the type of the labial cartilages of the Elasmobranchs. The development of the olfactory organ of the Lamprey proves that the single nasal sac of *Amphioxus* is the homologue of the nasal sac of the Marsipobranchii (at least of that part which is lined by the Schneiderian membrane), to which, however, two olfactory nerves, produced apparently by the division of a primitively simple and median nerve, proceed. The term "Monorhina," applied by Haeckel to the Marsipobranchii, therefore, is not strictly applicable, and I cannot attach any great taxonomic value to the structure of the olfactory organs in this group. The external duplication of the nasal apertures in the higher Vertebrata appears to me to be chiefly due to the fact that, in them, the cerebral hemispheres are thrown out in front of the anterior cerebral vesicle, the front wall of which (the *lamina terminalis* of the third ventricle of the fully developed brain) corresponds with the anterior end of the cerebro-spinal axis of *Amphioxus*, and attains a large size and considerable downward growth before the olfactory sacs are distinguishable. The regions whence the olfactory nerves will be developed are thus widely separated, and thrown to the ventral and lateral aspect of the head, before the Schneiderian membrane is differentiated. It must also be recollected that, when the naso-frontal process of the embryo appears, the olfactory sacs become connected with one another by a transverse groove, which is persistent in the Rays, and has the same relations as the middle of the olfactory sac of the Marsipobranchii would have if it were supposed to be transversely elongated.

Recent investigations lead me to think that the lower jaw is by no means wanting in the Marsipobranchii, though it presents a very curious modification. In the Ammocœte the hyoidean cleft, which has been overlooked, is present; and the manner in which the branchial filaments are developed leads me to believe that those which are first formed represent the external gills of the Elasmobranchii, Ganoidei, Dipnoi, and Amphibia.

I have formerly expressed the opinion that the naso-palatine canal of the Marsipobranchii represents the "primitive mouth" of the Vertebrata. The resemblance of the mouth of *Amphioxus* to that of an Ascidian renders this comparison questionable; but, on the other hand, it is a remarkable circumstance that the median nasal involution of *Amphioxus* corresponds very nearly, in its relation to the segmented mesoblast, with the oral aperture of an Arthropod or an Annelid; and it may be that the canal represents the ordinary invertebrate oral passage.

The dorso-median brain-lobe of the Marsipobranch appears to me to be represented in the higher Vertebrata by the peduncle of the pineal gland, which in the embryo is a hollow process of the roof of the anterior cerebral vesicle. It is particularly conspicuous in young Elasmobranchs.

In a few Metazoa, as in some small Rotifera and in the Gordiaceæ, the alimentary canal never becomes developed, although these animals clearly belong to groups in which the alimentary apparatus is normally formed, and may be safely regarded as modified Gastreæ. Whether the like is true of the Cestoidea, which are so closely allied with the Trematoda, and of the Acanthocephala, is not certain. Probable as it may be that these are Gastreæ with aborted digestive cavities, it may be well to bear in mind the possibility of their never having passed through the

Gastrula stage. It is conceivable that an opaliniform *Morula* should, under completely parasitic conditions of life, have developed the organization of a Cestoid worm. At any rate, the contrary must not be assumed without good evidence; and to indicate the doubt, it may be well to establish a provisional group of Agastreæ for these forms.

I subjoin a tabular arrangement of the animal kingdom according to the views expressed in this paper, remarking, in conclusion, that, in my belief, the progress of knowledge will eventually break down all sharp demarcations, and substitute series for divisions.

ANIMALIA.

I. *PROTOZOA.*

i. MONERA.

Protamœbidæ. Protomonadidæ. Myxastridæ. Foraminifera.

ii. ENDOPLASTICA.

Amœbidæ. Infusoria flagellata. Gregarinidæ. Acinetidæ.
Infusoria ciliata. Radiolaria.

II. *METAZOA.*

A. GASTREÆ.

i. POLYSTOMATA.

Porifera (or *Spongida*).

ii. MONOSTOMATA.

1. Archæostomata.

a. Scolecimorpha.

Rotifera. Turbellaria.
Trematoda.
Nematoidea. Hirudinea.
Oligochæta.

b. Cœlenterata.

Hydrozoa.
Actinozoa.
(*Ctenophora*).

2. Deuterostomata.

a. Schizocœla.

Annelida polychæta. *Gephyrea* (?).
Arthropoda.

b. Enterocœla.

Brachiopoda. *Enteropneusta,*
Polyzoa (?). *Chætognatha,*
Mollusca. *Echinodermata.*

c. Epicœla.

Tunicata or *Ascidioida.*
Vertebrata.

B. AGASTREÆ (provisionally).

Cestoidea. Acanthocephala.

Observations on Bees, Wasps, and Ants.—Part II. By Sir John Lubbock, Bart., F.R.S., M.P., F.L.S., Vice-Chancellor of the University of London.

[Read December 17th, 1874.]

In the Twelfth Volume of the Journal, the Society has done me the honour to publish some observations on Bees and Wasps, of which the present paper is a continuation.

Bees.

Following up the observations recorded in my previous paper, on the 19th July I put a bee (No. 10) to a honeycomb containing 12 lbs. of honey

at 12.30 ;	at 12.36 she went back to the hive ;
,, 12.50 she returned ;	,, 12.55 ,, ,,
,, 1. 6 ,,	,, 1.12 ,, ,,
,, 1.53 ,,	,, 1.57 ,, ,,
,, 2. 5 ,,	,, 2. 9 ,, ,,
,, 2.16 ,,	,, 2.20 ,, ,,
,, 2.28 ,,	,, 2.32 ? ,, ,,
,, 2.49 ,,	,, 2.55 ,, ,,
,, 3.13 ,,	,, 3.20 ,, ,,
,, 3.31 ,,	,, 3.39 ,, ,,
,, 3.45 ,,	,, 3.55 ,, ,,
,, 4. 2 ,,	,, 4. 8 ,, ,,
,, 4.18 ,,	,, 4.24 ,, ,,
,, 4.31 ,,	,, 4.37 ,, ,,
,, 8.47 ,,	,, 4.58 ,, ,,
,, 5.10 ,,	,, 5.19 ,, ,,
,, 5.27 ,,	,, 5.30 ,, ,,
,, 6. 9 ,,	,, 6.15 ,, ,,
,, 6.23 ,,	,, 6.29 ,, ,,
,, 7.19 ,,	,, 7.24 ,, ,,
,, 7.35 ,,	,, 7.40 ,, ,,
,, 7.50 ,,	,, 7.55 ,, ,,

and during all this time no other bee came to the comb.

On the following morning, July 20, this bee came to the honeycomb

at 6. 5 A.M. ;	at 6.10 she went back to the hive ;
,, 6.37 she returned ;	,, 6.42 ,, ,,
,, 7.17 ,,	,, 7.21 ,, ,,

at	7.41 she returned;		at	7.47 she went back to the hive;	
,,	8. 8	,,	,,	8.12	,, ,,
,,	8.21	,,	,,	8.25	,, ,,
,,	8.32	,,	,,	8.54	,, ,,
,,	9. 4	,,	,,	9. 9	,, ,,
,,	9.45	,,	,,	9.51	,, ,,
,,	10. 4	,,	,,	10.10	,, ,,
,,	10.19	,,	,,	10.26	,, ,,
,,	10.40	,,	,,	10.47	,, ,,
,,	10.59	,,	,,	11. 4	,, ,,
,,	11.14	,,	,,	11.19	,, ,,
,,	11.44	,,	,,	11.52	,, ,,
,,	11.59	,,	,,	12. 6	,, ,,
,,	12.15	,,	,,	12.23	,, ,,
,,	12.29	,,	,,	12.35	,, ,,
,,	12.41	,, was disturbed,	,,	12.52	,, ,,
,,	1. 2	,,	,,	1. 9	,, ,,
,,	1.16	,,	,,	1.30	,, ,,
,,	1.46	,,	,,	1.55	,, ,,

I then left off observing; but during the whole of this time no other bee had come to the comb.

Oct. 9. I took a bee (No. 11) out of the hive and put her to some honey; she returned and kept on visiting it regularly.

Oct. 10. This bee came to the honey at 7.30 A.M., and went on visiting it; but I was not able to watch her continuously. During these two days no other bee came to this honey.

Oct. 11. No. 11 came to the honey

at	7.12 A.M., but did not alight;				
,,	7.18 she returned, and at 7.21 went back to the hive;				
,,	7.27	,,	,,	7.31	,,
,,	7.38	,,	,,	7.44	,,
,,	7.51	,,	,,	7.56	,,
,,	8. 2	,,	,,	8. 8	,,
,,	8.15	,,	,,	8.22	,,
,,	3.30	,,	,,	8.35	,,
,,	8.41	,,	,,	8.46	,,
,,	8.55	,,	,,	8.59	,,
,,	9. 6	,,	,,	9.11	,,
,,	9.20	,,	,,	9.25	,,
,,	9.45	,,	,,	9.50	,,

Oct. 11. No. 11 (*continued*).

at 9.55 she returned,	and at	10. 1	went back to the hive;
„ 10. 7 „	„	10.11	„
„ 10.19 „	„	10.23	„

„ 10.30 a strange bee came; I killed her.

At 10.35 No. 11 returned,	and at	10.40	went back to the hive;
„ 10.55 „	„	10.59	„
„ 11. 4 „	„	11. 8	„
„ 11.26 „	„	11.30	„
„ 11.35 „	„	11.38	„

Another strange bee came; I killed her also.

At 11.52 she returned,	and at	11.55	went;
„ 12. 7 „	„	12.12	„
„ 12.17 „	„	12.22	„
„ 12.31 „	„	12.36	„
„ 12.58 „	„	1. 2	„
„ 1. 8 „	„	1.12	„
„ 1.19 „	„	1.23	„
1.30 „	„	1.34	„
1.45 „	„	1.48	„
2. 2 „	„	2. 6	„
„ 2.15 „	„	2.18	„
„ 2.29 „	„	2.35	„
„ 2.45 „	„	2.47	„
„ 2.50 „	„	2.52	„
„ 2.57 „	„	3	„

after which she did not come any more that day. It was, however, a bad day, and after 1 o'clock she was almost the only bee which came out of the hive. The following morning she came to the honey at 7.58 A.M., but did not alight, behaving just as she had done the day before.

At 8. 6 A.M. No. 11 returned to the honey,	and at	8. 9	she went;
„ 8.14 „ „ „		8.20	„
„ 8.30 „ „ „		8.34	„
„ 8.42 „ „ „		8.46	„
„ 8.54 „ „ „		8.59	„
„ 9. 9 „ „ „		9.14	„
„ 9.19 „ „ „		9.24	„
„ 9.29 „ „ „		9.33	„
„ 9.37 „ „ „		9.44	„
„ 9.54 „ „		but was disturbed.	

A strange bee came, which I killed. At 9.59 No. 11 went away;

at 10. 5	she returned	to the honey,	„ 10. 8	„
„ 10.12	„	„	„ 10.13	„
„ 10.16	„	„	„ 10.20	„
„ 10.26	„	„	„ 10.28	„
„ 10.33	„	„	„ 10.36	„
„ 10.40	„	„	„ 10.46	„

„ 10.55 a strange bee came which I killed. No. 11 returned to the honey regularly; and went on coming.

Oct. 13. 6.28 A.M. she came, but, as before, flew away again without alighting.

At 6.32	she came	to the honey,	at 6.36	she went away;
„ 6.42	„	„	„ 6.46	„
„ 6.51	„	„	„ 6.56	„
„ 7.10	„	„	„ 7.14	„
„ 7.26	„	„	„ 7.34	„
„ 7.46	„	„	„ 7.50	„
„ 7.55	„	„	„ 8.	„
„ 8.12	„	„	„ 8.15	„
„ 8.20	„	„	„ 8.26	„
„ 8.30	„	„	„ 8.33	„
„ 8.37	„	„	„ 8.44	„
„ 8.50	„	„	„ 8.56	„

and so on.

Oct. 14. She came for the first time at 8.15 A.M., and went on visiting the honey at the usual intervals. After this day I saw her no more; she had probably met with some accident. But these facts show that some bees, at any rate, do not communicate with their sisters, even if they find an untenanted comb full of honey, which to them would be a perfect Eldorado. This is the more remarkable because these bees began to work in the morning before the rest, and continued to do so even in weather which drove all the others into the shelter of the hive. That the few strange bees which I have recorded should have found the honey is natural enough, because there were a good many bees about in the room.

The following fact is mentioned by F. Müller as seeming also to show a limited power of communicating facts on the part of bees:—"Once," he says*, "I assisted at a curious contest, which took place between the queen and the worker bees in one of my hives,

* 'Nature,' June 11, 1874.

and which throws some light on the intellectual faculties of these animals. A set of forty-seven cells had been filled, eight on a nearly completed comb, thirty-five on the following, and four around the first cell of a new comb. When the queen had laid eggs in all the cells of the two older combs she went several times round their circumference (as she always does, in order to ascertain whether she has not forgotten any cell), and then prepared to retreat into the lower part of the breeding-room. But as she had overlooked the four cells of the new comb, the workers ran impatiently from this part to the queen, pushing her, in an odd manner, with their heads, as they did also other workers they met with. In consequence the queen began again to go around on the two older combs; but as she did not find any cell wanting an egg she tried to descend, but everywhere she was pushed back by the workers. This contest lasted for a rather long while, till the queen escaped without having completed her work. Thus the workers knew how to advise the queen that something was as yet to be done, but they knew not how to show her *where* it had to be done."

I have already mentioned with reference to the attachment which bees have been said to show for one another, that though I have repeatedly seen them lick a bee which had smeared herself in honey, I never observed them show the slightest attention to any of their comrades who had been drowned in water. Far, indeed, from having been able to discover any evidence of affection among them, they appear to be thoroughly callous and utterly indifferent to one another. As already mentioned, it was necessary for me occasionally to kill a bee; but I never found that the others took the slightest notice. Thus on the 11th of October I crushed a bee close to one which was feeding—in fact, so close that their wings touched; yet the survivor took no notice whatever of the death of her sister, but went on feeding with every appearance of composure and enjoyment, just as if nothing had happened. When the pressure was removed, she remained by the side of the corpse without the slightest appearance of apprehension, sorrow, or recognition. It was, of course, impossible for her to understand my reason for killing her companion; yet neither did she feel the slightest emotion at her sister's death, nor did she show any alarm lest the same fate should befall her also. In a second case exactly the same occurred. Again, I have several times, while a bee has been feeding, held a second bee by the leg close to her; the prisoner, of course, struggled to escape and buzzed as loudly as she could; yet the selfish (?) eater took no notice whatever. So far, therefore, from being at all affectionate, I doubt whether bees are in the least fond of one another.

Their devotion to their queen is generally quoted as a most characteristic trait; yet it is of the most limited character. For instance, I was anxious to change my black queen for a Ligurian; and accordingly on the 26th of October Mr. Hunter was good enough to bring me a Ligurian queen. We removed the old queen, and we placed her with some workers in a box containing some comb. I was obliged to leave home on the following day; but when I returned on the 30th I found that all the bees had deserted the poor queen, who seemed weak, helpless, and miserable. On the 31st the bees were coming to some honey at one of my windows, and I placed this poor queen close to them. In alighting, several of them even touched her; yet not one of her subjects took the slightest notice of her. The same queen, when afterwards placed in the hive, immediately attracted a number of bees.

Although the experiments on colour which I have already recorded seem to me tolerably conclusive, still I thought it would be worth while to make a few more. Accordingly, on the 12th July I brought a bee to some honey which I placed on blue paper, and about 3 feet off I placed a similar quantity of honey on orange paper. After she had returned twice, I transposed the papers; but she returned to the honey on the blue paper. After she had made three more visits, always to the blue paper, I transposed them again, and she again followed the colour, though the honey was left in the same place. The following day I was not able to watch her; but on the 14th, at

7.29 A.M.	she returned to the honey on the blue paper.	7.31 left.
7.44	„	7.47 „
7.56	„ „	

I then again transposed the papers. At 8.5 she returned to the old place, and was just going to alight; but observing the change of colour, without a moment's hesitation, darted off to the blue. No one who saw her at that moment could have entertained any further doubt about her perceiving the difference between the two colours. At 8.9 she went;

8.13	she returned to the blue.	8.16 went.
8.20	„ „	8.23 „
8.26	„ „	8.30 „

Transposed the colours again.

At 8.35 she returned to the blue, and at 8.39 went;

8.44	„	„	8.47 „
8.50	„	„	8.53 „

Transposed the colours again.

8.57	she returned again to the blue.		9 „
9. 4	„	„	9. 7 „
9.12	„	„	9.15 „
9.19	„	„	9.22 „
9.25	„	„	8.27 „
9.30	„	„	9.34 „
9.40	„	„	9.44 „
9.50	„	„	9.55 „

Transposed the colours again.

10. 2	she returned again to the blue.		10. 6 „
10.10	„	„	10.14 „
10.20	„	„	10.25 „
10.30	„	„	10.34 „
10.40	„	„	10.44 „
10.48	„	„	10.51 „
11.12	„	„	11.14 „
11.21	„	„	and flew about, having been disturbed.
11.26	„	„	11.28 went.
11.36	„	„	11.40 „
12. 5	came and flew about, but did not settle till		
12.17.			12.17 went;
12.21	came and flew about.		

Though it was a beautiful afternoon, she did not return any more that day.

That bees can distinguish scents is certain. On the 5th Oct. I put a few drops of Eau de Cologne in the entrance, and immediately a number (about fifteen) of bees came out to see what was the matter. Rose-water also had the same effect; and, as will be mentioned presently, in this manner I called the bees out several times; but after a few days they took hardly any notice of the scent. For instance, on the 17th Oct. I tried them with twenty drops of Eau de Cologne, the same quantity of essence of violet, of lavender-water, of essence of musk, of essence of Patchouli, and of spirits of wine; but they took no apparent notice of any of them.

I have also made some observations with the view of ascertaining whether the same bees act as sentinels. With this object, on the 5th of October, I called out the bees by placing some eau de Cologne in the entrance, and marked the first three bees that came out. At 5 P.M. I called them out again; about twenty came, including the three marked ones. I marked three more.

Oct. 6. Called them out again. Out of the first twelve five were marked ones. I marked three more.

Oct. 7. Called them out at 7.30 A.M. as before. Out of the first nine, seven were marked ones.

At 5.30 P.M. called them out again. Out of six, five were marked ones.

Oct. 8. Called them out at 7.15. Six came out, all marked ones.

Oct. 9. Called them out at 6.40. Out of the first ten, eight were marked ones.

„ „ „ 11.30 A.M. Out of six, three were marked. I marked the other three.

„ „ „ 1.30 P.M. Out of ten, six were marked.

„ „ „ 4.30. Out of ten, seven were marked.

Oct. 10. „ „ 6.5 A.M. Out of six, five were marked.

„ Shortly afterwards I did the same again, when out of eleven, seven were marked ones.

„ 5.30, P.M. Called them out again. Out of seven, five were marked.

Oct. 11. 6.30 A.M. Called them out again. Out of nine, seven were marked.

„ 5 P.M. „ Out of seven, five were marked.

After this day they took hardly any notice of the scents.

Thus in these nine experiments, out of the ninety-seven bees which came out first, no less than seventy-one were marked ones, though out of the whole number of bees in the hive there were only twelve marked for this purpose, and, indeed, even fewer in the earlier experiments. I ought, however, to add that I generally fed the bees when I called them out.

It is sometimes said that the bees of one hive all know one another, and immediately recognize and attack any intruder from another hive. At first sight this certainly implies a great deal of intelligence. It is, however, possible that the bees of particular hives have a particular smell. Thus Langstroth, in his interesting 'Treatise on the Honey Bee,' says :—"Members of different colonies appear to recognize their hive companions by the sense of smell;" and I believe that if colonies are sprinkled with scented syrup, they may generally be safely mixed. Moreover, a bee returning to its own hive with a load of treasure is a very different creature from a hungry marauder; and it is said that a bee, if laden with honey, is allowed to enter any hive with impunity. Mr. Langstroth continues, "There is an air of roguery about a thieving bee which, to the expert, is as characteristic as are the motions of a pickpocket to a skilful policeman. Its sneaking look and nervous guilty agitation, once seen, can never be mistaken." It is at any rate natural that a bee which enters a wrong hive by accident should be much surprised and alarmed, and would thus probably betray herself.

On the whole, then, I do not attach much importance to their recognition of one another as an indication of intelligence.

I had made some observations also with the view of ascertaining whether the bees which collect honey also work in the hive and attend to the brood, or whether they devote themselves exclusively to one or other of these duties. My observations, however, were not conclusive; but some light has been thrown on the subject by Dzierzon, from which it would appear that for the first fortnight of a bee's life she attends exclusively to indoor duties, and only afterwards takes to the collection of honey and pollen. Dzierzon's statements have been confirmed by Dr. Dönhoff. On the 18th April he introduced a Ligurian queen into a hive of black bees. The first Ligurian workers emerged on the 10th May, and made their first appearance outside the hive on the 17th; but not until the 25th did any of the Ligurian workers appear on his feeding-troughs, which were constantly crowded with common bees, nor were any seen to visit the flowers. Repeated observations, says Dr. Donhoff, "force me to conclude that during the first two weeks of the worker-bee's life the impulse for gathering honey and pollen does not exist, or at least is not developed, and that the development of this impulse proceeds slowly and gradually. At first the young bee will not even touch the honey presented to her; some days later she will simply taste it; and only after a lapse of time will she consume it eagerly. Two weeks elapse before she readily eats honey; and nearly three weeks pass before the *gathering*-impulse is sufficiently developed to impel her to fly abroad and seek for honey and pollen among the flowers"*.

In my first memoir I alluded to the difficulty which bees experience in finding their way about. In this respect they certainly differ considerably. Some of the bees which came out through the little postern door (already described) were able to find their way back after it had been shown to them a few times. Others were much more stupid; thus, one bee came out on the 9th, 11th, 12th, 14th, 15th, 16th, 17th, 18th, and 19th, and came to the honey; but though I repeatedly put her back through the postern, she was never able to find her way for herself.

I often found that if bees which were brought to honey did not return at once, still they would do so a day or two afterwards. For instance, on July 11, 1874, a hot thundery day, and when the bees were much out of humour, I brought twelve bees to some honey; only one came back, and that one only once; but on the following day several of them returned.

My bees sometimes ceased work at times when I could not account for their doing so. Oct. 19 was a beautiful, sunshiny, warm day. All the morning the bees were fully active. At 11.25 I brought one to the honey-comb, and she returned at the usual intervals for a couple of hours; but after that she came no more, nor were there any other bees at work. Yet the weather was lovely, and the hive is so placed as to catch the afternoon sun.

I have made a few observations to ascertain, if possible, whether the bees generally go to the same part of the hive. Thus,

Oct. 5. I took a bee out of the hive, fed her and marked her. She went back to the same part.

Oct. 9. At 7.15 I took out two bees, fed and marked them. They returned; but I could not see them in the same part of the hive. One, however, I found not far off.

At 9.30 brought out four bees, fed and marked them. One returned to the same part of the hive. I lost sight of the others.

Since their extreme eagerness for honey may be attributed rather to their anxiety for the commonweal than to their desire for personal gratification, it cannot fairly be imputed as greediness; still the following scene, one which most of us have witnessed, is incompatible surely with much intelligence. "The sad

* 'Hive- and Honey-Bee,' Langstroth, p. 195.

fate of their unfortunate companions does not in the least deter others who approach the tempting lure from madly alighting on the bodies of the dying and the dead, to share the same miserable end. No one can understand the extent of their infatuation until he has seen a confectioner's shop assailed by myriads of hungry bees. I have seen thousands strained out from the syrup in which they had perished; thousands more alighting even upon the boiling sweets; the floor covered and windows darkened with bees, some crawling, others flying, and others still, so completely besmeared as to be able neither to crawl nor fly—not one in ten able to carry home its ill-gotten spoils, and yet the air filled with new hosts of thoughtless comers"*.

If, however, bees are to be credited with any moral feelings at all, I fear the experience of all bee-keepers shows that they have no conscientious scruples about robbing their weaker brethren. "If the bees of a strong stock," says Langstroth, "once get a taste of forbidden sweets, they will seldom stop until they have tested the strength of every hive." And, again, "Some bee-keepers question whether a bee that once learns to steal ever returns to honest courses." Siebold has mentioned similar facts in the case of wasps (*Polistes*).

Wasps.

Sept. 13. At 6 A.M. I put a wasp to some honey on green paper, and about a foot off I put some more honey on orange paper. The wasp kept returning to the honey at the usual intervals. At 8.30 I transposed the papers; but the wasp followed the colour. At 9 o'clock I transposed the papers again, but not the honey; she returned again to the green, from which it would appear that she was following the colour, not the honey. At 10.20 I again transposed them, with the same result.

Ants.

M. Forel, in his excellent work 'Les Fourmis de la Suisse.' asserts that Ants, when they first quit the pupal state, like the bees, devote themselves to household duties and the care of the young, not taking any part in the defence of the nest until a later period of life. He has repeated many of Huber's experiments. As regards the memory of ants, he convinced himself that they recognized their companions after a separation of

* 'Hive- and Honey-Bee,' Langstroth, page 277.

four months; but he believes they would not do so for more than one season. In my previous memoir I have described the behaviour of ants to companions from whom they had been separated for several months, and mentioned that I could not satisfy myself as to the lively manifestations of joy and satisfaction described by Huber as being shown under such circumstances. M. Forel, in the above-mentioned work, expresses his opinion that the signs which Huber regarded as marks of affection, were in reality signs of distrust and fear, which, however, were soon removed.

Ants of different nests are generally enemies; but M. Forel assures us (p. 262) that when they first quit the pupa-stage, ants do not distinguish friends from foes, though three or four days are sufficient to enable them to do so. It is to be regretted that he does not give the facts on which this interesting statement is based.

The behaviour of ants to one another differs very much according as they are alone or supported by numerous companions. An ant which would run away in the first case, will fight bravely in the second (p. 249).

MM. Forel and Ebrard both assert that if an ant is a little ill or slightly wounded, she is carefully tended by her companions; while, on the other hand, those which are dangerously ill or wounded are carried out of the nest to die. I have not met with any cases of this kind.

Again, some days I found no ants about on my window-sill as usual, although there seemed nothing in the weather to account for it.

I quote the following in order to show the steadiness with which ants work.

July 13. At 6.20 A.M. I put an ant to some honey; at 6.40 she went, 7.2 she returned, and at 7.8 went away again, but not to the nest; at 7.11 she returned, and at 7.15 went away again.

At	7.27 she came back.	7.40 went.
	7.49 „	8. 5 „
	8.14 „	8.19 „
	8.31 „	8.39 „
	8.43 „	8.47 „
	8.55 „	9 „
	9. 8 „	9.10 „
	9.17 „	9.26 „

At 9.34 she came back, and		at 9.40 went;	
9.49	"	10	"
10.11	"	10.20	"
10.27	"	10.36	"
10.44	"	10.52	"
12.52	"	12.54	"
1. 3	"	1.20	"
1.30	"	1.41	"
1.51	"	2. 6	"

after which I was unable to go on watching.

Another ant the same morning

came to the honey at	6.55 A.M.,	at	7. 4	went away.
Returned at	7.10	"	7.14	"
"	7.34	"	7.36	"
"	7.45	"	7.50	"
"	8. 2	"	8. 7	"
"	8.17	"	8.22	"
"	8.31	"	8.36	"
"	8.44	"	8.58	"
"	8.59	"	9	"

after which she came back no more. During this time fifteen others had come to the honey.

That ants have a certain power of communication has been proved by Huber and other observers. Several striking cases are mentioned by M. Forel. For instance (*op. cit.* p. 297), an army of Amazon ants, on an expedition in search of slaves, attacked a nest of *Formica rufibarbis*. In a few seconds (quelques secondes) the dome of the nest was covered with *F. rufibarbis*, which rushed out to defend their house.

On another occasion he placed a number of *Tetramorium cæspitum* about four inches from a colony of *Pheidole pallidula*. "En un clin d'œil," he says (p. 384), "l'alarme fut repandue, et des centaines de Pheidole se jetèrent au devant de l'ennemi."

Again, he (p. 349) placed some earth containing a number of *Tetramorium* about four inches from a nest of *Strongylognathus Huberi*. Several combats took place; but after the lapse of a few minutes (quelques minutes) a whole army of *S. Huberi* emerged and attacked the intruders.

On another occasion, some Amazon ants (p. 301) were searching in vain for a nest of *Formica rufibarbis*. After a while some of them found the nest. "Immediately" (aussitôt), he says, "a signal was given, the Amazons rushed in the right direction and pillaged the nest in spite of its inhabitants." This is a surprising statement. If it is to be taken literally, the communication cannot have been made by the antennæ; the signal can hardly have been a visible one; are we then to imagine a sound or smell to have been made use of which our auditory and olfactory nerves are incapable of perceiving? or have ants some sense which we do not possess?

It would even appear, from M. Forel's statements, that in some cases one species comprehends the signs of another. This is, of course, the case when different species live in association; but I am now speaking of hostile species. *Formica sanguinea*, he assures us, understand the signals of *F. pratensis*. "Elles savent," he says (p. 359), "toujours saisir l'instant où les *pratensis* se communiquent le signal de la déroute, et elles savent s'apprendre cette découverte les unes aux autres avec une rapidité incroyable. Au moment même où l'on voit les *pratensis* se jeter les unes contre les autres en se frappant de quelques coups rapides, puis cesser toute résistance et s'enfuir en masse, on voit aussi les *sanguinea* se jeter tout-à-coup au milieu d'elles sans la plus petite retenue, mordant à droite et à gauche comme des *Polyergus*, et arrachant les cocons de toutes les *pratensis* qui en portent."

He is of opinion (p. 364) that the different species differ much in their power of communicating with one another. Thus, though *Polyergus rufescens* is smaller than *F. sanguinea*, it is generally victorious, because the ants of this species understand one another more quickly than those of *F. sanguinea*.

It appeared to me that the following experiment might throw some light on the power of communication possessed by ants, viz. to place several small quantities of honey in similar situations, then to bring an ant to one of them, and subsequently to register the number of ants visiting each of the parcels of honey, of course imprisoning for the time every ant which found her way to the honey except the first. If, then, many more came to the honey which had been shown to the first ant than to the other parcels, this would be in favour of their possessing the power of communicating facts to one another, though it might be said they came by scent. Accordingly on the 13th July, at 3 P.M., I took a piece of cork about 8 inches long and 4 inches wide, and stuck into it seventeen pins, on three of which I put pieces of card with a little honey. Up to 5.15 no ant had been up any of these pins. I then put an ant to the honey on one of the bits of card. She seemed to enjoy it, and fed for about five minutes, when she went away. At 5.30 she returned, but went up six pins which had no honey on them. I then put her on to the card. In the mean time twelve other ants have been up wrong pins and two up to the honey; these I imprisoned for the afternoon. At 5.46 my ant went away. From that time to 6 o'clock seven ants came, but not the first. One of the seven went up a wrong pin, but seemed surprised, came down and immediately went up the right one. The other six went straight up the right pin to the honey. Up to 7 o'clock twelve more ants went up pins—eight right, and four wrong. At 7 two more went wrong. Then my first ant returned, bringing three friends with her; and they all went straight to the honey. At 7.11 she went: on her way to the nest she met and spoke to two ants, both of which then came straight to the right pin and up it to the honey. Up to 7.20 seven more ants came and climbed up pins—six right, and one wrong. At 7.22 my first ant came back with five friends; at 7.30 she went away again, returning at 7.45 with no less than twenty companions. During this experiment I imprisoned every ant that found her way up to the honey. Thus, while there were seventeen pins, and consequently sixteen chances to one, yet between 5.45 and 7.45 twenty-seven ants came, not counting those which were brought by the original ant; and out of these twenty-seven, nineteen went up the right pin. Again, on the 15th July, at 2.30, I put out the same piece of cork with ten pins, each with a piece of card and one with honey. At 4.40 I put an ant to the honey; she fed comfortably, and went away at 4.44.

At 4.45 she returned, and at 5. 5 went away again.
„ 5.40 „ „ 5.55 „
„ 6.13 „ and again at 6.25 and 6.59.

There were a good many other ants about, which, up to this time, went up the pins indiscriminately.

At 7.15 an ant came and went up the right pin, and another at 7.18. At 7.26 the first ant came back with a friend, and both went up the right pin. At 7.28 another came straight to the honey.

At 7.30 one went up a wrong pin.
„ 7.31 one came to the right pin.
„ 7.36 „ „ with the first ant.

At 7.39 one came to the right pin.
„ 7.40 „ „
„ 7.41 „ „
„ 7.43 „ „
„ 7.45 „ „
„ 7.46 „ „
„ „ wrong
„ „ „
„ 7.47 two „ „
„ 7.48 one „ right
„ the first ant came back.
„ 7.49 another came to the right pin.
„ 7.50 „ „ wrong „
„ 7.51 „ „ right „
„ three „ wrong „
„ 7.52 one „ right „
„ 7.55 „ „ wrong „
„ „ „ right „
„ 7.57 „ „ wrong „
„ 7.58 „ „ right „
„ 7.59 „ „ wrong „

Thus after 7 o'clock twenty-nine ants came; and though there were ten pins, seventeen of them went straight to the right pin.

On the 16th July I did the same again. At 6.25 I put an ant to the honey; at 6.47 she went.

At 6.49 an ant came to the right pin.
„ 6.50 another „ „
„ 6.55 „ „ „
„ 6.56 „ „ wrong pin, and then to the right one.
„ 6.58 „ „ right pin.
„ 7 „ „ „
„ 7. 5 the first ant came back, and remained at the honey till 7.11.
„ another came to the right pin; but she was with the first.
„ 7. 6 another ant came to the right pin.
„ 7. 6 „ „
„ 7.12 „ „
„ 7.13 „ „

These two ants were met by the first one, which crossed antennæ with them, when they came straight to the honey.

At 7.14 another ant came straight to the honey.

At 7.21 the first ant returned; at 7.26 she left.
„ 7.24 another ant came, but went to a wrong pin, and then went on to the right one.
„ an ant came to wrong pin.
„ „ „ „
„ „ „ „
„ 7.34 „ „ „
„ 7.35 „ „ „
„ 7.38 the first came back, at 7.45 went away again.
„ 7.42 an ant went to a wrong pin.
„ 7.47 „ „ „
„ 7.48 „ „ „
„ 7.49 „ „ „
„ 7.52 „ the right pin.
„ 7.55 the first ant returned, and at 7.56 went away again.
„ 7.57 an ant went to wrong pin.
„ 7.58 „ right „
„ 8 „ wrong „
„ „ right „
„ 8.1 „ wrong „

After this, for an hour no more ants came. On this occasion, therefore, while there were ten pins, out of thirty ants, sixteen came to the right one, while fourteen went to one or other of the nine wrong ones.

July 18. I put out the boards as before at 4 o'clock. Up to 4.25 no ant came. I then put one (No. 1) to the honey; she fed for a few minutes, and went away at 4.31.

At 4.35 she came back with four friends, and went nearly straight to the honey. At 4.42 she went away, but came back almost directly, fed, and went away again.

At 4.57 she returned, and at 5.8 went away again.
„ 4.45 an ant came to wrong pin.
„ 4.47 „ „
„ 4.49 „ „
„ 4.50 „ right pin.
„ 4.52 „ „
„ 4.55 „ wrong pin.
„ 4.56 „ right pin. This ant (No. 2) I allowed to return to the nest, which she did at 5.23.
„ 5. 6 „ right pin.

At 5.11 an ant came to wrong pin.
,, 5.12 ,, right pin.
I changed the pin.
,, 5.16 an ant came to the pin which I had put in the same place.
,, ,, right pin.
,, 5.19 ,, ,,
,, 5.20 two ants ,, with No. 2.
,, ant No. 1 ,, and went at 5.25.
,, 5.25 an ant ,, : this ant had been spoken to by No. 2.
,, 5.26 another ant ,,
,, 5.35 ,, ,,
,, 5.37 ,, ,,
,, 5.40 ,, ,,
,, 5.41 ant No. 1 ,, and went at 5.49.
,, 5.45 another ant ,,
,, 5.50 ,, ,,
,, 5.51 ant No. 1 came back, and 5.54 went.
,, 5.58 two ants came to the right pin.
,, 5.59 another ant ,, ,,
,, ,, ,, a wrong pin.
I changed the pin again.
,, 6.49 an ant came to the pin which I had put in the same place.
,, 7. 1 another ant came to the right pin.
,, 7.20 ,, ,,
,, 7.33 ,, ,,
,, 7.46 ant No. 1 returned, 7.55 went.

Thus during this time, from 4.50 until 7.50, twenty-nine ants came, twenty-six went to the right pin, while only three went up any of the nine wrong ones. Moreover, out of these twenty-six, only four were distinctly brought by the two ants which I had shown the honey.

On the 19th I tried a similar experiment. The marked ants frequently brought friends with them; but, without counting these, from 3.20 to 8 o'clock, out of forty-five ants, twenty-nine went up the right pin, while sixteen went up the nine wrong ones. Thus on

July 13, out of 27 ants, 19 went right and 8 wrong.
,, 15, ,, 29 ,, 17 ,, 12 ,,

July 16, out of 30 ants,	16 went right	and	14	wrong.
„ 18, „ 26 „	23	„	3	„
„ 19, „ 45 „	29	„	16	„

Or adding them all together, while there were ten pins at least, out of 156 ants 103 came up the right pin, and only 53 up the others.

It certainly appeared to me that some of the ants were much cleverer in finding their way to the honey than others; several ants which I put on honey came back to nearly the same place, and yet did not seem able to find the exact spot.

Again, some appeared to communicate more freely with their friends than others; and I have met with cases which show that some ants certainly do not, under such circumstances, summon others to their assistance. From this point of view the following observation may be compared with those already recorded. On the 1st August an ant came to the honey at 4.20 and went away a few minutes afterwards.

At 4.36	she returned, and at	4.41	went away again.
„ 4.52	„	4.58	„
„ 5.11	„	5.15	„
„ 5.30	„	5.35	„
„ 6. 5	„	6.10	„
„ 6.21	„	6.31	„
„ 6.39	„	6.43	„
„ 6.55	„	6.59	„
„ 7.30	„	7.36	„
„ 7.49	„	7.54	„

Yet during all this time she brought no friend with her.

The following additional observations were made after the reading of the paper, at the dates severally mentioned below.

Thus on the 3rd Jan. I placed some larvæ in three small porcelain saucers in a box 7 inches square attached to one of my frame-nests. The saucers were in a row 6 inches from the entrance to the frame and $1\frac{1}{2}$ inch apart from one another.

At 1.10 an ant came to the larvæ in the cup which I will call No. 1, took a larva, and returned to the nest.

At 1.24 she returned and took another.

1.45 „ „

2.10 she went to the further saucer, No. 3. I took her up and put her to No. 1. She took a larva and returned.

2.24 she returned to cup No. 3. As there were only two larvæ in this cup, I left her alone. She took one and returned.

At 2.31 she returned to cup No. 3 and took the last larva.

2.40 she came back to cup No. 3 and searched diligently, went away and wandered about for two minutes, then returned for another look, and at length at 2.50 went to cup No. 1 and took a larva.

3 came to cup 1 and took a larva.

3. 7 " "

3.15 " " , first, however, going and examining cup 3 again.

3.18 came to cup 3, then went to cup 2 and took a larva.

3.30 " " 2 "

3.43 " " 2 "

5.53 came to cup 3, but did not climb up it, then went to cup 2 and took a larva, which she either dropped or handed over to another ant; for without returning to the nest, at 3.55 she returned to the empty cup, and then to cup 2, where she took the last larva, so that two cups are now empty.

4. 3 she came to cup 3, then to cup 2, and lastly to cup 1, when she took a larva.

4.15 came to cup 1 and took a larva.

4.22 " "

4.38 " "

5 came to cup 3, then to cup 2, and lastly to cup 1, when she took a larva.

5.19 came to cup 1 and took a larva.

5.50 came to cup 2 and then to cup 1 and took a larva.

6.20 " 1 and took the last larva.

I now put about 80 larvæ in cup 3.

It is remarkable that during all this time she did not come straight to the cups, but took a roundabout and apparently irresolute course.

At 7. 4 she came to cup 1 and then to cup 3, and then home.

There were at least a dozen ants exploring in the box; but she did not send any of them to the larvæ.

At 7.30 she returned to cup 3 and took a larva.

I now left off watching for an hour. On my return at

8.30 she was just carrying off a larva.

8.40 she came back to cup 3 and took a larva.

8.55 she came to cup 1 then to cup 3 and took a larva.
9.12 „ „ „ „
9.30 „ 3 „ „
9.52 „ „ „ „
10.14 „ 1 „ „
10.26 she went and examined cup 2, then to cup 3 and took a larva.

At 10.45 she came to cup 3, and I went to bed. At 7 o'clock the next morning the larvæ were all removed. In watching this ant I was much struck by the difficulty she seemed to experience in finding her way. She wandered about at times most irresolutely, and, instead of coming straight across from the door of the frame to the cups, kept along the side of the box; so that in coming to cup 3 she went twice as far as she need have done. Again, it is remarkable that she should have kept on visiting the empty cups time after time. I watched for this ant carefully on the following day; but she did not come out at all.

During the time she was under observation, from 1 till 10.45, though there were always ants roaming about, few climbed up the walls of the cups. Five found their way into the (empty) cup 1 and one only to cup 3. It is clear, therefore, that the ant under observation did not communicate her discovery of larvæ to her friends.

The following day I watched again, having, at 7 A.M., put larvæ into one of the porcelain cups arranged as before. No ants found them for several hours.

At 11.37 one came and took a larva.
„ 11.50 she returned and took a larva.
„ 11.59 she returned „
„ 12. 9 „ „
„ 12.16 „ „
„ 12.21 „ „
„ 12.26 „ „
„ 12.32 „ „
„ 12.37 „ „
„ 12.41 „ „
„ 12.45 „ „
„ 12.50 „ „
„ 12.57 „ „
„ 1. 5 „ „
„ 1.11 „ „

At 1.21 she returned and took a larva.
,, 1.35 ,, ,,
,, 1.40 ,, ,,
,, 1.44 ,, ,,
,, 1.52 ,, ,,
,, 1.56 ,, ,,
,, 2. 2 ,, ,,
,, 2.10 ,, ,,
,, 2.17 ,, ,,
,, 2.24 ,, ,,
,, 2.30 ,, ,,
,, 2.36 ,, ,,
,, 2.43 ,, ,,
,, 2.48 ,, ,,
,, 2.54 ,, ,,
,, 2.59 ,, ,,
,, 3. 3 ,, ,,
,, 3.10 ,, ,,
,, 3.14 ,, ,,
,, 3.19 ,, ,,
,, 3.34 ,, ,,
,, 3.39 ,, ,,
,, 3.47 ,, ,
,, 3.56 ,, ,,
,, 4. 7 ,, ,
,, 4.13 ,, ,,
,, 4.20 ,, ,,
,, 4.28 ,, ,,
,, 4.39 ,, ,,
,, 4.44 ,, ,,
,, 4.50 ,, ,,
,, 4.55 ,, ,,
,, 5. 1 ,, ,,
,, 5. 7 ,, ,,
,, 5.17 ,, ,,
,, 5.23 ,, ,,
,, 5.28 ,, ,,
,, 5.40 ,, ,,
,, 5.45 ,, ,,
,, 5.59 ,, ,,
,, 6. 9 ,, ,,
,, 6.13 ,, ,,

At 6.35 she returned and took a larva.
„ 6.40 „ „
„ 6.46 „ „
„ 6.51 „ „
„ 6.58 „ „
„ 7. 2 „ „
„ 7. 8 „ „
„ 7.12 „ „
„ 7.16 „ „
„ 7.21 „ „
„ 7.26 „ „
„ 7.39 „ „
„ 7.44 „ „
„ 7.53 „ „
„ 7.57 „ „
„ 8. 3 „ „
„ 8. 8 „ „
„ 8.13 „ „
„ 8.20 „ „
„ 8.26 „ „
„ 8.31 „ „
„ 8.38 „ „
„ 8.45 „ „
„ 8.50 „ „
„ 8.55 „ „
„ 9. 2 „ „
„ 9.11 „ „
„ 9.19 „ „
„ 9.25 „ „
„ 9.33 „ „
„ 9.40 „ „
„ 9.46 „ „
„ 9.52 „ „

This is an unusually long interval; still I am sure the time is correct.

„ 10.32 „ „
„ 10.39 „ „
„ 10.49 „ „
„ 10.54 „ „
„ 11. 1 „ „

At this time I went to bed. There were still about twenty-five larvæ in the cup, which had all been removed when I looked at 6.15 the next morning. During the whole time she was under observation, only two strange ants found their way to the cup, though there were some wandering about in the box all day. Towards evening, however, they went into the nest, and for some hours my ant was the only one out. It will be observed that she returned at shorter intervals than the previous ones. This was partly because she had a shorter distance to go, and partly because she was not bewildered by three cups, like the preceding. I had placed a bit of wood to facilitate her ascent into the cup. This she made use of, but instead of going the shortest way to the cup, she followed the side of the box, partly, perhaps, because the floor was covered with a plate of porcelain. This, however, would not account for the fact that at first she invariably went beyond the cup, and even past the second cup; gradually, however, this circuit became smaller and smaller; but to the last she went round the outside of cup 1 instead of going straight to the spot where I had placed the bit of wood.

On the 9th January again I watched her under similar circumstances. From 9.35 to 1.40 she made 55 journeys to and fro, carrying off a larva each time; but during this period only one strange ant found the larvæ.

In the afternoon of the same day I watched the ant which had been under observation on the 3rd Jan. From 3.27 to 9.30 she made forty-two visits, during which time only four strange ants came to the larvæ.

On the 10th Jan. I watched the same ant as on the 4th. Between 11 A.M. and 10 P.M. she made no less than ninety-two visits; and during the whole time only one strange ant came to the larvæ.

On the 18th Jan. I put out some more larvæ in the small porcelain cups. Between 8 and 9 both these ants found them, and kept on coming all day up to 7 P.M., when I left off observing. There were a good many ants wandering about in the box; but up to 4 o'clock only four came to the larvæ. Two of them I imprisoned as usual; but two (which came at 4.30 and 4.36) I marked. These went on working quietly with the first two till I left off observing at 7 P.M.; and during this latter time only three other ants found the larvæ.

On the 31st Jan. I watched another specimen. At 9.14 I put her into a small cup containing a number of larvæ. She worked continuously till half-past seven in the evening, when I left off watching. During that time she had made more than ninety journeys, carrying each time a larva to the nest. During the whole time not a single other ant came to the larvæ.

Again on the 7th Feb. I watched two ants in the same manner. At 7 A.M. I put some larvæ in the small china cups. Up to 8 no ants had come to them. Soon after 8 I put two marked ants, neither of them being the same as these whose movements are above recorded. They were then watched until a quarter to eight in the evening, during which time one of them had made twenty-six journeys, carrying off a larva each time; the other forty-two. During this period of about eleven hours, two strange ants had come to the cup at which these were working, and the same number to one of the other cups.

None of these ants, therefore, though they had found a large number of larvæ, more than they could carry in a whole day, summoned any other to their assistance.

NOTICE.

Henceforward the Zoological and Botanical portions of the Journal will be published separately.

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1876.

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Diagnoses of new Genera and Species of Hydroida.

By Professor ALLMAN, M.D., LL.D.,F.R.S., Pres. L.S., &c.

[Read December 17th, 1874.]

(PLATES IX.–XXIII.)

SOME very interesting collections of Hydroida have been recently placed in my hands for determination. One of the most important of these is from the Zoological Museum of the University of Copenhagen, and consists exclusively of gymnoblastic forms. It has been obtained from various parts of the world; but most of the species are from the Scandinavian shores. It has been put into spirits, and is, for the most part, in a very good state of preservation, so much so, indeed, as frequently to admit of accurate drawings being made from the soft parts. Among the Hydroids of this collection sufficiently well preserved for determination, are seven undescribed species, referable to six genera. For the opportunity of examining it I am indebted to Professor Lütken, of the University of Copenhagen.

Another collection, also preserved in spirits, consists entirely of calyptoblastic forms, and was made in the Japan seas by Capt.

St. John, of H.M.S. 'Silvia.' It was submitted to me for determination by Mr. J. Gwyn Jeffreys, by whom it is destined to form part of the collection of the British Museum. It consists of seven species; and not one of these has been hitherto described. They are referable to four genera, of which two, namely *Campanularia* and *Thuiaria*, are well represented in the European seas, while two are now for the first time defined, and, so far as I know, have no representatives elsewhere.

This collection, though small, is thus of special interest, coming as it does from a region whose Hydroid fauna has been hitherto entirely unexplored, and which, I am strongly induced to believe, constitutes a distinct and well-defined area in the geographical distribution of the Hydroida.

To Mr. Busk I am indebted for a collection of calyptoblastic Hydroids, consisting entirely of dried specimens or of specimens which, after having been dried, had been mounted in liquid for the microscope. It contains a large number of species: many of these have been already examined and described by himself; many others he has also examined, designated by MS. names, and, in many cases, figured, so that his very careful and accurate work only awaits publication. Others, again, hitherto unexamined, he has liberally intrusted to myself; and these are described and figured in the present paper.

From Mr. Holdsworth I have received a collection of dried specimens, made on the shores of Ceylon. It contains several new and interesting species, chiefly belonging to the Aglaophenian section of the Plumulariidæ.

Lastly, a small collection of Hydroida and Polyzoa was made by the Rev. A. E. Eaton during a yacht voyage to Spitzbergen. The specimens were collected in the Spitzbergen seas, and were placed by Mr. Eaton at my disposal. Among the Hydroids, however, of this collection there is only one specimen sufficiently well preserved for determination.

HYDROIDA GYMNOBLASTEA.

BOUGAINVILLIIDÆ.

Perigonimus.

Perigonimus multicornis. Plate IX. figs. 1, 2.

Trophosome. Hydrocaulus attaining a height of about two inches, springing from a creeping network of hydrorhizal tubes, not fascicled, very much branched, with a subalternate disposition of the branches, which ascend at a small angle from the main stem and from one another; ultimate ramuli annulated at their origin, rest of the hydrocaulus smooth, except with an occasional annulation here and there. Hydranths with about forty tentacles.

Gonosome. Gonophores springing from the ultimate ramuli at some distance below the hydranth.

Locality. Kattegat, collected by Mr. Oersted, *Zool. Mus. Cop.*

The gonophores in the specimen were not sufficiently far advanced to enable their true structure to be determined; and little more than their position in the hydrosoma can be asserted of them. Their appearance, however, renders it highly probable that they become developed into planoblasts of the type met with in the genus *Perigonimus*; but in the absence of an accurate knowledge of the developed gonosome, the reference of the present species to that genus cannot be viewed as otherwise than provisional.

The most striking peculiarity of the species is the great number of tentacles in the hydranth.

EUDENDRIIDÆ.

Eudendrium.

Eudendrium rigidum. Plate IX. figs. 3, 4.

Trophosome. Hydrocaulus attaining a height of about one inch, much and very irregularly branched, springing out of an entangled mass of tortuous wiry filaments, fascicled in the main stem and principal branches; subordinate branches not fascicled, capillary, and strongly annulated throughout, the whole forming rigid tufts. Hydranths with about twenty tentacles.

Gonosome not known.

Locality. Denmark, *Zool. Mus. Cop.*

There can be little doubt that the Hydroid just described is a true *Eudendrium*; for though no gonosome was present in the specimen, the trophosome is entirely that of a *Eudendrium*; and, from all we know of the species of *Eudendrium*, the trophosome of this genus will in itself afford characters sufficient for generic determination.

The species here described bears a considerable resemblance to *Eudendrium capillare*; but the strongly fascicled condition of the main stem and principal branches, and the complete annulation of the unfascicled portion, at once distinguish it from that species. It is this fascicled condition which gives it the rigid habit which has suggested its specific name.

Such hydranths as are present in the specimen are evidently those of a second crop which had replaced an earlier one—a phenomenon not uncommon in Hydroid trophosomes. Each is borne on the summit of an attenuated continuation of the original branch; and the new growths have much the appearance of having been produced in the confinement of an aquarium; at all events, the attenuated extension of the branches is plainly not the normal condition of these parts.

HYDRACTINIIDÆ.

Hydractinia.

Hydractinia monocarpa. Plate X. figs. 1–3.

Trophosome. Basal expansion thin, furnished with well-developed chitinous spines; spines with a continuous axile cavity, and destitute of longitudinal furrows, except close to the base, frequently bifurcate. Hydranths with about twelve tentacles.

Gonosome. Blastostyles short, destitute of capitulum, and terminating distally in a blunt point; each blastostyle (female) carrying near its middle a single very large sessile spherical sporosac.

Locality. Spitzbergen, *Zool. Mus. Cop.*

This is a very interesting and well-marked form. It is easily distinguished from *H. echinata* by its nearly smooth spines, and especially by its noncapitate blastostyles, each with its single sporosac. The sporosac is very large, and encloses a great number of ova; while that portion of the blastostyle which lies at the distal side of the point of attachment of the sporosac is much attenuated, and bent to one side by the enormously developed sporosac. The blastostyle, with its sporosac, presents entirely the condition met with in certain calyptoblastic Hydroids, in which the gonangium contains only a single sporosac, by the great development of which the blastostyle becomes more or less atrophied and displaced.

The basal expansion is thin, and its chitinous framework far less developed than in *H. echinata.* The superficial cœnosarcal layer is very distinct, and is extended over the whole surface of the spines.

The chitinous walls of the hollow spines, besides presenting a general lamination, consist of two distinct layers. The external one, itself distinctly laminated, forms a sort of sheath which invests the inner one, also laminated, and can be separated from it by the needle. The tubular cavity of the spine, which is continuous from its summit to its base, is filled with cœnosarc.

The description here given is that of a female colony, no male specimen being contained in the collection.

The colony covered the surface of a gasteropodous shell, *Trophon clathratum*, Linn., which was obtained off the coast of Spitzbergen, and is still inhabited by the mollusk. Its high northern locality thus gives to *Hydractinia monocarpa* a special interest from a distributional point of view.

PODOCORYNIDÆ.

Podocoryne.

Podocoryne inermis. Plate X. figs. 4, 5.

Trophosome. Hydrorhizal expansion forming a thin layer entirely destitute of projecting chitinous spines. Proliferous hydranths but slightly smaller than the sterile hydranths.

Gonosome. Gonophores forming a verticillate cluster at a short distance below the tentacles.

Localities. Oeresund and Middelfartsund, Denmark, *Zool. Mus. Cop.*

The present species comes very near to *Podocoryne carnea*, and may possibly be only a varietal modification of it. It differs from it, however, in the entire absence of the chitinous spines which in *P. carnea* are developed from the hydrorhizal expansion, as well as in the much less arrested condition of the proliferous hydranths. It is possible that specific characters may be afforded by the free planoblasts; but the exact form of these can be determined only from living specimens.

The specimens occur on the shells of young living individuals of *Nassa reticulata*.

CLADOCORYNIDÆ.

Cladocoryne.

Cladocoryne pelagica. Plate X. figs. 6, 7.

Trophosome. Hydrocaulus attaining a height of about one fifth of an inch, simple, with the perisarc distinctly annulated towards the base.

Gonosome. Gonophores borne singly on short peduncles, which spring from the body of the hydranth within the tentacles.

Habitat. On *Sargassum bacciferum.*

Locality. Gulf-stream, collected by Mr. Hygom, *Zool. Mus. Cop.*

Hitherto only one species of the genus *Cladocoryne* has been described. This (*C. floccosa*) was discovered by Mr. W. D. Rotch, in Herm, one of the Channel Islands; but no trace of the gonosome was present in any of his specimens, and it was therefore impossible to draw up a complete character of either the species or the genus. The specimens of the new species from the Copenhagen Museum supply in some degree the deficiencies in our knowledge of this remarkable genus, though they still leave much to be determined. It seems pretty certain that the gonophores are phanerocodonic or medusiform; but the state of the specimens does not allow of an absolute determination of this point.

Cladocoryne pelagica is a smaller form than *C. floccosa*, from which it also differs in the very distinctly annulated condition of the lower part of its stem. It had attached itself to gulf-weed obtained in lat. 57° N., long. 13° W., by the late Mr. Hygom, who, as I am informed by Prof. Lütken, was "the captain of a trading-vessel, and a zealous and intelligent collector."

CORYMORPHIDÆ.

Amalthæa.

Amalthæa islandica. Plate IX. figs. 5, 6.

Trophosome. Hydrocaulus attaining a height of about $1\frac{1}{10}$ inch, swollen below, where it is provided with numerous rows of papilliform processes, which become longer as they approach the base, and are ultimately replaced by long filaments, which form a dense tow-like hydrorhizal plexus. Proximal tentacles about twenty in number, and about $\frac{8}{10}$ of an inch in length; distal tentacles rather long, very numerous, and forming a dense terminal brush.

Gonosome. Gonophores oval, in about nine pendulous clusters, each cluster consisting of numerous gonophores, which are borne on short stalks from all sides of a rather long common peduncle; more mature gonophores with four short tentaculiform processes on the summit.

Locality. North Iceland, *Zool. Mus. Cop.*

This is an interesting Hydroid, and, as far as can be determined from the specimen, is an *Amalthæa* nearly allied to *Amalthæa* *sarsii*, Steenstrup, from which it would seem to differ chiefly in its shorter stem, less numerous proximal tentacles, and longer distal ones, and in the simple common peduncles of its gonophore-clusters. The structure of its gonophores, however, could not be determined with certainty; and though these appear to develop into true planoblasts of the *Amalthæa* type, it was impossible, from a mere spirit specimen, to satisfy one's self entirely on this point. The reference of the Hydroid to the genus *Amalthæa* is thus, to a certain extent, provisional.

One of the most striking features in the present species consists in the great length of its proximal tentacles. These nearly equal the entire height of the stem, round which, in the living state of the animal, they must have formed a graceful inverted tassel of flexile filaments, subject to the impulse of every passing current of the surrounding water.

The thin pellicle which in *Amalthæa* replaces the strong perisarc of other Hydroids, was here irregularly corrugated and separated by a considerable interval from the ectoderm of the stem; but this latter state was probably connected with the alcoholized condition of the specimen.

MONOCAULIDÆ.

Monocaulus.

Monocaulus grœnlandica. Plate IX. figs. 7, 8.

Trophosome. Hydrocaulus attaining a height of about 1 inch, emitting towards the base numerous capillary filaments. Hydranths with the tentacles of the proximal zone moderately long, about twenty in number; tentacles of the distal zone very short and numerous.

Gonosome. Gonophores oviform, destitute of tentaculiform appendages, in seven or eight clusters, each cluster consisting of numerous gonophores, which are borne on all sides of a common peduncle, on which they are sessile.

Locality. Greenland, collected by Hollböll, *Zool. Mus. Cop.*

There can be scarcely any doubt that the gonophores of this Hydroid are simple fixed sporosacs, and that the species is rightly referred to the genus *Monocaulus.* The pellicle, which takes the place of the perisarc, is somewhat thicker than in *Corymorpha* and other so-called naked Hydroids, but is yet very different from the thick firm perisarc of *Tubularia*, *Eudendrium*, &c. It loses itself on the base of the hydranth, and in the specimen is irregularly corrugated and separated along the stem by a considerable interval from the ectoderm, this interval becoming still wider at the base of the stem; the separation of the pellicle from the ectoderm, however, may be due to the action of the alcohol in which the specimen is preserved.

The filaments, which are emitted from the stem, commence at some distance above the base; they are simple and capillary, and are each surrounded by a delicate extension of the investing pellicle of the stem.

The proximal tentacles, which are of moderate length, taper towards their extremity, where they end in a blunt, slightly enlarged extremity, showing an apparent tendency to a capitate termination. The distal tentacles, which are very short and very numerous, cover a narrow zone just below the mouth.

The clusters of gonophores lie, in the specimen, entirely at the distal side of the longer tentacles; and it does not seem that in the living state of the Hydroid they could have formed pendulous groups hanging below the tentacular verticil. No evidence of the sex of the specimen could be obtained.

The specimens are adhering by their base to fragments of shell, and seem to have been dredged from a bottom of shelly sand. They were collected by Mr. Holböll, mentioned in a note from Prof. Lütken as "the lamented Governor of South Greenland, a zealous and able collector."

HYDROIDA CALYPTOBLASTEA.

CAMPANULARIIDÆ.

Campanularia.

Campanularia crenata. Plate XI. figs. 1, 2.

Trophosome. Hydrophyton a creeping adherent filament, which sends off from distance to distance short free hydrotheca-bearing branches; adherent portion smooth, hydrothecal branches very distinctly ringed, slightly thinner than the adherent portion. Hydrothecæ deep and narrow, about $\frac{1}{10}$ of an inch in height, somewhat tumid at the base, slightly contracting upwards, and then gradually expanding at the orifice, so as to form an everted lip; margin of orifice crenate, with eight broad shallow lobes.

Gonosome. Not known.

Locality. Japan, *Capt. St. John.*

This Campanularian is remarkable for the comparatively large size of its hydrothecæ, with their elegantly crenate lip. It occurred creeping over the stems of a *Thuiaria* (*T. crassicaulis*). The specimen is well preserved, many of the hydranths being still quite perfect in the hydrothecæ; but the absence of all knowledge of the gonosome renders its reference to the genus *Campanularia* entirely provisional.

CAMPANULARIA GRANDIS. Plate XII. figs. 2–4.

Trophosome. Hydrophyton consisting of creeping, tortuous, smooth, more or less aggregated tubes, which send off from distance to distance the peduncles of the hydrothecæ; peduncles slightly thinner than the tubes from which they spring, scarcely attaining a length equal to that of the hydrothecæ, immediately below which they have a node-like enlargement. Hydrothecæ $\frac{2}{10}$ of an inch in height, gradually narrowing upwards, and terminating with an abruptly everted lip.

Gonosome. Gonangia springing in a dense cluster from the aggregated basal tubes, nearly sessile, lageniform, with strong longitudinal ridges, slightly exceeding a quarter of an inch in height.

Locality. Japan, *Capt. St. John.*

The comparatively enormous size of the hydrothecæ constitutes a very remarkable feature in this Hydroid. It is also strikingly marked by its very large, lageniform, ridged gonangia.

The adherent portion of the hydrophyton consists of strong tubes which creep over the surface to which it has attached itself. In the specimen examined it had taken possession of another Hydroid (*Selaginopsis fusca*), the older parts of whose stem it had enveloped in a close plexus. This plexus had entirely replaced the stem which had originally given it support; and it was from this part that the gonangia sprung in a dense group. They had the appearance of being sessile, but are in reality borne each upon a very short peduncle. Their large size and the peculiar way in which they were grouped together suggested at first the possibility of their being only the ovarian nidus of a gasteropodous mollusk instead of the gonangia of the Hydroid. They attain about the size of the nidus of *Buccinum lapillus*; and it was only by a careful examination that their real nature was made apparent. It was impossible, however, from the dead specimen to determine whether the contents of the gonangia were sporosacs or planoblasts; and it is therefore, as in all similar cases, only provisionally that the present Hydroid can be assigned to a definite genus.

CAMPANULARIA GRACILIS. Plate XII. figs. 5, 6.

Trophosome. Hydrophyton a slender, smooth, creeping tube, sending off from distance to distance long slender hydrothecal branches; hydrothecal branches with one or two rings at their origin from the creeping stem, and two deep constrictions at the base of the hydrotheca, destitute of annulation on the remainder of their length. Hydrothecæ deep bell-shaped, about $\frac{1}{30}$ of an inch in height.

Gonosome. Gonangia borne by the creeping tube, scattered, cylindrical, about $\frac{1}{15}$ of an inch in height, deeply and regularly annulated, tapering below into a short peduncle, and terminating distally in a truncated summit.

Locality. Japan, *Capt. St. John.*

This little Campanularian occurred abundantly on the same Hydroid which gave support to *Campanularia grandis*, and crept also over the stems and hydrothecæ of the latter, with whose great size this small form strikingly contrasted. Numerous young solitary individuals, with the embryonal hydrorhizal shield still present, had attached themselves to the supporting Hydroids.

Though the hydranths were sufficiently well preserved, nothing could be determined regarding the contents of the gonangia; and without a knowledge of these the reference of the Hydroid to the genus *Campanularia* is only provisional. It is probably, however, a true *Campanularia*, and appears to be nearly allied to *C. Johnstoni.*

CAMPANULARIA JUNCEA. Plate XI. figs. 3, 4.

Trophosome. Hydrocaulus consisting of a cluster of strong stems, which spring from a common entangled mass of hydrorhizal filaments, and, after rising to some height as simple undivided tubes, begin to send off thinner, simple, for the most part alternately disposed branches, and continue to ascend to a height of about 12 inches, becoming gradually thinner towards the distal extremity. Hydrothecæ large, tobacco-pipe-shaped, almost sessile, supported on bracket-like lateral processes, which are situated close to the distal ends and on alternate sides of rather short internodes, into which both main tube and branches are divided; margin of orifice entire, surrounded by a narrow band-like rim.

Gonosome. Not known.

Locality. Ceylon, *Mr. Holdsworth*.

Campanularia juncea is a very large, strong species; the stems, towards their base, where they are as yet unbranched, have a thickness of about $\frac{1}{20}$ of an inch, and might here almost be taken for a cluster of the stems of *Tubularia indivisa*. The specimens were all incrusted with an opaque calcareous deposit; and when freed from this, the stems presented a light-brown glossy surface marked by shallow longitudinal corrugations. The hydrothecæ have a singular resemblance to the usual form of the bowl of a tobacco-pipe; they measure about $\frac{1}{10}$ of an inch in height, and contract below into a very short peduncle, by which they are supported on the bracket-like processes of the hydrocaulus. The branches are considerably thinner than the main stem, from which they spring at a wide angle; they attain a length of from $\frac{1}{2}$ an inch to about 2 inches, and are mostly given off from alternate sides.

The Hydroid grew in dense clusters of closely approximated tubes; the clusters often measure at their base 1 or 2 inches in diameter.

As nothing is known of the gonosome, the reference of this species to *Campanularia* is provisional.

SERTULARIIDÆ.

SERTULARELLA.

SERTULARELLA JOHNSTONI, *Gray*. Plate XIII. figs. 1, 2.

Syn. *Sertularella Johnstoni*, Gray, in Dieffenbach's New Zealand; Coughtrey in Journal of Otago Institute, May 1874.

Sertularella gracilis, Allman, MS.

Trophosome. Hydrocaulus attaining a height of about 4 inches, very slender, much and irregularly branched; branches zigzag, sending off pinnately-disposed alternate ramuli at regular intervals along their length, the whole forming a dense tuft. Hydrothecæ carried each near the middle of a rather short, well-defined internode, adnate to the internode for about half their height, free portion slightly contracted; orifice with three well-marked teeth, one of which is superior and two lateral.

Gonosome. Gonangia borne both upon the main stem and the ramuli, each springing from a point just below a hydrotheca, obovate, gradually contracting below into a short peduncle, terminating above in a tubular orifice, which is situated excentrically on the truncated summit, distinctly and closely annulated in its entire length.

Locality. New Zealand, *Mr. Busk's collection.*

Mr. Coughtrey's amended description of the *Sertularella Johnstoni* of Gray renders it pretty certain that Gray's description was intended to apply to the present species, and necessitates the suppression of the specific name "*gracilis*," under which I had originally described it, in favour of the name previously assigned to it by Gray*. It is a delicate and very elegant species, rendered obvious to the naked eye by the tufts of long slender stems with their regular pinnately disposed ramuli. In the same collection is a form differing from that here described in the central position of its less decidedly exserted gonangial orifice; in all other respects it is indistinguishable from it. I regard the difference as merely varietal or possibly sexual.

SERTULARELLA INTEGRA. Plate XIII. figs. 3, 4.

Trophosome. Hydrocaulus attaining a height of about an inch, simple, or sparingly branched. Hydrothecæ adnate to each internode by somewhat more than a third of their height, slightly swollen below, becoming gradually narrower towards the orifice, marked upon the upper side with shallow annulations, orifice destitute of teeth.

Gonosome. Gonangia springing from a point just below the base of a hydrotheca, ellipsoidal, marked in somewhat more than the distal half by shallow annulations, terminating by a tubular 4-toothed orifice.

Locality. New Zealand *Mr. Busk's collection.*

The perfectly even rim of the hydrotheca, destitute of all trace of teeth, is an obvious feature in this species. Just within the orifice, upon the inferior walls of the hydrotheca, is a very distinct

* The proof-sheets of the present paper were passing through my hands when, by the kindness of Mr. Coughtrey, I received a copy of his "Notes on the New Zealand Hydroideæ," read before the Otago Institute, May 1874. The paper is accompanied by figures, and amends in many important points the descriptions already given by Gray (Catalogue in Driffenbach's 'New Zealand') and by Captain Hutton ("On the New Zealand Sertularians," Trans. New Zeal. Inst. vol. v. 1872). Without such figures and corrections it would, indeed, in many cases be impossible to identify the species to which the descriptions of these naturalists refer.

conical process, similar to that which in other Hydroids (*Thuiaria*) gives attachment to a valve-like operculum. No trace of the operculum was detected in the dried specimens.

SERTULARELLA EPISCOPUS. Plate XIII. figs. 5–7.

Syn. *Sertularia fusiformis*, Hutton in Trans. N. Z. Inst. 1872; Coughtrey in Journ. Otago Inst. 1874.

Trophosome. Hydrocaulus attaining a height of about an inch, simple, given off at short intervals from a creeping ramified tubular fibre. Hydrothecæ tubiform, springing from the distal end of the supporting internode, to which they are attached by their fundus, free in the remainder of their height, and strongly diverging from the stem; orifice deeply cleft above and below, so as to present a mitre-like form, bordered by a thickened margin, below which, on the side facing the internode, there is a thickened involution of the walls of the hydrotheca.

Gonosome. Gonangia elongated, ovoid, with one wide and shallow, and two narrow and deep longitudinal depressions, which extend from the summit to the base, supported on a short thickish peduncle, springing one from each internode at the side opposite to that which carries a hydrotheca.

Locality. New Zealand, *Mr. Busk's collection.*

Notwithstanding a want of sufficient exactness in the description given by Captain Hutton of his *Sertularia fusiformis*, there can, I think, be little doubt that that species is identical with the *Sertularella episcopus* of the present paper. The name of *fusiformis*, however, has been already assigned by Hincks to a very different British species, and therefore cannot be given to the New-Zealand one. Mr. Coughtrey has in some points amended Captain Hutton's description, and has given us a figure of the species.

The remarkable mitriform and margined hydrothecæ of this curious Hydroid at once distinguish it from all other known species. The hydrothecæ, besides diverging from the stem to the right and left, spring more decidedly from one of the remaining two sides than from the other, and are directed at a low angle from the plane of this side. The stem thus presents an anterior (from which the hydrothecæ spring) and a posterior, as well as a right and a left side. The origin of the gonangia is also somewhat from the anterior side of the internode.

The specimens formed a dense growth on the surface of a fucoid alga. In every instance the gonangia presented a collapsed appearance, with wide longitudinal depressions (mostly three) separated from one another by narrow longitudinal ridges. This condition was not obliterated by boiling in water or in a solution of caustic potash; but it is possible that it does not exist in the living Hydroid.

Sertularia.

Sertularia arctica. Plate XIV. figs. 1, 2.

Trophosome. Hydrocaulus attaining a height of about $1\frac{1}{2}$ inch, main stem undivided, slightly zigzag, sending off pinnately disposed alternate ramuli, each internode of the ramuli carrying, near its middle, a pair of opposite, or nearly opposite, hydrothecæ. Hydrothecæ elongated, free, and divergent from the internode for rather more than their distal half, narrowing towards the aperture; aperture cleft, so as to present two broad lateral teeth, to the lower angle between which is attached a valve-like operculum.

Gonosome. Gonangium springing from the internode, just below the base of a hydrotheca, elongate-ovate, with a constriction a little beyond its middle, terminating distally in a rather wide tubular outlet.

Locality. Spitzbergen, *Mr. Eaton.*

This is an elegant and delicate little species. It is difficult to determine the exact form of the hydrothecal orifice, the walls being here very thin and collapsible. In most of the hydrothecæ the appearance of an imperfect diaphragm could be seen at some distance within the orifice.

Desmoscyphus, nov. gen.

Trophosome. Hydrocaulus jointed, each internode corresponding to one or more pairs of hydrothecæ. Hydrothecæ adnate to one another in pairs, and each pair adnate to the front of the hydrocaulus.

Gonosome. Gonangia simple, borne along the front of the hydrocaulus.

The genus *Desmoscyphus* resembles *Thuiaria* in its hydrothecæ being adnate to the hydrocaulus; but it differs from it in the fact of its hydrothecæ being also adnate to one another in pairs, which are thus all brought to one side of the hydrocaulus, and in the further fact of certain parts of its hydrocaulus being divided into regular internodes, which correspond in number to the pairs of hydrothecæ.

Desmoscyphus Buskii. Plate XIV. figs. 3–7.

Trophosome. Hydrocaulus attaining a height of about 3 inches; main stem sending off at irregular and distant intervals pinnately disposed ramuli, which are much attenuated at their origin, and are divided into regular internodes, each of which carries one pair of hydrothecæ. Hydrothecæ swollen below, narrowing towards the orifice, and here slightly curving outwards; orifice oval, entire; pairs of hydrothecæ closely approximate on the pinnæ, but on the main stem separated from one another by considerable intervals; main stem with only an occasional joint at distant and irregular intervals.

Gonosome. Gonangia ovoid, with a truncated contracted summit, springing from the front of the pinnæ between the diverging summits of the hydrothecæ.

Locality. New Zealand, *Mr. Busk's collection.*

The present Hydroid occurs attached to a *Sertularella* indistinguishable from the widely distributed *Sertularella gayii.* The greatest diameter of the hydrothecæ is not seen in a directly front or in a directly lateral view of the stem or pinnæ, but only when viewed in a position intermediate between these two. The inner surface of the gonangium just within its orifice is set with some irregular short furcate spines.

Synthecium.

Trophosome. Hydrocaulus divided into internodes, each internode carrying a pair of opposite sessile hydrothecæ.

Gonosome. Gonangia supported upon peduncles which spring from within the cavity of certain hydrothecæ, where they take the place of the hydranth.

The genus *Synthecium* is characterized by a feature which is absolutely without parallel in any other known group of hydroids. This is found in the relation of certain hydrothecæ to the gonangia, the peduncle of the hydrotheca being enclosed within the cavity of the gonangium.

The hydrothecæ which thus carry gonangia differ in no respect, either in form or position, from those which continue to exercise the normal function of giving protection to the hydranth; and I can find no clue to the meaning of this most exceptional character.

SYNTHECIUM ELEGANS. Plate XV. figs. 1–3.

Trophosome. Hydrocaulus attains a height of about 2 inches, springing from a creeping tubular filament and soon sending off opposite pinnately arranged branches; internodes separated from one another by a deep constriction. Hydrothecæ borne along both the main stem and its branches, deep, tubular, cylindrical, with perfectly even orifice, adnate to the internode for about two thirds of their height, and then becoming free and curving outwards.

Gonosome. Gonangia large, elliptical, opening on the summit by a tubular orifice, strongly annulated, with the annular ridges, discontinuous, where they meet a mesial zigzag line on the front and the back of the gonangium, peduncle of gonangium entirely concealed within the hydrotheca which encloses it.

Locality. New Zealand, *Mr. Busk's collection.*

I have elsewhere* given a general description of this remarkable hydroid, but without the technical diagnosis which I have here supplied. It is a beautiful little species, rendered striking by the regularity of its ramification, its distinctly separated perfectly symmetrical pairs of hydrothecæ and its large curiously ornamented gonangia borne in pairs corresponding to those of the hydrothecæ out of which they spring.

The peduncle of the gonangium nearly fills the cavity of the long tubular hydrotheca, from the very bottom of which it springs. It is covered with a delicate chitinous perisarc, and immediately on emerging from the cavity of the hydrotheca carries the gonangium on its summit. Its cœnosarc is doubtless continuous at the bottom of the hydrotheca with that of the common stem; but as the specimens examined had all been dried before I received them, the exact relation of the soft parts could not be determined.

In the dried trophosome itself there is nothing exceptional. Indeed, so far as this part of the hydroid is concerned, there is nothing which would separate it generically from a typical *Sertularia.*

Whether those hydrothecæ from which the peduncles of the gonangia emerge ever carried hydranths which subsequently became replaced by the gonosome, or whether they have been all along exclusively devoted to the gonosome, it is impossible to determine from dead and desiccated specimens.

* 'Gymnoblastic Hydroids,' p. 229.

THUIARIIDÆ.

Thuiaria.

The characters which have been hitherto employed in the definition of the genus *Thuiaria* are altogether inadequate. The species have all a very distinctive aspect, and the whole facies of the forms which are referable to this genus is so characteristic as at once to strike the observer; and yet in the attempts hitherto made to define the genus not a single character has been introduced which will not just as well apply to some of the typical Sertulariidans.

The peculiarity which has been regarded as of sufficient importance to constitute the essential character of the genus *Thuiaria* is the more or less completely adnate condition of the hydrothecæ to the hydrocaulus, which gives to these receptacles the appearance of being immersed in the substance of the stem and branches. The degree, however, in which this condition presents itself varies greatly in the different species; and the character is just as decided in many species rightly referred to *Sertularia* or *Sertularella.*

The adnate condition of the hydrotheca affords, in fact, no distinctive character at all; and if *Thuiaria* is to stand as a legitimate genus, some other character must be sought for. Now this will be found in the mode of division of the hydrocaulus into internodes. In all the true Sertulariidans (*Sertularia*, *Sertularella*, *Diphasia*) there is a joint occurring at regular intervals between every two or every two pairs of hydrothecæ quite irrespectively of the degree of adhesion of the hydrotheca to the hydrocaulus; while in *Thuiaria* the joints occur at distant and, for the most part, irregular intervals, thus leaving numerous hydrothecæ to be carried on each internode. It is this, combined with the far less distinctive feature of the more or less adnate condition of the hydrothecæ, which gives its peculiar aspect to a *Thuiaria*, and which must be taken as the essential character of the genus*.

Thuiaria.

Thuiaria crassicaulis. Plate XVI. figs. 1–5.

Trophosome. Hydrocaulus attaining a height of six inches, very

* Guided by this character, some of the species hitherto included among the true Sertularians must be removed to *Thuiaria*. Thus the *Sertularia argentea* and *S. cupressina* of authors are true *Thuiariæ*. Indeed *S. cupressina*, even in subordinate details, the immersion of its hydrothecæ and its peculiar ramification, is in all respects a typical Thuiarian.

thick, having, just above the base, a diameter of $\frac{2}{10}$ of an inch, irregularly branched; hydrothecal ramuli dichotomously divided, forming fan-shaped groups, which are disposed upon the main stem in a closely set spiral, a joint for the most part at the proximal side of each bifurcation. Hydrothecæ alternate, flask-shaped, with a short blunt tooth at each side of the orifice, separated from one another by slight intervals towards the proximal parts of each fan-shaped group of ramuli, but closely approximated towards the distal parts, where the base of each hydrotheca is slightly overlapped by the summit of that below it.

Gonosome. Gonangia forming two alternating rows on the upperside of the hydrotheca-bearing ramuli, each gonangium springing from a point just below the base of a hydrotheca, obconical, crowned with eight short thick spines which surround the broad summit, in the centre of which is the slightly elevated orifice; margin of orifice with minute teeth, which are directed towards the centre.

Locality. Japan, *Capt. St. John.*

This species is especially remarkable for the great thickness of its stem. The thick chitinous walls of the stem are traversed by very numerous irregular longitudinal canals, which, for the most part, communicate laterally with one another and with the great irregular central canal. This central canal, in the specimen examined, was bounded by a wall of chitine much thicker, but lighter-coloured, than that which surrounded the more external canals. The remains of the cœnosarc were visible not only in the central, but in some of the external canals; and it is probable that in a living state they were all pervaded by it.

THUIARIA CORONIFERA. Plate XVII. figs. 1–3.

Trophosome. Main stem attaining a height of more than 4 inches, sparingly branched, not fascicled, slightly zigzag, carrying dichotomous hydrothecal ramuli, which are spirally disposed around the stem, extending backwards for some distance from the summit. Hydrothecæ flask-shaped, alternate.

Gonosome. Gonangia [female] borne upon the upperside of the hydrothecal ramuli, springing each from a point just below the base of a hydrotheca, obovate, crowned by about nine hollow bifurcating spines, whose length equals that of the gonangium.

Locality. Japan, *Capt. St. John.*

The specimen examined was plainly a part of a female colony, and contained within the cage-like chamber formed by the spines of the gonangium a well-preserved acrocyst. I have no knowledge of the form of the gonangia in the male; but, judging from analogy, they are probably destitute of the marsupial chamber and acrocyst which characterize the female. This species is thus distinguished by the peculiar form of its female gonangia, which differ from those of the other described species of *Thuiaria* much as the female gonangia of *Diphasia* differ from those of *Sertularia*.

The specimen being imperfect, its actual height could not be ascertained. About four inches of the stem remained; but it had evidently been broken off at some distance from the root.

When the gonangia are young, they are obconical in form, with a broad, flat summit, and in this stage show no trace of marsupial spines. As the gonangium continues to increase in size it assumes an obovate form, and the spines begin to grow out round the margin of its summit. These are at first simple, and afterwards become bifurcate. There are three bifurcations in every spine, each branch of the first bifurcation dividing into two.

An extension of the cœnosarc is continued through the whole length of the spines, from the enlarged summit of the blastostyle; and as the blastostyle must be homologically regarded as a hydranth arrested and adapted to functions connected with reproduction instead of nutrition, I look upon the spines here in the same light as I regard the corresponding parts in the gonangium of *Diphasia*, namely as blastostylic tentacles, thus representing the tentacles of a hydranth which have lost their prehensile functions, become clothed with chitine, and adapted to the protection of the ova during an early period of their development.

The ova are formed as usual, in a sporosac which springs from the blastostyle within the gonangium, and are subsequently discharged into the marsupial chamber, where, however, they are not free, but continue for some time confined within an acrocyst.

THUIARIA BIDENS. Plate XVIII. figs. 1, 2.

Trophosome. Hydrocaulus attaining a height of 4 inches, springing from an entangled mass of tubular filaments, much and irregularly branched, pinnate, main stem and principal branches fascicled for some distance from their origin, becoming monosiphonic towards their extremities; pinnæ alternate; hydrothecæ of the pinnæ adnate in their entire height, alternate, following one another without an interval, somewhat swollen below, slightly narrowing upwards, orifice with two narrow teeth projecting from the inner side of the margin; hydrothecæ of the main stem and branches separated from one another by considerable intervals.

Gonosome. Gonangia borne by the stem and pinnæ, each springing from a point just below the base of a hydrotheca, nearly sessile, ovoid, with truncated summit, strongly annulated in their distal half or two thirds, orifice borne on the summit of a narrow tube which springs from the centre of the truncated summit.

Locality. New Zealand, *Mr. Busk's collection.*

This is a fine species, with a handsome plumose aspect, conferred on it by the pinnate disposition of its ultimate ramuli.

THUIARIA DOLICHOCARPA. Plate XIX. figs. 3, 4, and 4 *a*.

Trophosome. Hydrocaulus attaining a height of about four inches, and formed by an undivided main stem with closely set pinnately disposed, simple, opposite ramuli. Hydrothecæ alternate, closely set on the ramuli, more distant on the main stem, diverging upwards; margin of orifice strongly toothed, with a deep notch on each side, separating it from the hydrocaulus, the notch surrounded by a thickened rim; teeth three on each side of the orifice, and one in front; hydrothecæ adnate to the pinnæ from their base to the bottom of the marginal notch; pinnæ with a strongly marked mesial keel running down each side; main stem not keeled, with joints at irregular intervals, and its hydrothecæ more distant, and with the margin less distinctly dentate than is the case with the hydrothecæ of the pinnæ.

Gonosome. Gonangia springing by a small basal joint from the pinnæ, close to the base of a hydrotheca, very long, being about twelve times the length of a hydrotheca, rapidly widening upwards for some distance from their origin, then becoming nearly cylindrical to within a short distance of the summit, and then continued by a short, tubular prolongation, which carries the terminal orifice.

Locality. Northern Island, New Zealand, *Dr. Andrew Sinclair*, *Mr. Busk's collection.*

Thuiaria dolichocarpa is a striking form, conspicuous by its pinnately disposed opposite ramuli, springing from a simple stem, and giving to the entire Hydroid an elegantly plumose habit, as well as by the strongly dentate margin of its hydrothecæ, and its greatly elongated gonangia. The strong keels running down, one on one side and the other on the opposite side of the pinna, to which they give a somewhat prismatic form, constitute also a striking feature.

Only a single specimen of this species was contained in the collection. Its main stem was quite simple; and this is probably the general character of the species. Its hydrorhiza was not present.

THUIARIA CERASTIUM. Plate XVIII. figs. 3, 4.

Trophosome. Hydrocaulus attaining a height of about two inches, springing from a bundle of entangled tubular filaments, simple for some distance from the hydrorhiza, and then becoming dichotomously branched with great regularity; simple portion of hydrocaulus and its more proximal subdivisions fascicled, the rest of the subdivisions monosiphonic. Hydrotheceæ tubular, with entire orifice, adnate to the hydrocaulus in their entire length, alternate; hydrothecæ of each series closely approximate to one another, directed alternately (when viewed from the free side) to the right and to the left.

Gonosome. Gonangia springing singly by a narrow point close to the angle of each subdivision of the dichotomous stems, broadly obovate, strongly annulated, opening at the broad distal end by a narrow tubular projection.

Locality. Northern Island, New Zealand, *Dr. Andrew Sinclair, Mr. Busk's collection.*

The very regular dichotomous ramification, with the gonangia situated in the axils of the branches, gives to this species a very striking aspect, and strongly suggests the form of inflorescence met with in certain common caryophyllaceous plants.

THUIARIA PERSOCIALIS. Plate XVII. figs. 4–6.

Trophosome. Hydrocaulus attaining a height of about $2\frac{1}{2}$ inches; main stem undivided, monosiphonic, sending off along its entire length pinnately disposed opposite ramuli, and having a well-marked transverse joint between every pair of ramuli; ramuli with a joint here and there at irregular intervals. Hydrothecæ deep flask-shaped, with entire, semielliptical orifice, those of each series separated from one another by scarcely any interval on the pinnæ, more separated on the main stem, subopposite, or opposite on the pinnæ, more decidedly opposite on the common stem. Axis of pinnæ frequently extended beyond the distal extremity as a cylindrical tube, destitute of hydrothecæ, and serving for attachment.

Gonosome not known.

Locality. Natal, *Mr. Busk's collection.*

The opposite regularly disposed pinnate ramuli of this species give it an elegantly plumose habit, while one of its most striking features will be found in the curious tendril-like prolongations of the pinnæ. The Hydroid grows in crowded groups; and the tendril-like processes, after extending themselves for some distance, with a more or less tortuous course, finally adhere by their distal extremities to some part of the same or of neighbouring hydrophytons, so that the whole group becomes tied together into a complicated mass. The attachment of these processes is by their extreme ends, which are applied in a somewhat sucker-like fashion to the surface to which they adhere.

SELAGINOPSIS, gen. nov.

Trophosome. Hydrophyton consisting of a single axile tube, to which the hydrothecæ are adnate, and on which they are disposed in several longitudinal rows.

Gonosome. Not known.

The genus *Selaginopsis* is allied to *Grammaria*, Stimpson, from which it differs chiefly in consisting throughout of a single axile tube, to whose sides the comparatively short hydrothecæ are adnate, while in *Grammaria* the elongated hydrothecæ are continued into tubes which are combined into a fascicled stem. From *Cryptolaria*, Busk, it further differs in the polystichous disposition of its hydrothecæ, these being distichous in *Cryptolaria.*

With *Pericladium*, another Japanese genus, it has also strong affinities. From this, however, it differs in the disposition of its hydrothecæ in longitudinal series as well as in its totally different type of ramification.

Were we acquainted with its gonosome we should probably find other points either of alliance or divergence of which we are at present ignorant.

SELAGINOPSIS FUSCA. Plate XII. fig. 1, and Plate XIX. figs. 1, 2.

Trophosome. Hydrophyton attaining a height of 4 (or more) inches, irregularly branched, with joints at irregular intervals; branches contracted at their origin. Hydrothecæ with margin of orifice slightly waved, disposed in four rows along the stem and branches; the whole very dark brown and opaque.

Gonosome. Not known.

Locality. Japan, *Capt. St. John.*

The hydrophyton in the present species is very opaque and dark-coloured; when boiled in a solution of caustic potash, it becomes much lighter and more transparent; and it is only then that a knowledge of the true form of the hydrothecæ and of their relation to the other parts of the Hydroid can be obtained. It will be then seen that they are nearly cylindrical in form, with a very definite floor, and closely adhere to the sides of a continuous axile tube, with which the hydrotheca communicates by a central orifice in its floor. The hydrothecæ are disposed so as to form four longitudinal rows, which are approximated in pairs, so that two rows run down one side of the stem and two down the other.

The specimen was imperfect, and was in great part enveloped by the adherent tubes of the two Campanularians described above as *C. grandis* and *C. gracilis.*

PERICLADIUM, gen. nov.

Trophosome. Hydrothecæ more or less immersed and closely set round bifurcating ramuli, which spring from the sides of a common stem.

Gonosome. Gonangia scattered, springing from between the hydrothecæ.

The genus *Pericladium* approaches *Thuiaria,* from which, however, it differs in the disposition of its hydrothecæ. In *Thuiaria* the hydrothecæ are disposed distichally, being always arranged in two opposite longitudinal series, while in *Pericladium* they surround the ramulus on all sides.

PERICLADIUM BIDENTATUM. Plate XX. figs. 1–4.

Trophosome. Stem attaining a height of about 4 inches, simple, not fascicled; hydrothecal ramuli cylindrical, two or three times bifurcate, attaining a length of about $\frac{3}{4}$ of an inch, springing from the main stem in a close spiral. Hydrothecæ flask-shaped, immersed for the greater part of their length and arranged in imbricated or closely approximate alternating verticils, but towards the proximal end of the bifurcating ramulus separated from one another and irregularly scattered; orifice with an acute tooth on each side.

Gonosome. Gonangia carried on the upperside of the hydrothecal ramuli near their origin from the common stem, obovate, contracting below into a short curved peduncle, marked by shallow transverse corrugations towards the summit, and terminated by a slightly elevated aperture.

Locality. Japan, *Capt. St. John.*

This Hydroid has much the habit of certain true *Thuiariæ*. It is a large and beautiful species. The specimens were loaded with gonangia, which were confined to the basal portion of each system of bifurcating ramuli, where the hydrothecæ are separated from one another by intervening spaces; it is from these spaces that the gonangia arise in two longitudinal rows upon the upperside of the ramulus. The gonangia-bearing portion of the ramulus is separated from the more distal portion by a transverse joint.

PLUMULARIIDÆ.

Aglaophenia.

Aglaophenia acanthocarpa. Plate XXI. figs. 1–4.

Trophosome. Hydrocaulus attaining a height of upwards of three inches, irregularly branched, pinnæ springing from the anterior aspect of the stem. Hydrothecæ closely approximate, rather deep, gradually expanding upwards, margin deeply toothed, with the second tooth from the front on each side strongly everted; intrathecal ridge strong, extending from about the middle of the back of the hydrotheca transversely to within a short distance of the anterior mesial line; mesial nematophore adnate to the front of the hydrotheca from its base to its margin, and then becoming free, and extending forwards and upwards as a long thickish beak-like process, in which there is a lateral as well as a terminal orifice; lateral nematophores overtopping the hydrotheca, very divergent in a front view; rachis of pinna with an imperfect septum continuous with the intrathecal ridge, and another oblique one at the base of the lateral nematophores.

Gonosome. Corbulæ open, with a short stalk, and with about eighteen pairs of free leaflets, which decrease in length towards the distal extremity of the corbula, and give off on each side numerous closely set, long, opposite, blunt spine-like nematophores; each leaflet with a double nematophore near its base.

Locality. New Zealand, *Mr. Busk's collection.*

This is a very elegant species, with much of the habit of our European *Aglaophenia pluma*. Its hydrothecæ are remarkable for the great development of the free portion of the mesial nematophore—a character in which it agrees with Kirchenpauer's subgenus *Macrorynchia*, with which it further agrees in the fact of this free portion of the mesial nematophore being provided not only with a terminal orifice, but with the lateral one to which Kirchenpauer first drew attention as occurring in those forms which he united in his subgenus *Macrorynchia*. The species, however, included by Kirchenpauer in this subgenus have a gonosome very different from that of the present species, the gonangia of the *Macrorynchiæ* being unprotected by corbulæ, and merely supported on the surface of more or less modified pinnæ.

But the most striking feature of *Aglaophenia acanthocarpa* will be found in its beautiful corbulæ. The leaflets which form the walls of the corbula are free in their entire length, and carry along their opposed edges opposite pinnately disposed nematophores, each in the form of a blunt spine, and having both a terminal orifice and, close to its base, a lateral one, exactly as in the mesial nematophores of the hydrothecæ. The longest leaflets, which are situated near the proximal end of the corbula, carry about eleven pairs of nematophores; the shortest, which are at the distal end, carry usually from five to seven pairs; each leaflet, moreover, has a transverse joint between every pair of nematophores, and at its base carries upon one side two nematophores, which spring, by a common root, from the basal joint of the leaflet.

This double nematophore is especially interesting in a homological point of view; for it represents the two lateral nematophores of a hydrotheca, the mesial nematophore being represented in a greatly modified form by the leaflet itself, and the hydrotheca being entirely suppressed.

The short stalk by which the corbula is attached to the stem carries a single hydrotheca.

Aglaophenia laxa. Plate XXI. figs. 5–7.

Trophosome. Stem attaining a height of about two inches, fascicled below, irregularly or subalternately branched; branches all lying in the same plane, divided into rather long internodes, each internode carrying a pinna; pinnæ distant, each supported on a short process, which springs from the latero-anterior aspect of the hydrocaulus. Hydrothecæ approximate, rather deep, gradually widening upwards, margin deeply toothed, with the second tooth from the front everted; intrathecal ridge strong, situated near the middle of the hydrotheca, and running transversely from its posterior to its anterior wall; median nematophore adnate to front of the hydrotheca nearly as far as the margin, and then projected as a free beak-like process, which is provided with a lateral as well as terminal orifice; lateral nematophores slightly overtopping the hydrotheca; cauline nematophores broad, two on each internode, one being situated immediately below, and the other immediately above the supporting process for the pinna.

Gonosome. None present in the specimen.

Locality. New Zealand, *Mr. Busk's collection.*

The length of the pinna-bearing internodes, and consequent intervals between the pinnæ are unusually great in this species; and the plumes thus present a rather open habit, which contrasts with the denser plumes of others. The hydrothecal internodes have three distinct diaphragms—one which is a continuation of the intrathecal ridge, one at the base of the lateral nematophores, and one at the base of the hydrotheca.

In the absence of all knowledge of the gonosome, the reference of the present species to the genus *Aglaophenia* is only provisional. It will be seen that in the possession of two orifices by the free portion of the mesial nematophore we have a character which Kirchenpauer assigns to his subgenus *Macrorynchia*. This, however, is by no means an exclusive character of the forms which he would include under *Macrorynchia* (see description given above of *Aglaophenia acanthocarpa*), while the general form of the hydrotheca in the present species agrees more closely with that of the true *Aglaopheniæ*.

The specimen was growing over the surface of a litoral fucus.

HALICORNARIA, *Busk* (modified).

Trophosome. Hydrocaulus with pinnate ramification. Hydrothecæ usually with an intrathecal ridge. Nematophores fixed; mesial nematophore adnate for a greater or less extent to the front of the hydrotheca, rarely free.

Gonosome. Gonangia not included in corbulæ or protected by gonangial ramuli, but carried on the common stem, or on more or less modified hydrothecal pinnæ.

The genus *Halicornaria* was originally instituted by Busk to include certain Plumulariidæ, in which the reproductive capsules were not included in basket-like receptacles or corbulæ. Within its original limits it would have included the species referable to the type of *Plumularia setacea*, Linn. With our present more extended knowledge of the Plumulariidæ, however, it must be restricted to species which, with a trophosome formed on the general type of *Aglaophenia pluma*, have their gonangia never included in corbulæ, or connected in any way with the special gonangial ramuli which in certain other species we find developed for their protection.

Dr. Kirchenpauer, in his valuable memoir on the genus *Aglaophenia*, institutes under the name of *Macrorynchia* a subgenus for certain forms with unprotected gonangia, giving, however, as the chief character of the group, the great development of the free portion of the mesial nematophore, and its being provided with a lateral as well as a terminal orifice. This condition of the mesial nematophore, however, we have seen to exist in a true corbula-bearing species (*Aglaophenia acanthocarpa*); and it probably occurs in many others besides those which Kirchenpauer would refer to his subgenus *Macrorynchia.* The genus *Halicornaria* would include not only the forms embraced by Kirchenpauer in his *Macrorynchia* group of *Aglaopheniæ*, but others, which, with unprotected gonangia, do not possess the double-mouthed nematophore.

HALICORNARIA SACCARIA. Plate XV. fig, 4, and Plate XXII. figs. 1, 2.

Trophosome. Hydrocaulus attaining a height of about 9 inches, rooted by a spongy mass of entangled filaments, much and very irregularly branched, fascicled, very thick towards the base, and thence gradually thinning away as the polysiphonic condition becomes less and less, until towards their distal extremities the branches have entirely lost their fascicled condition and become monosiphonic; pinnæ alternate, arising from the anterior surface of the rachis. Hydrothecæ with the orifice directed forward; margin waved, but not dentate; anterior walls deeply inflected just below the orifice; intrathecal ridge rudimental; mesial nematophore adnate to the hydrotheca for about half the height of the hydrotheca, and then forming a rather long, stout, free spine, having, besides its terminal aperture, a lateral one on its upper side close to the point where it becomes free; lateral nematophores nearly cylindrical, long, extending beyond the orifice of the hydrotheca; a double cauline nematophore just below the origin of each pinna.

Gonosome. Gonangia borne singly on a short pinna, which carries usually two hydrothecæ at the proximal side of the gonangium, and at its distal side is reduced to a short blunt spine destitute of hydrothecæ; gonangia oval, greatly compressed, concave on one side and convex on the other, with a transparent wing-like margin; sporosac encircled near its summit by a band of refringent roundish corpuscles.

Locality. Ceylon, *Mr. Holdsworth.*

This is a loosely branched straggling species; the peculiar form of the hydrothecæ, with the deep inflexion below the margin, somewhat resembles that of a sac constricted by a cord below its mouth, and has suggested the specific name.

The remarkable band by which the solitary sporosac which occupies the gonangium is encircled, is composed of highly refringent spherical corpuscles, which by mutual pressure have become more or less polygonal. They possess a central nucleus-like body, which, when the gonangia are subjected to a short boiling in a solution of caustic potash, becomes resolved into a cluster of granules. It is impossible to form any valid conclusion as to the significance of these bodies; they are certainly not ova.

The gonangium is solitary, and is borne on a shortened hydrothecal pinna whose proximate two hydrothecæ present the normal condition, while the third hydrotheca is replaced by the gonangium, its mesial and lateral nematophores continuing, with but slight arrest, to occupy their usual position, so that the mesial nematophore is placed in front of the gonangium, where it remains free, and the lateral nematophores one on each side of it and distally. That portion of the pinna which lies at the distal side of the gonangium has become arrested and reduced to the condition of a thick blunt spine.

Were it not for the much less modified condition of the pinna which carries the gonangium, the present species would form a typical example of Dr. Kirchenpauer's macrorynchial section of *Aglaophenia.*

HALICORNARIA INSIGNIS. Plate XXIII. fig. 1, and Plate XXII. figs. 3, 4.

Trophosome. Hydrocaulus attaining a height of 9 inches, simple, monosiphonic, closely set with opposite pinnæ. Hydrothecæ with a very long recurved and strongly divergent tooth on each side, intrathecal ridge strong, extending from about the middle point of the mesial line in front to a point about halfway between the anterior and posterior walls of the hydrotheca; mesial nematophore very long, adnate to the whole height of the anterior wall of the hydrotheca, and then extending for a distance about equal to the length of its adnate portion as a free, gently recurved, hollow spine, with a lateral as well as a terminal orifice.

Gonosome. Not known.

Locality. Ceylon, *Mr. Holdsworth*.

This is a beautiful species; its long flexile and eminently graceful plumes grew in rich masses over the stems of another large Hydroid (*Halicornaria bipinnata*). In some of the specimens examined an imperfect septum was apparent, stretching across the cavity of the mesial nematophore at a little distance from its terminal orifice. This, however, was by no means of constant occurrence. The opposite, instead of alternate, disposition of the pinnæ on the common stem is a condition of very rare occurrence among the Plumulariidæ.

As no gonosome was present in any of the specimens examined, the reference of the species to *Halicornaria* is provisional; the general character of the hydrothecæ, however, belonging as these do to the macrorynchial type, renders it probable that the species is correctly allocated to *Halicornaria*.

HALICORNARIA BIPINNATA. Plate XXIII. fig. 2, Plate XXII. fig. 5.

Trophosome. Hydrocaulus attaining a height of upwards of a foot, fascicled, rooted by a dense sponge-like mass of entangled fibres, strong and thick at its origin, where it measures about a quarter of an inch in diameter, and soon thinning away as it becomes irregularly branched; branches mostly in the same plane, sending off along their whole length rather closely set, short, alternate pinnæ, which are destitute of hydrothecæ, and along the intervening spaces short, slender, hydrotheca-bearing pinnæ; non-hydrotheca-bearing pinnæ rigid, fascicled at their origin, thinning away and becoming monosiphonic towards their distal extremities, carrying very short secondary, alternate, monosiphonic hydrotheca-bearing pinnæ, each secondary pinna springing from a short internode of the primary pinnæ. Hydrothecæ closely set, deep, with the anterior wall deeply involuted below the orifice, which is directed forward; margin of orifice extended in the form of a broad wing-like cheek on each side; intrathecal ridge situated near the base of the hydrotheca, and extending forwards for a short distance from its posterior wall; mesial nematophore adnate for the greater part of the height of the hydrotheca, and then becoming free for a short distance; lateral nematophores long, cylindrical, diverging; each internode of the primary pinnæ carrying two cauline nematophores close to the base of the secondary pinna.

Gonosome. Gonangia compressed, cup-shaped, opening by a wide orifice at the distal end, springing by a very short latero-basal peduncle from the back of each secondary pinna close to its origin.

Locality. Ceylon, *Mr. Holdsworth.*

The doubly pinnate ramification of *H. bipinnata* impresses on the Hydroid a striking physiognomy. The species is rendered still further remarkable by the large size of its strong rigid hydrocaulus, while the branches, being given off to the right and left, lie mostly in the same plane, and confer on it somewhat the aspect of certain species of *Antipathes* or *Gorgonia.* The hydrothecæ are proportionally small; and the pinnæ which carry them are slender and easily detached from the rest of the hydrocaulus. Though the hydrothecæ resemble those of the macrorynchial species in the forward direction of the orifice and in the deep involution of the anterior wall, the free portion of the mesial nematophore is but little developed, and is provided with only the terminal aperture.

The main stem and branches are strongly fascicled; and the principal tube of the primary non-hydrotheca-bearing pinnæ (that from which the secondary pinnæ arise) is accompanied by two or three tubes from the branches, which, however, soon cease; and the primary pinna then continues its course as a single tube.

Some of the specimens were loaded with gonangia, which were always very thin-walled and provided with a very wide orifice; but how far the form of these receptacles in the dried specimens corresponded with their condition in the living animal is somewhat doubtful. Their origin from the back of the hydrocaulus is very remarkable, and quite exceptional in the group.

DESCRIPTION OF THE PLATES.

[All the magnified figures, and many of those representing the species of its natural size, are from drawings made from nature by the author. The figures on Plate XXIII., and some of the other natural-size figures, are from drawings by Mr. A. T. Hollick.]

PLATE IX.

Figs. 1, 2. *Perigonimus multicornis.*
- 1. Natural size.
- 2. A portion, magnified.

3, 4. *Endendrium rigidum.*
- 3. Natural size.
- 4. A portion, magnified.

5, 6. *Amalthæa islandica.*
- 5. Natural size.
- 6. Magnified.

7, 8. *Monocaulus grœnlandica.*
- 7. Natural size.
- 8. Magnified.

PLATE X.

Figs. 1–3. *Hydractinia monocarpa.*
- 1. A colony, natural size, growing over the shell of *Trophon clathratus.*
- 2. A portion of the colony, magnified.
- 3. Longitudinal section of one of the chitinous spines: *a*, external laminated layer; *b*, internal laminated layer; *c*, axile cavity.

4, 5. *Podocoryne inermis.*
- 4. Natural size, spreading over the shell of *Nassa reticulata.*
- 5. Portion of a colony, magnified.

6, 7. *Cladocoryne pelagica.*
- 6. Natural size, growing over the surface of an air-vesicle of *Sargassum bacciferum.*
- 7. Portion of a colony with hydranth and gonophores, magnified.

PLATE XI.

Figs. 1, 2. *Campanularia crenata.*
- 1. Natural size.
- 2. Magnified.

3, 4. *Campanularia juncea.*
- 3. Portion of a colony, natural size.
- 4. Portion, magnified.

Plate XII.

Fig. 1. *Selaginopsis fusca* and *Campanularia grandis*, natural size. (For magnified details of *Selaginopsis fusca*, see Pl. XIX. figs. 1, 2.)

1 *a, a*. *Selaginopsis fusca.*

1 *b, b, b*. *Campanularia grandis.*

2. *Campanularia grandis* and *Campanularia gracilis*, magnified.

2 *a, a*. *Campanularia grandis.*

2 *b, b, b*. *Campanularia gracilis* growing over the surface of *Campanularia grandis.*

Young individuals with their hydrorhizal disks have attached themselves to the hydrothecæ of the large *Campanularia.*

3. Gonangium of *Campanularia grandis*, magnified.

4. *Campanularia gracilis*, natural size.

Plate XIII.

Figs. 1, 2. *Sertularella Johnstoni.*

1. Natural size.
2. A portion, magnified.

3, 4. *Sertularella integra.*

3. Natural size.
4. A portion, magnified.

5–7. *Sertularella episcopus.*

5. Natural size.
6. A portion, magnified.
7. Outline of transverse section of gonangium.

Plate XIV.

Figs. 1, 2. *Sertularia arctica.*

1. Natural size.
2. A portion, magnified.

3–7. *Desmoscyphus Buskii.*

3. Natural size.
4. A portion of main stem and branch, magnified, lateral view.
5. A portion of a branch, magnified, front view.
6. Same, back view.
7. Same, oblique view.

Plate XV.

Figs. 1–3. *Synthecium elegans.*

1. Natural size.
2. Magnified.
3. A portion with gonangia, still further magnified.

Fig. 4. *Halicornaria saccaria*, natural size. (For magnified details of this species see Pl. XXII. figs. 1, 2.)

Plate XVI.

Figs. 1–5. *Thuiaria crassicaulis.*

1. A nearly perfect colony, natural size.
2. Portion of a bifurcating branch, magnified.
3. Portion of same, more magnified; lateral view of hydrothecæ with gonangium.
4. Same, front view of hydrothecæ.
5. Transverse section of stem near proximal end, magnified, showing the great central irregular canal and the peripheral canals in the thick chitinous perisarc.

Plate XVII.

Figs. 1–3. *Thuiaria coronifera.*

1. Natural size.
2. Part of a branch, magnified.
3. Hydrotheca, front view.

4–6. *Thuiaria persocialis.*

4. Natural size.
5. A portion, magnified, showing the tendril-like processes.
6. Hydrotheca, front view.

Plate XVIII.

Figs. 1, 2. *Thuiaria bidens.*

1. Natural size.
2. A portion, magnified.

3, 4. *Thuiaria cerastium.*

3. Natural size.
4. A portion, magnified.

Plate XIX.

Figs. 1, 2. *Selaginopsis fusca.*

1. A portion of the hydrophylon in its natural condition, magnified.
2. A portion after having been boiled in a solution of caustic potash, showing the form and relation of the hydrothecæ.

(For *Selaginopsis fusca,* natural size, see Pl. XII. fig. 1 *a*, *a.*)

3, 4, 4ª. *Thuiaria dolichocarpa.*

3. Natural size.
4. Portion of a pinna, magnified, with proximal portion of hydrotheca.

4ª. Distal portion of same hydrotheca.

Plate XX.

Figs. 1–4. *Pericladium bidentatum.*

1. A portion of a colony, natural size.
2. One of the bifurcating branches, magnified.
3. A portion of a branch near its proximal end, with gonangia, still more magnified.
4. A portion of a branch near its distal end, magnified still further.

Plate XXI.

Figs. 1–4. *Aglaophenia acanthocarpa.*

1. A colony, natural size.
2. Portion of a pinna, magnified, lateral view.
3. Same, front view.
4. A corbula, magnified. (In order to give the figure greater clearness the leaflets of one side are omitted.)

5–7. *Aglaophenia laxa.*

5. A colony, natural size.
6. Portion of a pinna, magnified, lateral view.
7. Same, front view.

Plate XXII.

Figs. 1, 2. *Halicornaria saccaria.*

1. A portion of stem with two pinnæ, one carrying a gonangium, magnified, lateral view.
2. A gonangium, less magnified than in fig. 1, front view.

(For *Halicornaria saccaria*, nat. size, see Pl. XV. fig. 4.)

3, 4. *Halicornaria insignis.*

3. Portion of a pinna, magnified, lateral view.
4. One of its hydrothecæ, front view.

(For *Halicornaria insignis*, nat. size, see Pl. XXIII. fig. 1.)

Fig. 5. *Halicornaria bipinnata*, portion of stem and pinna, magnified.
(For *Halicornaria bipinnata*, nat. size, see Pl. XXIII. fig. 2.)

Plate XXIII.

Fig. 1. *Halicornaria insignis*, nat. size.
2. *Halicornaria bipinnata*, nat. size, drawn from a small specimen.
(For the magnified details of this plate see Plate XXII. figs. 3, 4, 5.)

On the supposed Rarity, Nomenclature, Structure, Affinities, and Source of the large human Fluke (*Distoma crassum*, Busk). By T. SPENCER COBBOLD, M.D., F.R.S., F.L.S., Lecturer on Parasitic Diseases.

[Read February 10, 1875.]

IT will be within the recollection of some of the senior members of the Society that about thirty years ago Professor Busk discovered fourteen large flukes in the duodenum of a Lascar who died at the Seamen's Hospital. Not only were these parasites correctly regarded as new to science at the time, but, what is more remarkable, no second instance of the occurrence of this entozoon has since been placed on record. To be sure, there are several human parasites that have only once been observed; but these instances refer, for the most part, to minute helminths, such as the dwarf tapeworm (*Tænia nana*) and the almost microscopic fluke known as the *Distoma heterophyes*. It is therefore, I repeat, rather strange that during the interval elapsing from the winter of 1843 to the spring of 1874, this comparatively large Trematode should not have been again encountered—and the more so, since our professional friends stationed in India, and throughout the East generally, have of late years shown great activity in searching for entozoa.

In reference to the assumed rarity of the parasite, it will not be out of place to refer to other instances of a similar kind affecting animal hosts. I will adduce only two cases, in both of which the entozoa, though now known to be abundant, were for a long time overlooked, and consequently supposed to be extremely rare.

In the year 1858 I discovered a small fluke in the liver-ducts of an American red fox (*Canis fulvus*) that had died at the Zoological Society's Gardens; but no second instance of the occurrence of this parasite (*Distoma conjunctum*) was recorded until the year 1871, when Dr. Lewis found great numbers infesting the pariah dogs of India. The second and far more striking instance of verification after a long interval of time is that of *Stephanurus dentatus*. This rather large Nematode was originally discovered by Natterer at Barra do Rio Negro, Brazil, in 1834. He found it infesting a Chinese variety of the common hog. It was shortly afterwards described and figured by Diesing; and nothing could exceed the accuracy of the description given by the Vienna helminithologist, who at the time was still in possession of his eyesight. Here, again, however, no second instance of the occurrence of the "parasite" was made known until thirty-five years had elapsed. In the year 1869 Professor Verrill described what he very naturally supposed to be a new entozoon infesting the hogs of the United States. He called the species *Sclerostoma pinguicola*. Specimens of these worms, however, having been forwarded to me by Professor Fletcher, of Indianapolis, I at once saw that Verrill's *Sclerostomata* were the *Stephanuri* of Diesing and Natterer. Subsequently also I detected this self-same entozoon in a batch of parasites sent from Australia to the Microscopical Society of London for the purpose of identification. It thus appears, from the case of *Stephanurus*, that a parasite capable of producing serious mischief and even death amongst well-known animals may evade rediscovery for a very long period of time, and this, too, notwithstanding the ever-increasing number of natural-history observers. Of more importance, also, is the consideration that many a species, hitherto assumed to be extremely rare and local, may turn out to be both numerically abundant and of wide geographical distribution. As will be seen in the sequel, the latter part of this inference applies with some force to the parasite now before us; and I should not be at all surprised if its supposed rarity were eventually proven to be without foundation in fact.

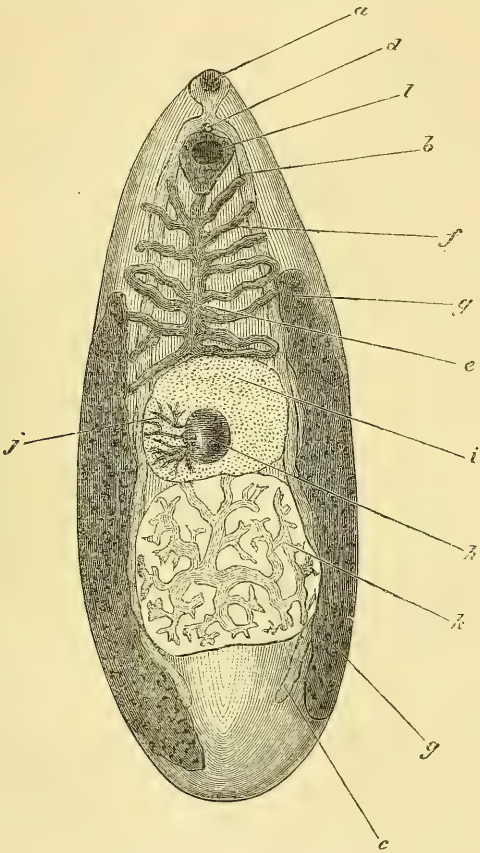
For an opportunity of securing fresh examples of the *Distoma crassum* I stand indebted to Dr. George Johnson, F.R.S., who in the spring of last year recommended two of his patients—a missionary and his wife—to call on me in order that I might have an opportunity of examining and identifying the parasites that were occasionally escaping their bearers *per vias naturales*. I should mention that Dr. Johnson readily recognized the trematode character of the helminths, and that he advised accordingly. Reserving purely professional details for publication elsewhere, I have to state that from the missionary and his partner I learned that they had been resident in China for about four years. During that time they had together freely partaken of fresh vegetables in the form of salad, and also occasionally of oysters, but more particularly of fish, which, in common with the oysters, abound in the neighbourhood of Ningpo. From their statements it appeared to me that to one or other of these sources we must look for an explanation of the fact of their concurrent infection. Fluke larvæ, as we know, abound in mollusks and fish; but whether any of the forms hitherto found in oysters or in fish have any genetic relation to the flukes of man, is a question that cannot very well be settled in the absence of direct experimental proof. I should add that it was not until after their visit to the interior of the country, some 130 miles distant from Ningpo, that the symptoms which Dr. Johnson and myself consider to have been due to the presence of the parasites made their appearance. Whilst in the country they freely partook of freshwater fish, and on one occasion they received a quantity of oysters that had been sent up from Ningpo. The missionary assured me that the fish were always thoroughly well cooked.

From the size and almost leathery texture of the two flukes which were in the first instance submitted to my notice, I at once recognized the species; but as they were spirit-specimens, I requested that if any more examples were obtained they should be sent to me in the fresh state. Fortunately others were brought in a few days, when, from an examination conducted whilst they were still fresh, I was able to make out several details of structure which had hitherto escaped notice. Altogether I secured seven specimens, three of them being in a mutilated condition. In what way these mutilations (as shown by the dried specimens) occurred I have not been able to make out, either by personal observation or by questioning the bearers. Two of the parasites look as though their bodies had been carefully excised near their centre. Such new facts as I have gleaned were derived from two comparatively small specimens, one of which, in the dried state, has since been deposited in the anatomical department of the University Museum at Oxford. I may add that I took the earliest opportunity of bringing some of the specimens under Mr. Busk's attention, when he at once recognized them as referable to the species he had so long ago discovered.

Of the fourteen original specimens found by Mr. Busk, several have been lost. The one that he himself gave me I handed over to Professor Leuckart; and it is figured in his work (Die mensch. Par. i. s. 586). A second is preserved in the Museum attached to the Middlesex Hospital; and a third is contained in the Museum of the Royal College of Surgeons. This last-named specimen is the best of the original set. It supplied me with the few details of structure figured in outline in my 'Introductory Treatise' (fig. 42, p. 193), published in 1864; and it also in part formed the basis of the description of the species communicated to this Society in June 1859 (Synopsis of the Distomidæ, p. 5, Proceedings, vol. v.). The late Dr. Lankester, it is true, in his English edition of Küchenmeister's work on Parasites, was the first to give a distinctive title to this entozoon (*Distoma Buskii*); but as the discoverer objected to this nomenclature, and as Dr. Lankester's proposed terms were unaccompanied by any original description, I requested Mr. Busk to suggest a new name for the worm, which he accordingly characterized as above. As I subsequently pointed out, Von Siebold had already employed the compound title *Distoma crassum* to designate a small fluke infesting the House-Martin (*Hirundo urbica*); but for reasons similar to those which contributed to set aside Dr. Lankester's nomenclature, the title adopted in my synopsis at length came to be recognized by Leuckart and other well-known helminthologists. Before this recognition took place, however, Dr. Weinland, of Frankfort, had so far accepted Lankester's nomenclature as to call the species *Dicrocœlium Buskii*. In my judgment there were no sufficient grounds for placing the parasite in Dujardin's unsatisfactory genus. Be that as it may, I have only further to observe that in addition to the original specimens above particularized, two others are preserved in the Museum at King's College. Thus probably only five out of the fourteen specimens are still in existence; and such being the case, I have thought it worth while to collect and record these few particulars.

The earliest literary notice of the entozoon appeared in Dr. Budd's classical treatise 'On Diseases of the Liver;' and in it the author correctly stated, from data supplied by Dr. Busk, that these human flukes were "much thicker and larger than those of the sheep," being, it is added, from "an inch and a half to near three inches in length." The longest of my recent specimens, however, scarcely exceeds two inches, whilst the smallest and most perfect (the one at Oxford) measures less than an inch from head to tail. The greatest width of my broadest specimen is little more than half an inch, or $\frac{9}{16}''$. None of the twelve examples that I have examined approach the length of three inches; but Mr. Busk assured me that, judging from his recollection, some of his specimens were even longer than that. I fear, nevertheless, that the estimate given in my Synopsis is somewhat exaggerated; at all events it is so for average specimens.

The new anatomical facts made out by me bear reference principally to the reproductive apparatus. What else I have observed is, for the most part, confirmatory of the statements made by Mr. Busk. In particular, his brief account of the position and character of the digestive organs was not only confirmed by my earlier examinations, but is now reverified. In the representation given in my 'Introduction' I showed in dotted outline two large organs which I supposed to be the testes. I distinctly observed radiating lines proceeding from each of these masses; but I could not discover the slightest trace of any limiting border to



Distoma crassum, Busk.

a, oral sucker; *b*, digestive tube; *c*, cæcal end of the same; *d*, reproductive papilla; *e*, central uterine duct; *f*, lateral process or fold of the same; *g*, vitelligene gland; *h*, diverticulum; *i*. ovary; *j*, probable shell-gland; *k*, testis and seminal ducts. Magnified twice the natural size.

either organ. I have now found in their place two irregularly spherical and flattened masses with clearly defined limits (*i*, *k*). I entertain no doubt as to the testicular character of the lower organ (*k*). In the outline drawing I further indicated the presence of a third and much smaller globular mass, which I termed the ovary; and this organ was seen with remarkable distinctness in most of my recent specimens (*h*). The radiating, broad and branching seminal ducts were in all cases beautifully distinct, forming the most attractive feature of the parasite's organization (*k*). Connected with the supposed ovary were a number of small but very conspicuous tubes, which stood out as if they formed a special organ (*j*), whose common ducts emptied themselves into, or were connected with, the ovary. In whatever way we may interpret its character, nothing could exceed its distinctness in the fresh state; and it may still be seen with clearness in one or two of the dried specimens. The supposed upper testis (*i*) displayed no radiating seminal tubes; consequently I now conclude that it is the ovary, whilst the small, black, spherical body lying immediately in front of it is what Von Siebold would call the internal seminal vesicle (*h*). It is probably a diverticulum formed at the junction of the ovarian and vitelligene ducts, whilst the singular branched tubes in all likelihood represent a special shell-gland (*j*). I made out the female reproductive organs with somewhat more completeness. In the outline drawing already referred to, I gave a diagram of the probable position of the uterine folds, reducing the organ to the simplest condition. The conjecture was right. In the fresh specimens, I found the uterus to comprise a large number of unevenly folded tubes, which apparently proceed laterally from either side of a large median duct (*e*). This duct could be distinctly traced to its outlet in the reproductive papilla, which, as usual in true Distomes, is placed in the middle line, immediately above the ventral sucker. In my examination of Mr. Busk's original specimens I could not find the slightest trace of vitelligene organs; but in the present set of fresh examples I not only obtained proof that these organs were largely developed, but that their limitations could be fixed with accuracy (*g g*). They consisted of two large elongated masses, one on either side of the body, occupying about two thirds of the entire length of the parasite. Their yelk-vesicles were distinctly seen; but the main efferent canals were only here and there traceable. Clearly the position and character of the yelk-forming glands of the large human fluke are quite unlike those of any of its congeners. This fluke is a remarkably fine species, and, when viewed in the fresh state with a powerful pocket-lens, presents a most striking appearance. I did not observe any cutaneous spines. I found the eggs to present an average long diameter of about $\frac{1}{200}''$, by $\frac{1}{330}''$ in breadth. They are therefore somewhat smaller than those of the common fluke. In the specimen preserved in the Hunterian Museum there was evidence of the presence of an excretory outlet at the caudal extremity; but in the present examples I did not succeed in finding any trace of the water-vascular system. I have no doubt, however, that it exists in the usual form.

As regards the affinities of *Distoma crassum*, it is clear that this Trematode has little in common either with the liver-fluke of cattle and sheep (*Fasciola hepatica*), or the still larger species obtained by me from the giraffe (*Fasciola gigantea*). The simple character of the digestive tubes obviously connects it more closely with the lancet-shaped fluke (*Distoma lanceolatum*—the last-named parasite being also an occasional resident in the human liver, where its presence has been known to contribute to the production of a fatal result. Here, I may remark that it has struck me as not a little singular that most of the flukes which take up their residence in the liver exhibit a branched arrangement of the digestive tubes; and but for the circumstance that the *Distoma lanceolatum* forms a notable exception, I should have been disposed to consider that a branched state of the alimentary apparatus was of necessity associated with this special habitation. At all events it is interesting to observe that no species of intestinal fluke is known to display this complex form of digestive apparatus, the species before us forming no exception to the rule. In the fluke (*Campula oblonga*) that I discovered in the liver of a porpoise, there were traces of this tendency of the tubes to branch, whilst an extreme development of this sort is seen in the fluke which proves so destructive to elephants (*Fasciola Jacksoni*). Taking the genus *Distoma* as representing central type forms of the Trematoda, I look upon the flukes that have dendritically branched cæca as aberrant types; and it is just these particular forms that show the strongest zoological affinity with the Planarians, not only by virtue of the anatomical peculiarity in question, but also as regards their habits. If the contents of the cæca be examined, epithelium and blood-corpuscles derived from their bearers will be found amongst the *débris*; and it is well known that the Planarians, especially the terrestrial forms, are carnivorous in their habits. In proof of this view of their habits, Mr. Moseley has recently brought forward additional evidence in his elaborate memoir "On the Land-Planarians of Ceylon" (Phil. Trans. 1874). The significance of these facts in relation to any theory of descent must not be lost sight of. Without dwelling upon that point, however, I pass on to observe that our *Distoma crassum*, both as regards the restricted charcter of the vitelligene glands and the simple form of the testis, and also in respect of the unbranched state of the digestive cæca, shows a close adherence to the central Distome type, in which, as we have seen, Mr. Busk originally placed it. If there be any structural departures from the common type, they are connected with the testes. I believe that the two organs are here merged in one large compound gland. Amongst Trematodes, as Von Siebold long ago pointed out, such an arrangement occasionally exists. Further observations are necessary to clear up this and one or two other points of structure which I strove in vain to make out accurately. Nevertheless, fragmentary as the present data are, it is something not only to have stumbled upon a second and a third instance of the occurrence of this rare entozoon in the human body, but also to have been enabled to confirm the truth of almost all that had been previously conjectured respecting its structure, and at the same time also to have acquired new facts of sufficient importance to fix the affinities with precision.

Here my paper, as regards new facts, virtually closes; but so much interest naturally attaches itself to the question of the origin and early stages of growth of the parasite, that I feel our time will not be wasted if we take into consideration some of the more important and recently ascertained facts that tend to throw light upon the subject.

At the outset I hinted that the Ningpo oysters may have played the *rôle* of intermediary bearers in the case before us; and as tending in some measure to strengthen that notion, it should be borne in mind that Mr. Busk's original fluke-bearer came from eastern parts. It is not improbable, therefore, that the Lascar may have partaken of the same species, either of fish or of shell-fish, that the missionary and his wife partook of. Be that as it may, the frequency of the occurrence of Trematodes and their larvæ in marine mollusks is well known; though until comparatively lately it was not so well understood that the singular double-tailed redia or organized germ-sac, known as *Bucephalus*, was an occupant of saltwater as well as freshwater mollusks. The original specimens which gave origin to the genus were found by Von Baer in the freshwater mussel; but since the publication of his memoir (Nova Acta, xiii.), the same, or at all events similar forms of larvæ have been encountered in a variety of mollusks. Up to the present time *Bucephali* have been found in *Unio pictorum*, *Anodonta cellensis*, and *A. anatina*, *Cardium edule* and *C. rusticum*, *Ostrea edulis*, *Planorbis marginata*, and in one or more species of *Paludina*. According to Woodward, several species of oyster are sold in the Indian and Chinese markets; so that there may be some difficulty in determining the particular species to which the Ningpo oysters should be referred.

Now that I am thus incidentally led to speak of the *Bucephali*, I may mention that on the 7th of last October several examples of free rediæ were exhibited by Mr. Badcock at a Meeting of the Royal Microscopical Society, on which occasion Mr. Charles Stewart, Mr. White, Mr. Slack, and other well-known microscopists communicated observations. I understood that Professors Huxley and Reay Greene determined the bucephaloid character of these cercarians from specimens that were separately brought under their notice.

The recent contribution by M. A. Giard on the encystation of *Bucephalus Haimeanus* contains important additions to our knowledge, whilst at the same time it affords a useful summary of the facts previously supplied by Von Baer, Steenstrup, Von Siebold, Claparède, and Lacaze-Duthiers. Dr. Pagenstecher's memoir appears to have escaped Giard's notice; yet the Heidelberg savant was one of the first to point out that the highly contractile double tail-like appendages of this remarkable germ-sac were capable of developing into new germ-sacs, which latter, in their turn, developed within them fresh *Bucephali*. M. Giard shows that *Bucephalus Haimeanus* encysts itself in the viscera of the garfish (*Belone vulgaris*), especially in the peritoneum, liver, and genital glands (Comptes Rendus, Aug. 17, and Ann. Nat. Hist. for Nov. 1874). The predilection of *Bucephali* for the reproductive territory, so to speak, causes sterility in their molluscan intermediary bearers. This was pointed out by Claparède, who also found rediæ of this kind attached to Medusæ; but since there was no evidence to show that this attachment presented the semi-parasitic character of a commensal or fellow-boarder, it is fair to suppose that the connexion was merely accidental. The free *Bucephali* found by Claparède off the coast of Normandy did not differ materially from those obtained by Lacaze-Duthiers from the Mediterranean.

From all the facts at present before us M. Giard argues that it is most probable the *Bucephali* of the garfishes attain sexual maturity as *Gasterostomata* in sharks and dogfishes, and perhaps also in certain large species of *Gadidæ*, which feed on the garfishes when they frequent the shore for the purpose of spawning. In drawing this conclusion, M. Giard has probably been much influenced by the opinion of Von Siebold, who long ago suggested, but of course could afford no experimental proof, that *Bucephalus polymorphus* was the larval representative of *Gasterostoma fimbriatum*.

If we accept these views, as I believe we must, it becomes extremely unlikely that the *Bucephali* should in any way be concerned in causing the infection of our missionary and his wife; nevertheless there remains the probability that the human bearers in question swallowed other kinds of Trematode larvæ when they consumed the Ningpo oysters. Moreover, if it should happen that none of the other larvæ occurring in oysters are capable of developing into flukes in the human territory, it yet remains highly probable that some one or other of the various encysted (and therefore sexually immature) Trematodes known to infest marine fishes will turn out to be the representative of our *Distoma crassum*. In this connexion we must not forget that Leuckart has pointed to the flesh of Salmonidæ as the probable source of human *Bothriocephali*; and there is some likelihood that salt-water fishes, if not actually the primary, may become (after the manner explained by M. Giard) the secondary intermediary bearers of fluke-larvæ.

On the whole, I am still inclined to look to the Ningpo oysters, or to some other of the various species of marine shell-fish sold in eastern markets, as the direct source of *Distoma crassum*; for, in addition to the bucephaloid cercarians, we have abundant evidence of the existence of other and more highly developed fluke-larvæ in bivalve mollusks. So far back as the year 1841 Mr. Garner, F.L.S., in his paper on the Lamellibranchiate Conchifera (Zool. Trans. vol. ii.) referred to a species of *Distoma* in the freshwater Mussel; and he subsequently attempted to prove the parasitic origin of pearls from a similar source (Brit. Assoc. Rep. 1862). I had an opportunity of examining some of these *Distomata*, and satisfied myself that they were only sexually immature forms awaiting their final passive transference to the intestine of some vertebrate host. To be sure, the ultimate bearer need not be the human species; yet, on the other hand, such a contingency is by no means improbable. Here I would remark that we have very little knowledge of the parasites which take up their abode in the viscera of savages. This ignorance results partly from the fact that these untutored races, as proved by the statements of Kaschin and others, actually suffer much less from the presence of intestinal worms than their civilized congeners do, and partly because no one, so far as I am aware, has cared to institute the necessary inquiries in a methodical way. I strongly suspect that several of the human parasites which we now consider to be rare would be found to be abundant, if, by means of *postmortem* examinations and other methods of investigation, we could be made acquainted with the facts of helminthism as they occur amongst the fish- and raw-flesh eating savage tribes. Of course any person, notwithstanding the utmost care and cleanliness, as in the cases before us, may contract a noxious parasite; nevertheless, speaking generally, it may be said that the measure of internal parasitism affecting any given class of people bears a strict relation to the degree of barbarism shown by such persons in their choice of food and drink, and in their manner of eating and drinking. This statement, if true, is not destitute of sanitary importance. Thus we may say to those interested in the matter, "Imitate the Cossacks, Burates, and Abyssinians in their fondness for raw meat, and you will be invaded by *Tæniæ*; or imitate the very similar habits of North Greenlanders in respect of fish, and you will probably enjoy the privilege of entertaining *Bothriocephali.* If you have a predilection for unfiltered waters, you are likely, sooner or later, to play the *rôle* of host to some highly irritating nematode guest; or, as so frequently happens in Iceland and Australia, you will be particularly liable to contract the so-called *Echinococcus*-disorder." Clearly it remains to be proved that shell-fish are altogether unconcerned in the matter of human helminthism; yet I quite believe that danger from this source is limited to certain mollusks living in eastern waters. In all likelihood the *Distoma crassum* is obtained by the consumption either of fish or of shell-fish. There remains, however, the consideration that its larvæ may possibly reside in minute slugs frequenting vegetables employed as salads. The rarity of fluke-disease (or, at all events, of its recognition) is tolerably conclusive against the latter view. At the Bath Meeting of the British Association, in 1864, Mr. Gwyn

Jeffreys maintained that the *Cercariæ* found in *Succinea* were the sexually immature representatives of the common liver-fluke (*Fasciola hepatica*), which, I may observe, has some twenty times been found infesting the human body. At the time in question I maintained that Mr. Jeffreys's opinion had no foundation in fact, as the negative data supplied by Moulinié and Leuckart strongly went to prove. It now turns out, from the experimental proofs recently afforded by Dr. Ernst Zeller, that the cercarian contents of *Leucochloridium* found in *Succinea* attain sexual maturity in the intestines of various insectivorous birds of the family Sylviadæ. I am indebted to Mr. Dallas for first calling my attention to this discovery. (See Ann. Nat. Hist. for Feb. 1875, p. 146; from Humbert, in Bibl. Univ., Bull. Sci. 1874, p. 366; also Zeller in S. & K. Zeitsch. für wiss. Zool. vol. xxiv. p. 564, 1874.) In connexion with any explanation of the rapid appearance of fluke-disease amongst animals in particular districts, it is especially worthy of remark that the *Cercariæ* of *Distoma macrostoma* pass into the sexually mature condition in a few days after their change of residence has been effected, whilst in less than a week's time the formation of ova has already commenced.

In conclusion, I ought perhaps to apologize for having introduced so many remarks of a practical nature into a paper otherwise purely zoological; but the supposed extreme rarity of our *Distoma crassum*, its apparently formidable character as a human guest, and the special precautions that appear to be necessary against infection have together seemed to me to be a fair excuse for sounding a note of warning to naturalists and others whose rambles or professional duties may happen to carry them to the shores of the Chinese and other eastern seas.

Similitudes of the Bones in the Enaliosauria. By Harry Govier Seeley, F.L.S., F.G.S., Professor of Physical Geography in Bedford College, London.

[Read March 18, 1875.]

PART I.

THE RESEMBLANCES OF ICHTHYOSAURIAN BONES TO THE BONES OF OTHER ANIMALS.

§ 1. *The Mammalian Characters of* Ichthyosaurus.

A skull of *Ichthyosaurus* could not easily be changed into that of a mammal; for though Cetaceans offer close resemblance of *form*, especially in the snout, the lateral position of the exterior nares in *Ichthyosaurus*, in front of the large circumscribed circular orbits, necessitates the enormous lateral development of the premaxillaries and a backward position of the maxillary bones. The lateral relation of the premaxillary bones in *Icthyosaurus* divides them proximally, and allows the nasal bones a large space in which to elongate and widen between them; while in Porpoises (supposing the bones correctly determined) the nasal bones are small, and only just indent the premaxillary bones behind, and the premaxillary bones, drawn together mesially, allow the maxillary bones to extend external to them along their length, and to carry the teeth. In early life Porpoises, like Ichthyosaurs, carry their teeth in a groove instead of in sockets.

Wagler and other naturalists have compared the foramen parietale of Ichthyosaurs to the spiracles of Porpoises. And as the foramen descends obliquely forward into the skull, the structures have characters in common. If, then, we suppose the perforations to have become larger with functional activity in the Porpoise and more nearly vertical than in *Ichthyosaurus*, so as to have advanced forward through the frontal bones, then the median premaxillary bones of the Porpoise would have to be called nasals to bring them into harmony with *Ichthyosaurus*, while the maxillary bones would become the premaxillaries. But however plausible this interpretation looks in the skull seen from above, it becomes untenable on turning to the palate, where in both types (using the usual nomenclature) the premaxillary bones form the end of the snout, and are parted by the vomers behind, while the maxillary bone in both carries teeth and extends back beyond the alveoli.

In those Porpoises in which the occipital condyles blend into one long crescent, the single articulation is entirely made by the exoccipital bones, excluding the basioccipital; while in *Ichthyosaurus* the basioccipital forms the entire condyle and excludes the exoccipital bones.

In the Elephant the external nostrils are far back, but the nasal bones are entirely behind them; and, after the manner of all mammals except the true Whales, the maxillary bones meet mesially on the palate, which they never do in Ichthyosaurs.

The centrum of a vertebra is not usually quite so long in *Ichthyosaurus* as in Porpoises, and differs in being deeply biconcave (as in fishes), in not having epiphyses, in having the transverse process replaced by tubercles for the rib, in the not dissimilar neural arch being permanently separated from the centrum, while chevron bones are wanting in the tail, the caudal vertebræ elongate towards its end, and the prepelvic ribs have a double articulation with every vertebra.

No mammal has the rib articulated to the centrum by two articular facets; nor have mammals caudal ribs, as in *Ichthyosaurus*; nor are the short sternal bones ever transversely elongated to form median pieces which lap along the sides of sternal ribs.

The resemblance of the ichthyosaurian pectoral girdle to that of monotreme mammals is not close; for in the monotreme the coracoids are divided so as to form a pair of precoracoids which meet mesially, and are overlapped by the interclavicle, while no such division is seen in Ichthyosaurs; the scapula is a squamous broadly expanded bone with an acromion, very unlike the narrow elongated bone of *Ichthyosaurus*; the clavicles of the monotreme only extend to the acromion, instead of lapping along the whole anterior margin of the scapula as in *Ichthyosaurus*; and the interclavicle laps behind the clavicle, instead of beneath it as in *Ichthyosaurus*. The clavicle and interclavicle are the only bones which have any close similarity of form in the two types. The combined coracoid and precoracoid of the monotreme would not give the form of the coracoid bone in *Ichthyosaurus*, from which there would be a notable difference in the great thickness of the acetabular part of the bone.

The pelvic girdle is less like that of a mammal. There is a similarity in the ischium being larger than the pubis, in the narrow pubis having a straight anterior border, and in its being (sometimes) anchylosed to the ischium to enclose an obturator foramen. I do not remember any evidence whether the narrow curved iliac bones were inclined forward or backward: they had no osseous union with a sacrum. As a whole, the pelvis is probably least unlike that of the monotreme, omitting from consideration the prepubic bones, to which *Ichthyosaurus* has nothing corresponding.

The humerus has a general resemblance to that of Cetaceans in the shortness, strength, and compression of the bone, in the distal end being formed of the flat inclined articular facets, in the proximal end being hemispherical, and in the flattened underside of the bone being obliquely concave. The differences are, that in Cetacea the outer trochanteroid ridges are suppressed, while those on the inner side are so much developed, after the plan of the proximal end of the femur in *Chelone*, as to give the Porpoise-humerus a character very unlike *Ichthyosaurus*. The ridges on the humerus of *Ornithorhynchus* may also be compared.

In no mammal is a parallel found to the shortness of the ichthyosaurian ulna and radius, or to the uniform (commonly quadrate) shape of the other bones of the limb or to their arrangement, so that every surface except the exterior surface commonly touches another bone in the adult. Some Ichthyosaurs have a separate olecranon-ossification.

The femur in shortness and strength recalls some Seals; but in arrangement of parts the resemblance is closest to *Ornithorhynchus*, which similarly has lateral trochanters which extend the width of the bone at the proximal end, though in *Ichthyosaurus* they are not divided from the rounded articulation. In *Ichthyosaurus* the bone is shorter, compressed at right angles to the head at the distal end, which does not articulate chiefly with the tibia, but gives an equal flattened facet to both tibia and fibula. No mammal offers any parallel to the other bones of the hind limb, though in Cetacea the limbs are similarly enclosed in a fin-like sheath.

Prof. Owen has thought that since in Cetacea the terminal caudal vertebræ supporting a transverse fin are compressed from above downwards, we may infer that *Ichthyosaurus* had a vertical fin, since the terminal caudal vertebræ are compressed from side to side. But in the human species the caudal vertebræ are compressed from above downward, and in Crocodiles they are compressed from side to side, without in either case carrying a corresponding terminal fin.

§ 2. *The Avian Characters of* Ichthyosaurus.

Many birds, in general form of the head, resemble *Ichthyosaurus* in its different species; but in details the correspondence is not close. Thus, though in both the (usual) backward position of the external nares prolongs the premaxillary bones backward, diverging, along the alveolar border, yet in birds a median ray is prolonged backward between the nares, and overlapping the large nasal bones, so as to nearly hide them, and look from the outside as though it divided them; while in *Ichthyosaurus* there is no such median ray, and the separate premaxillary bones are divided by nasal bones relatively larger than those of Struthious birds. The premaxillary bones usually make more of the palate in birds than in Ichthyosaurs. The occipital condyle is similarly single, but the exoccipital bones partly contribute to form it, in birds. In both types the base of the sphenoid is expanded, and gives attachment in front to a long slender præsphenoid bone.

There is a difficulty in determining the bones of the Ichthyosaurian palate: the large bones which meet the quadrate bones and lap round the sides of the basisphenoid are unlike in form and relations to the style-shaped pterygoids of birds; then there is no certain evidence whether they give attachment to large and more bird-like palatines (usually anchylosing with the pterygoids), or whether the entire bone is pterygoid bone. But in any case there is a difference from birds in the long anterior ends being prolonged between the vomers, and in the existence of a long bone between the maxillaries, which, if the anterior parts of the inner pair of bones are the palatines, would be transverse bones, and which, if the entire bone is the pterygoid, would be palatine bones.

In many birds there is similarly a circle of sclerotic bones to the eye. Among the more striking differences, in birds the orbit is not usually surrounded by a circle of separate bones. The prefrontal and lachrymal are anchylosed together. The quadrate bone is never hidden by other bones, though it is partially covered in some struthious birds; there are no postorbital or supraquadrate bones, and usually no postfrontal. The lower jaw in *Ichthyosaurus*, except the hoof-like articular bone, is made by a number of long splint-like bones overlapping each other laterally, unlike those in the jaw of a bird.

There is nothing like the vertebral column of *Ichthyosaurus* among birds. The chief differences are in the absence of separate cervical and caudal ribs in the bird, in the large sacrum, in the transverse platform-processes to the dorsal vertebræ, in the union of the neural arch in each vertebra with its centrum, in the elongated centrum of the bird (which, however, exceptionally has biconcave articular ends, especially in the tail and back). There is a great difference usually in number of vertebræ, especially as seen in the relative lengths of neck and tail.

The costal ribs of Ichthyosaurs have two heads; but they articulate not with facets (except the upper head in the neck) or concavities, but with tubercles, which are always on the centrum. The median sternal ribs of Ichthyosaurs have in birds become a continuous median ossification or sternum.

The pectoral girdle of birds is not like that of Ichthyosaurs; and the difference is largely due to the development of a sternum in birds. The sternum of a young struthious bird, while its two halves remain separate, has quite the aspect of a pair of potential coracoid bones. And with such a view the interpretation of the keel in carinate birds as the potential interclavicle would be in harmony, since it overlaps the line of union of the two bones as in *Ichthyosaurus*.

The compressed elongated scapula of the bird, enlarging at the articular end, differs from that of *Ichthyosaurus* more in its slender proportion than in its plan, though it has in many water-birds an acromial tubercle for the end of the clavicle, and does not receive that bone along its whole anterior margin.

The clavicle of the bird differs from the typical single clavicle of *Ichthyosaurus* only in wanting connnexion with the margin of the scapula and with an interclavicle (unless it is supposed to occur when the clavicle articulates with the sternal keel). The coracoids of birds differ from those of Ichthyosaurs in their elongated form and in not meeting each other mesially.

The pelvis of a bird is entirely unlike that of an Ichthyosaur. In the Emu the pubis and ischium are more slender than in most Ithyosaurs; but the pubis has not the straight anterior margin of *Ichthyosaurus*, and the ischium has a tubercle towards the proximal end (by which it meets the side of the pubis), which in *Ichthyosaurus* is not developed. The ilium is totally different.

In the limbs of birds there is no structural resemblance, either in the forms of the bones or in their arrangement.

§ 3. *The Crocodilian Characters of* Ichthyosaurus.

The crocodilian head is usually more depressed than in any Ichthyosaur, and, except in the Gavials, has not so pointed a snout, while the surface of the cranial bones is always more or less pitted. The chief changes necessary to convert the crocodile into *Ichthyosaurus* would be an enormous enlargement of the eye, so as to raise it from its nearly flat position to a nearly vertical one. This would draw the maxillary bone up till it was nearly vertical, draw the prefrontal and postfrontal together above the orbit, and allow an enormous median triangular space for the nasal bones to expand in and encroach upon the frontal. The enlarging of the orbits would enlarge the temporal fossæ and extend the squamosals backward. The vacant space in the Crocodile-skull behind the orbit and between the postfrontal and malar would need to be covered by two bones—a postorbital (completing the orbit), and a supraquadrate (between the squamosal and quadrato-jugal).

These changes would probably bring the quadrate bone vertical. The parietal and frontal would both have to be double; and the anterior nares would have to be divided and carried backward between the maxillary and nasal bones till they met the lachrymals, prolonging, with them, the premaxillary bones, partly at the expense of the maxillary bones, and partly hiding them by overlap. Then, by adding a foramen parietale between the parietal and frontal bones, so far as the essential external characters went, the head of a crocodile would have become the head of *Ichthyosaurus.* Then, to complete the correspondence on the palate, it would be necessary to connect the quadrate bone made vertical with the hinder angle of the pterygoid, and to separate the pterygoid and palatine bones so as to exhibit the basisphenoid and presphenoid, circumscribe a large pear-shaped palatal vacuity wide behind, and obliterate the maxillo-pterygoid fossæ by pressing the palatine against the transverse bone. The vertical position of the maxillaries draws them apart on the palate, and away from the palatines, so that the premaxillaries are introduced internal to the maxillaries in front; and the vomers are introduced between the premaxillaries and the diverging palatines behind. Thus by opening the crocodilian palate it becomes ichthyosaurian.

The resemblances between the two types are thus seen not to be close; but the differences are chiefly dependent upon the position and condition of the orbits and nares. In both the occipital condyle is single; but in Crocodile it is hemispherical and small, and its upper angles are made by the exoccipital bones. In both the temporal fossa is surrounded by parietal, squamosal, and postfrontal bones. In the orbit the differences are that in *Ichthyosaurus* the frontal bone is entirely excluded, and the postorbital bone becomes ossified. The lower jaw has a general resemblance in both; but the os articulare is longer in Crocodile than in *Ichthyosaurus.* The teeth placed in a groove are in this said to be comparable to the posterior part of the jaw in the Black Alligator.

In the vertebral column there is but little other resemblance than that both have long tails. The chief points in which the Crocodile differs are:—in having the vertebræ much longer and less numerous, furnished with neural arches which unite suturally, and in the dorsal region give off strong compressed transverse processes to which the ribs are exclusively attached; that the centrum is procœlian, and in the caudal region furnished with chevron bones; that the articulation for the rib in passing from neck to back in Crocodile ascends, while in *Ichthyosaurus* it descends.

The ribs also have little in common; for in *Ichthyosaurus* they are of a generally uniform character, while in Crocodiles there are double-headed ⊥-shaped cervical ribs, double-headed dorsal ribs which never articulate with the centrum, and no caudal ribs at all. There are no median sternal ribs.

The pectoral girdle differs in crocodiles having no clavicles or interclavicle, and by the coracoids articulating with a narrow sternum which extends beyond them anteriorly and posteriorly.

The scapula of the crocodile would have a general similarity of form if its anterior margin were straight instead of being concave; but at the expanded end the surface for the coracoid would have to be in front, and that for the humerus behind; and the coracoids, besides a similar reversal of articular surface, swould require immense antero-posterior expansion to change the hourglass shape of the crocodilian bone into the transversely pedicled ovate shape of the bone in *Icthyosaurus.*

In the pelvis the ilium is quite dissimilar; and the crocodilian ischium differs in supporting the pubis (?) on a pedicle so as to exclude it from the acetabulum. And thus the pubes are thrust forward, so that they do not meet the ischia in the line of symphysis; and the crocodilian pubis never has the anterior margin straight. The ichthyosaurian ischium never has its proximal end so massive as in the crocodile.

The functional elongation of the limbs in crocodiles in relation to movement on land gives to their several segments characters which make comparison with Ichthyosaurs impossible. In the femur the only resemblances are that the articular ends are compressed, the proximal one rounded and at right angles to the distal end.

§ 4. *The Chelonian Characters of* Ichthyosaurus.

On the upper surface of the skull the correspondence between the two types is limited to the median bones of that roof of the skull being double, the elongation of the parietal bones in harmony with large temporal fossæ, the vertical position of the orbits, and an approximation of the prefrontal and postfrontal bones together, so as almost to meet in Chelonians as they do in Ichthyosaurs. Of all that part of the ichthyosaurian skull which is in front of the nares, the Chelonian skull has no representative. If, then, we took such a truncated ichthyosaurian skull and tried to approximate it towards a Tortoise, it would be necessary first to remove the nasal bones entirely. This would expose much of the frontal bones which they cover, and allow the prefrontal bones to be squeezed together to meet mesially and make the upper margin of the nares. A similar compression together of the terminal minute remnants of the premaxillaries would make the lower margin of a single terminal nostril like that of *Testudo*. The foramen parietale must be obliterated, and the supraoccipital developed and prolonged with the adjacent angle of the parietal bones into a strong median occipital crest. The postorbital and supraquadrate bones would be obliterated, and the malar, postfrontal, and quadrato-jugal bones prolonged behind the orbit to meet in a triradiate union. Then, with an inflating auditory excavation of the quadrate and squamosal bones, to outward view the upper part of the Ichthyosaur's skull would have become Chelonian. In the palate there is a primary difficulty with the homology of the bones, because on the ichthyosaurian palate there are small vacuities under the place of the external nares, which might be regarded as posterior nares, either potential or actual; and they are surrounded chiefly by two bones, the vomer internally and what might be the palatine externally, the premaxillary sometimes entering in front. I adopted another interpretation to explain the relation of the palate to that of Crocodiles; this interpretation would be as necessary to harmonize it with that of Chelonians. Then, to complete the resemblance to Chelonians, it would be necessary to unite the two vomers into a single median vomer, into which the pterygoids should not penetrate posteriorly; and then, by extending the pterygoid bones internally till they met mesially so as to hide the presphenoid and cover the palatal vacuity, the change would be perfect but for the want of teeth.

Thus the cranial resemblances of Chelonians to Ichthyosaurs are so slight that they are scarcely of any value. The back of the head is as unlike as the other parts: there the exoccipitals contribute equally with the basioccipital to the condyle, and in Testudinates the opisthotic meets the squamosal bone only, while in *Chelone* it meets the quadrate; in *Ichthyosaurus* it meets the quadrate by curving under the squamosal. The splint character is wanting from the Chelonian lower jaw; it has no keel behind the articulation; and the dentary bone is single.

The vertebral column is very dissimilar, there not being a single character in common.

The ribs, limited to the dorsal region in Chelonians, would seem to be as dissimilar as the vertebræ, unless, indeed, the seemingly double rib of the Ichthyosaur, grooved throughout its length, be an epipleural growth repeating the costal rib upon itself throughout its length, as is the case with Chelonians.

The pectoral girdle is altogether dissimilar, being formed in Chelonians of long spathulate coracoids which do not meet each other mesially, and of rod-like scapulæ which give off a long rod-like precoracoid process.

The pelvic arches are only similar in the form of the ilium, which in both is a short curved bone rather compressed. The two trochanters to the head of the femur of Chelydra, though not so well developed and not opposite to each other, are homologous with those of the head of the femur in *Ichthyosaurus*. Beyond this there is in the limbs no character in common worth dwelling on.

§ 5. *The Lacertian Characters of* Ichthyosaurus.

All living reptiles are with difficulty compared with *Ichthyosaurus*, owing to the backward and lateral position of its nares. *Polychrus anomalus* has the nares far back; and in the Nilotic Monitor they are not near the tip of the snout; but in no lizard do the premaxillaries form the lateral margins of the palate, as in *Ichthyosaurus*; and, contrary to the rule with Ichthyosaurs, they are single and prolonged back mesially between the nares, except when, as in *Monitor*, the nares reach so far back that they are divided by the nasal as they are in *Ichthyosaurus*; only in *Monitor* the nasal bone is single and narrow. Lizards differ in having the whole lateral alveolar border made by the maxillary bones margined by a conspicuous row of foramina.

The orbit of *Ichthyosaurus* is circumscribed by bones as in many lizards, such as *Iguana*, *Uromastix*, *Stellio*, *Scincus*, *Draco*, &c.; but the bones which enter into its outer margin are not the same. At the base in both is the long curved malar, and in front of that in lizards a small, and in Ichthyosaurs a large lachrymal bone, and above that a premaxillary; and both agree in excluding the maxillary bone from the orbit. But lizards appear almost invariably, and like Chelonians, to admit a small portion of the frontal into the upper orbital margin between the prefrontal and postfrontal, while in Ichthyosaurs these bones meet. In *Iguana* and many lizards, behind the orbit, completing it, is a bone which connects the postfrontal above and the malar below with the quadratojugal behind, and so has the relations of the postorbital in *Ichthyosaurus*—though, from the liberation of the quadrate bone in lizards, the postfrontal and squamosal have lost their function, and are of smaller size, and the postorbital and quadrato-jugal are of different form and relations. Lizards have no supraquadrate, often have the frontal single, always have the parietal single and diverging backward in a V-shape; while in *Ichthyosaurus* the backward divergence is less, and almost entirely made by the squamosal bones, which recurve forward round the temporal fossa to meet the postfrontals above the supraquadrate and postorbital bones—an arrangement not seen in lizards.

The foramen parietale is, in lizards, only a vertical puncture in the parietal, or between the parietal and frontal bones; in *Ichthyosaurus* it is an oblique canal. In *Ichthyosaurus* the quadrate bone is seen from behind to be supported by the squamosal, opisthotic, and pterygoid; in lizards its upper end unites with the transverse bar of the exoccipital, and its lower end with the slender backward prolongation of the pterygoid.

The palate in both types is open mesially, especially in such a lizard as *Monitor*, where the presphenoid is seen extending down a similar palatal vacuity. Lizards, however, have pedicels to the basisphenoid which meet the pterygoid bones; while in *Ichthyosaurus* the pterygoids are more expanded, and lap round the sides of the basisphenoid. In front of the long pterygoids are short palatine bones in *Monitor*; and between the pterygoid, palatine, and maxillary are small transverse bones. In *Ichthyosaurus* both of these bones are longer than the pterygoid (supposing, as was done in the comparison with crocodiles, that the palatine and pterygoid bones are usually anchylosed). The vomers of *Monitor* are long slender bones, as in *Ichthyosaurus*; but the palatine bones are not similarly prolonged between them, nor are the premaxillaries external to them.

The occipital condyle of lizards is largely made by the exoccipital bones. The teeth are never in a groove, and often differ in character in passing backward, unlike *Ichthyosaurus*. The lower jaw of lizards has a strong, vertically developed, coronoid bone, not seen in Ichthyosaurs; and the bones have not the usual splint-like overlapping. The dentary forms half of the jaw.

In number of vertebræ and in length of tail lizards rival Ichthyosaurs. And in the *Hatteria* the centrum is biconcave; but in all lizards it is greatly longer, and in most lizards the centrum is procœlous, and in certain tail-vertebræ ossified in two parts, anterior and posterior. In *Monitor* the neural spine is vertical and quadrate, but not so long as in *Ichthyosaurus*, except in the tail; and there, relatively to the centrum, it is not so wide. The neural arch is anchylosed to the centrum in lizards, and separate in Ichthyosaurs. In the lizards there are often both transverse processes and chevron bones in the tail, neither occurring in *Ichthyosaurus*—though the transverse processes of reptilian caudal vertebræ have the aspect of caudal ribs, like those of Ichthyosaurs, anchylosed to the centrum. The ribs of lizards are supported on a strong short pedicle, which appears to be contributed to by both neural arch and centrum, and is at the anterior end of the vertebra, well below the præzygapophysis; while in *Ichthyosaurus* the articular thoracic tubercles are small, double, and raised but little above the surface of the centrum.

The costal ribs of lizards are strong, less compressed from front to back, want the groove which runs along the middle of an Ichthyosaur's rib, and have the proximal articulation massive and single, instead of compressed and terminating in two articular tubercles.

The sternal and median ribs, unlike those of *Ichthyosaurus*, are modified in relation to a sternum, are not well ossified, and do not unite with the other costal elements by overlap.

In the pectoral girdle there is the fundamental difference that lizards have a sternum, but in spite of it the coracoids, by a wide median expansion, almost meet mesially. Their approximations, however, are (typically) deeply emarginate; and so the whole bone becomes dissimilar in form to the coracoid of *Ichthyosaurus*, though in *Polychrus*, for example, the coracoid is small and not unlike that of *Ichthyosaurus*. Here, too, the scapula is more ichthyosaurian than usual with lizards, some, like *Monitor*, having the bone united with the coracoid throughout its length, others, like *Iguana* and Skink, giving off a strong acromion process from the anterior margin; but in *Polychrus*, *Draco*, &c. the bone is compressed, with subparallel sides, moderately elongated, and expanded a little at the articular end, while it similarly carries the clavicle along its anterior margin. The clavicle, however, is double, as in some Ichthyosaurs, but otherwise not dissimilar, except that in lizards its length is very variable, and sometimes, as in *Scincus* and *Iguana*, it is compressed and widens from front to back. The interclavicle of lizards is usually T-shaped (though +-shaped in *Scincus*), and similar to that of *Ichthyosaurus*, except that most lizards carry the cross bar behind the clavicles, though *Polychrus* carries it below them as in *Ichthyosaurus*. The median bar, however, in lizards laps down the outside of the sternum, while in *Ichthyosaurus* it binds the coracoids together.

The pelvis is dissimilar; for in lizards the ischium has a posterior tuberosity, and the pubis an anterior tuberosity, the two bones do not meet at the symphysis, while the ilium extends both in front of and behind the acetabulum.

The limbs offer no community of structure. The proximal end of the femur in lizards has but one trochanter; and that is in a line at right angles to the ovate compression of the head.

§ 6. *The Chameleon-Characters of* Ichthyosaurus.

The chameleon-skull offers no resemblance of importance to *Ichthyosaurus* beyond such as are seen in the skulls of lizards, except that the anterior nares are better defined and lateral, that the orbit is relatively larger and has an osseous floor. The sutures, however, are less well defined.

The coracoid, but that it wants the anterior emargination, is like that of *Ichthyosaurus*; and the scapula, but that it is relatively too long and has the anterior border concave, approximates to the ichthyosaurian type. The chameleon pectoral arch differs in wanting a clavicle and interclavicle, and in possessing a sternum. The pelvis is very like that of *Ichthyosaurus*, except that the ilium is longer, and that the pubis and ischium do not meet at the symphysis. The pubis has the anterior margin straight, and differs chiefly in being perforated by the obturator nerve. The ischium differs chiefly in having a relatively greater antero-posterior extent along the symphysis.

§ 7. *The Rhynchocephalian Characters of* Ichthyosaurus.

Hatteria agrees with *Ichthyosaurus* in having the median bones which roof-in the skull all double; it has a large foramen parietale, but entirely within the parietal bones. The temporal fossæ are large in both types. In *Hatteria* the postfrontal is divided so as to form a bone like that named postorbital in Lizards; but in some Ichthyosaurs the postfrontal appears to be divided, as in lizards; and if so, the temporal fossæ are circumscribed by the same bones in *Hatteria* and *Ichthyosaurus*, and the bones are similarly placed. The nasals of *Hatteria* are relatively small, and do not extend over the frontals and between the orbits, nor do the postfrontal and prefrontal bones meet above the orbit, as in *Ichthyosaurus*. The quadrato-jugal, supraquadrate, and probably the postorbital bones are wanting from the skull of *Hatteria*, as well as the transverse bone. In *Hatteria* the base of the orbit is made by a large turtle-like maxillary, which almost excludes the malar bone. In *Ichthyosaurus* the malar bone forms the base of the orbit, and entirely excludes the maxillary. *Hatteria* possesses an interorbital septum, which does not exist in *Ichthyosaurus*. The quadrate bone is very unlike that of *Ichthyosaurus* in being perforated from back to front, and in sending a long process forward and inward to lap in front of the pterygoid; and it is jammed in the skull more firmly.

The palate is not so open as in *Ichthyosaurus*. And it is necessary to use the "chelonian" interpretation of *Ichthyosaurus* to harmonize the bones. The pterygoids of Ichthyosaur would need not to be prolonged anteriorly between the vomers, but only to meet them and allow the vomers to meet mesially. And the premaxillary would not need to be prolonged so far back between the maxillary and vomer to give the ichthyosaurian palate the essential peculiarities of *Hatteria*, except that in *Ichthyosaurus* the palatine does not carry teeth. Of course the prenasal part of the skull does not admit of comparison, any more than do the teeth.

The vertebræ, though shorter from back to front than in lizards, have the centrum much longer than in *Ichthyosaurus*; the neural arches are stronger than in *Ichthyosaurus*, and differ in being anchylosed to the centrum. The caudal vertebræ are ossified in two parts in *Hatteria*, so that the suture divides the two cups; but of this *Ichthyosaurus* shows no trace. There are median abdominal ribs; but the costal ribs of *Hatteria* have expanded single heads. The apparatus of infracostal ribs seems capable of being moved away with equal entirety in both groups, owing to the union of some of the elements by overlap. The scapula and coracoid are not dissimilar; but in *Hatteria* the coracoid has no anterior emargination, and the anterior margin of the scapula is not straight. The clavicles do not meet mesially, but unite suturally (as in some Ichthyosaurs) with a crescentic transverse bar of the interclavicle, which is closely united with a large pentagonal sternum and so far is unlike that of *Ichthyosaurus*; a large cartilage, however, extends the coracoid to meet both its vertical and transverse parts.

The pelvis is dissimilar; and the limbs are not comparable.

§ 8. *The Ophidian Characters of* Ichthyosaurus.

It were difficult to find any character of structural importance in common between these types. Prefrontal and postfrontal with an anterior division of the postfrontal, called the supraorbital bone, combine to exclude the frontal from the orbit in *Python*; but the nasals are small and the parietals single and long.

Nor is the correspondence close on the palate; for, besides all the bones being loose in serpents, there is a transverse bone, the pterygoids and palatines both carry teeth, and, though the palatines are separated in front by the vomers, the pterygoids are not prolonged forward between the palatine bones and vomers as they are in *Ichthyosaurus*. The pterygoids, as in lizards, meet tubercles of the basisphenoid, and then diverge outward and backward to the quadrate, and do not lap round the basisphenoid as in *Ichthyosaurus*. The lower jaw, too, is quite dissimilar, its anterior half being made up by the dentary bone.

In number of vertebræ serpents far surpass Ichthyosaurs; but the vertebræ have no character in common, serpents having the centrum much longer, procœlous, with one long tubercle for the rib, with the neural arch anchylosed to the centrum, a short neural spine, and a zygosphene; in the tail there are transverse processes and hypapophyses,—all of which characters distinguish the vertebræ of serpents from those of Ichthyosaurs.

§ 9. *The Urodelan Characters of* Ichthyosaurus.

The urodelan skull in the Hell-bender, Salamander, or Triton is not like that of *Ichthyosaurus*; for the palate is closed by a bone (parasphenoid) which divides the pterygoids and meets the vomers, which carry teeth. In *Ichthyosaurus* this bone does not exist. Then in these animals the orbit is confluent with the temporal fossa; and the space is not circumscribed, there being no malar, quadrato-jugal, supraquadrate, or postorbital bones. There are no palatal nares. There is no basioccipital; and the articulation with the vertebral column is formed by the exoccipital bones. And the quadrate is embraced exclusively by the pterygoid and squamosal. The anterior nares appear to be surrounded by the premaxillary, maxillary, small nasals and large frontals. The frontal bones, however, may as probably be the prefrontal, in which case it would be intelligible that the bones external to them should unite posteriorly with the parietals, being postfrontal bones. The lower jaw is almost entirely made of the dentary bone with an articular element behind, and a long angular or coronoid or opercular element on the inside.

The vertebral column has nothing in common, except that in both the centrum is biconcave. But in the Amphibians the centrum is long, the neural arch is depressed, the zygapophyses are nearly horizontal, and there is no neural spine. There is no atlas; and the axis has an odontoid process, the odontoid process really being the basioccipital bone. There are transverse processes given off from the combined neural arch and centrum; they are sometimes grooved, so as to have two articular heads for a rib; they are always directed backward, and are often long. These transverse processes are continued part of the way down the tail. The caudal vertebræ have chevron bones anchylosed to the underside of the centrum. In all these characters Amphibians differ from Ichthyosaurs.

The ribs are altogether dissimilar, except that they have two articular heads; for they are always very short, and do not contribute to enclose the viscera, but are directed horizontally outward and backward.

The pelvis is not like, there being no pubis ossified, and the ischium being a greatly expanded plate in no respect like the ischium of *Ichthyosaurus*.

The pectoral arch consists of a combined scapula and coracoid; but the bones do not meet mesially. The scapular portion is made unlike the scapula of *Ichthyosaurus* by its great width at the line of union with the coracoid, due to forward outgrowth, which makes the anterior margin deeply emarginate. The coracoid portion (which is not distinct) has neither the anterior nor posterior emarginations which characterize the coracoid of *Ichthyosaurus*.

The limbs are totally dissimilar.

§ 10. *The Piscine Characters of* Ichthyosaurus.

In the general form of the head, *Xiphias* resembles *Ichthyosaurus.* The premaxillaries in both are elongated, terminate the long snout, and form the alveolar border, which in *Xiphias* does not carry teeth; they are followed behind in both by a pair of greatly elongated triangular nasals, which widen behind.

The frontals and parietals of *Xiphias* are both large; the prefrontal is covered by nasal and frontal; and the prefrontal and postfrontal do not meet to exclude the frontal from the orbit. Neither orbits nor temporal fossæ are circumscribed; and there is no foramen parietale.

The basioccipital is conically cupped, and carries the exoccipitals, which meet below the neural canal, and furnish concave facets which contribute to the articulation with the vertebral column, which is thus very unlike that of *Ichthyosaurus.* The exoccipitals also enclose the neural arch above. On the palate, too, there is nothing in common, the bones being single and closing the palate mesially. In very few fishes is there a convex basioccipital; among such is *Fistularia.*

The vertebral column of fishes, though as variable as the skull, never approximates in any genus to that of *Ichthyosaurus*, except in the biconcavity and sometimes in the shortness of the centrum. The essential difference from a fish is in having the ribs articulated to the centrum by two tubercles.

The arches and limbs do not correspond at all.

§ 11. *The Plesiosaurian Characters of* Ichthyosaurus.

In *Plesiosaurus* the snout is never so long as in *Ichthyosaurus*, or so pointed; but the nostril is near the eye; and nostril, orbit, and temporal fossa are all surrounded with bone, though relatively to *Ichthyosaurus* the temporal fossa is large and the orbit small. The premaxillary is like that of *Ichthyosaurus*, only much smaller; and the nasals, which extend between the nostrils in front and behind, are narrow and small relatively to those of *Ichthyosaurus.* The frontal appears in *Plesiosaurus* to enter into the upper margin of the orbit; and the postfrontal appears to meet the malar and close the orbit behind; so that there are no postorbital or supraquadrate bones. And the outer margin of the temporal fossa is made by the malar meeting the squamosal; whether there is a quadrato-jugal I find no satisfactory evidence.

The palate differs in being closed mesially. The vomers appear to extend far forward between the maxillary bones. The median bones behind the vomers consist of palatine and pterygoid with a transverse bone external to these. In both the occipital condyle is single; but in Plesiosaurs the exoccipital bones usually enter into it. In both there is a foramen parietale. In Plesiosaurs the quadrate bone is directed backward, as in crocodiles and Teleosaurs, and is more intimately united to the skull than in Ichthyosaurs. The teeth differ in no essential, except that in Plesiosaurs the fang is cylindrical and the crown has a tendency to curve backward.

The pectoral girdle has much in common in plan in the two types, though the forms of the bones differ greatly. In order to convert the *Ichthyosaurus* into *Plesiosaurus*, it would be necessary to amalgamate the clavicle and interclavicle into one bone, and then contract the three arms till the scapulæ were drawn almost together in front, and the median ray only just met the coracoid behind. Sometimes the interclavicle entirely disappears; and then the scapulæ grow together mesially to replace it, and meet the coracoid mesially. The coracoid bones would require to be relatively enlarged and to be prolonged further backward.

The pelvis of *Plesiosaurus* in none of its elements closely resembles that of *Ichthyosaurus*. The ilium differs in being straighter, more massively expanded at the femoral end, and usually more compressed at the vertebral end. The ischium differs in being directed backward, and in being usually more extended along the symphysial line. The pubis is entirely different, being in *Plesiosaurus* subreniform.

The vertebral column has nothing in common in the two groups, except the biconcavity of the centrum. In *Plesiosaurus* the centrum is more elongated from back to front, and the neural arch is usually anchylosed to the centrum of the cervical vertebræ.

The femur differs in the relatively larger size of the proximal end, in wanting an inner trochanter at the proximal end, in the greater elongation of the shaft, and in the greater expansion of the distal end.

In *Plesiosaurus* there is some similarity in the ulna and radius, and carpus and tarsus, to those regions in *Ichthyosaurus*; and it is only by minute comparison that the bones can always be distinguished.

§ 12. *The Dinosaurian Affinities of* Ichthyosaurus.

The *Scelidosaurus* has the median roof-bones of the skull all double; the nasal bones are large and elongated, but they do not extend so far back as in *Ichthyosaurus*, and so the frontal bones occupy a much larger area of the skull. The frontal bone similarly does not enter into the orbit; but in *Scelidosaurus* the superior border is made by an anterior division of the postfrontal, which Prof. Owen names the superorbital bone. The orbits are vertical in both, and the temporal fossæ are horizontal. The bone behind the orbit in Ichthyosaurs is named postorbital; and as the sequence of the bones is the same in both, an advocate for a uniform nomenclature might propose to name the dinosaurian postfrontal postorbital, and the superorbital postfrontal. Then the bones surrounding the orbit would be the same in both. In both the eye is defended with sclerotic plates. But there is no supra-quadrate in the Dinosaur, and no clear evidence of a quadrato-jugal, while the quadrate would differ from that of *Ichthyosaurus* in its slender form and in the long inner process which laps along the pterygoid.

The palate of a Dinosaur is not very like that of a lizard, the pterygoid bones being more expanded; the pterygoid bones in *Scelidosaurus* are very unlike those of *Ichthyosaurus*.

The teeth of Dinosaurs are chiefly in the maxillary bone; and these teeth are always serrated. In *Hypsilophodon* the pre-maxillary teeth are very different from the maxillary teeth, and so are unlike those of *Ichthyosaurus*, although the crowns are conical.

The vertebral column has nothing in common, the dinosaurian centrum always being elongated as in Plesiosaurs, never deeply cupped, without tubercles for ribs on the dorsal vertebræ, always furnished with a large neural arch. In the caudal region there are chevron bones and transverse processes.

The pectoral girdle would appear to differ by the Dinosaurs being devoid of clavicle and interclavicle, and showing traces of a partly (?) osseous sternum. But of the other bones, the scapula and coracoid have considerable resemblance of form. The coracoid bone, for instance, usually referred to *Iguanodon* cannot be regarded as having any character to distinguish it from *Ichthyosaurus*; and the scapula differs chiefly in its relatively greater length, and the development of an acromial tubercle or prearticular prolongation on the anterior margin. The pelvic arches have little in common—the ilium being greatly expanded in Dinosaurs, while the pubis and ischium are more elongated than in Ichthyosaurs, and less expanded at the symphysial end.

The proportions of the limbs are reversed, the hind limbs of Dinosaurs being the larger. In the bones of the limbs there is no correspondence of form or plan.

§ 13. *The Dicynodont Characters of* Ichthyosaurus.

In *Dicynodon* the premaxillary and the parietal bones are single, and the foramen parietale perforates the parietal only, so far being unlike *Ichthyosaurus.* But the nares and orbits are lateral and circumscribed, though the orbits are relatively smaller, and the nares are, from the shortness of the snout, not so far back in the skull. The temporal fossæ are similarly circumscribed; and the parietals and squamosals similarly diverge behind, though often with a more marked V-shape in Dicynodonts than in *Ichthyosaurus.* The peculiar bones of the Ichthyosaur's skull are wanting; and the quadrate bone is a naked pedicle firmly united to the solid vertical back part of the skull. The dicynodont occipital condyle consists of three equal parts contributed by the exoccipital and basioccipital bones. The palate and teeth are both unlike those of *Ichhyosaurus.*

The vertebræ are often not dissimilar to those of *Ichthyosaurus* in the deep cupping of the centrum; but the centrum is longer, the neural arch is anchylosed to it, and the attachment for the ribs is altogether different in Dicynodonts.

The pectoral and pelvic arches are altogether dissimilar; and the limbs, except in the great expansion of the humerus at its proximal and distal ends, have nothing in common.

§ 14. *The Labyrinthodont Characters of* Ichthyosaurus.

Labyrinthodonts agree with Ichthyosaurs in having the median roof-bones of the skull all double, in having the orbits circumscribed with bones, with a postorbital bone behind, and a supraquadrate bone behind that, between the squamosal and quadrato-jugal. But they differ in having the temporal fossæ entirely roofed over, in the foramen parietale perforating the middle of the parietal bones, in the orbits being small, in the great elongation of the principal frontal bones, in the forward position of the nares (usually nearer to the end of the jaw than to the orbits), and in the short premaxillary bones (which sometimes have a tendency to unite mesially). The palate differs in having its anterior part largely made by the vomerine bones, which meet the potential presphenoid style behind.

The premaxillary and maxillary bones usually carry a continuous series of teeth smaller than those of *Ichthyosaurus*, while there is an inner series of teeth (on the vomers and palatine bones) of which some are larger than those of *Ichthyosaurus*. The arrangement of palate-bones is very unlike the ichthyosaurian. The substance of the teeth seen in transverse section is much more folded than in *Ichthyosaurus*. In *Mastodonsaurus*, according to Von Meyer, the presphenoid, basisphenoid, and occipital bones are all differentiated, thus approximating to *Ichthyosaurus*, though the articulation with the skull is made by two condyles. The surface of the skull usually differs in being sculptured.

The centrum of the vertebra is similar in the two groups, being very short and biconcave; but the neural arch is more like that of a crocodile than that of *Ichthyosaurus* in supporting the ribs on transverse processes. The ribs are similar to those of *Ichthyosaurus* in their length, flattened character, and the double head by which they articulate with the vertebra.

PART II.

THE RESEMBLANCES OF PLESIOSAURIAN BONES TO THE BONES OF OTHER ANIMALS.

§ 1. *The Mammalian Characters of* Plesiosaurus.

The sutures are not all well seen in skulls of *Plesiosaurus*; but enough is manifest to show that, in the small size of the parietal region, the large temporal fossa, and the considerable development of premaxillary, maxillary, and nasal bones in front of the anterior nares, the upper surface of the skull differs in aspect from the mammalian type. If the orbits are circumscribed by bones as they are in Ruminants and many other mammals, there is a difference, owing to the frontal bone being excluded, and its place taken by two bones which Prof. Owen names superorbital and postfrontal, but which it would be more consonant with simple naming to call respectively postfrontal and postorbital. The lachrymal bone does not similarly enter into the anterior nares in mammals, though in certain Ruminants there is so near an approximation to such an arrangement as to show that that condition is quite consistent with the mammal plan. The squamosal is extended outward to cover the quadrate; and so all the outer and backward part of the skull is modified on a plan unlike that of the mammal.

The occipital condyle would appear sometimes to consist only of the basioccipital bone, though in all the specimens in the Woodwardian Museum at Cambridge the exoccipital bones also contribute to it.

The teeth are all in sockets, as in adult Porpoises; about half appear to be in the premaxillary, and half in the maxillary bone. I have seen no evidence of their replacement by successional teeth in *Plesiosaurus*. The closed flat palate, which seems to have two perforations behind for the posterior nares, between the palatine and pterygoid bones, and two perforations external to these, margined outwardly by the transverse bones, finds a general parallel in the Porpoises, though the posterior nares in those animals are not ovoid perforations, and the external foramina have no existence.

The vertebræ have a mammalian aspect. The neck-vertebræ are shortened in *Pliosaurus*, as in Balænidæ and Elephants; but in most Plesiosaurs the centrum slightly elongates in the neck, as in many land mammals, though the vertebræ differ remarkably in number, sometimes counting as many as forty-five and never so few as seven. The atlas and axis are usually anchylosed together; and the cervical vertebræ all carry ribs, some of which sometimes have a divided articular head, and all of which articulate with the centrum: in these characters the vertebræ differ from mammals'. The dorsal vertebræ have much the proportion and characters seen in Porpoises, except that the epiphyses are not separable from the centrum, that the neural arch is often separable from the centrum, that the centrum is usually somewhat cupped, that the neural canal is smaller, and the transverse process rounder, longer, and stronger, and given off from the neural arch throughout the whole of the dorsal region. But in the cardinal character of having the ribs attached by single heads to transverse processes of the neural arch, a number of dorsal vertebræ of Porpoises offer a close resemblance to those of *Plesiosaurus*. And when only the centrum is preserved, it would often be impossible to distinguish between the Cetacean and the Plesiosaur. The neural arch in its general features is very similar in the two. In neither group is there a sacrum. The earlier caudal vertebræ of both have transverse processes jutting horizontally from the side of the centrum, and chevron bones between the centrums beneath. But in Cetacea the transverse processes on the centrum are common to the later dorsal vertebræ, and the neural arch and the chevron bones do not persist to the end of the tail, and the later caudal vertebræ of Cetaceans become singularly modified in form. As in Porpoises, the dorsal centrum is usually rather longer than the early caudal centrum. The dorsal ribs are similar to those of Cetaceans; but the sternal ribs of a Plesiosaur are unlike those of any mammal.

The pectoral girdle of *Plesiosaurus* has nothing in common with that of Cetaceans or any mammal beyond a distant resemblance to that of the Monotremes.

The humerus of *Phocæna* differs from that of *Plesiosaurus* chiefly in its shortness and the less constriction of the bone below the proximal articulation. And the position of the limb on the body appears to have been different; for in Cetaceans the proximal trochanter is anterior, while in *Plesiosaurus* it appears to be exterior. The points of resemblance are in the proximal and distal ends being in the same plane, in the side-to-side compression of the distal end, which similarly has two flat articular surfaces which meet at an angle, in the proximal end terminating in a hemispherical articulation on one side of the bone and a large trochanter on the other, though they seem to be on opposite sides.

The ulna and radius are relatively to the humerus much longer than in *Plesiosaurus*. The radius is a compressed bone with flattened articular ends in both groups; but the Porpoise differs in having the distal end the wider—while in Plesiosaurs the proximal end is the wider when the ends differ in width, and the anterior and posterior margins of the bone are both concave. The ulna differs in being much wider and usually reniform in Plesiosaurs, so that the posterior margin is convex and the anterior concave, while in Cetaceans the bone is long and narrow, concave behind and usually straight in front: it has a small olecranon process. When the olecranon is developed in Plesiosaurs, it always persists as a distinct ossification.

The carpal bones are so similar in the two groups that they cannot be distinguished from each other. In both they are flat, compressed, subhexagonal, or irregularly ovate ossicles. The phalanges are so similar that it would not be possible to distinguish between them. They are compressed or rounded hourglass-shaped bones with flat or moderately convex articular ends which often show numerous perforations for blood-vessels, around which the bone is slightly elevated. The digits on the radial side have most phalanges. There may be as few as three digits.

§ 2. *The Avian Characters of* Plesiosaurus.

The backward position and division of the anterior nares in birds, and the consequent extension of the premaxillary bones and backward position of the maxillary bones, accords well with the condition of the prenasal part of the skull in Plesiosaurs. In them the orbits are circumscribed by bones, being bordered below by the malar; they are placed much further forward, more towards the middle of the skull, than in birds; and thus there come to be large circumscribed temporal fossæ behind the orbits, to which there is nothing similar in birds. The eyes are more horizontal than in birds; and some Plesiosaurs, like some birds, have a sclerotic circle of bones. Unlike birds, the quadrate bone is firmly fixed in the skull, and covered, as in some struthious birds, by the squamosal on the outside, which latter bone accordingly does not enter into the brain-case. The cerebral part of the skull is of altogether different form. The occipital articulation is similar, being in both types contributed to by the exoccipital bones.

The palate of struthious birds would be very similar to that of *Plesiosaurus* if the palate were closed mesially and the posterior nares carried through the infraorbital foramina, the nares closed by the growing together of palatine and maxillary; and it would require that the pterygoid bones should be expanded inward and backward, so as to meet behind the nares and cover the region of the basisphenoid, carrying the quadrate bones backward with them. The lower jaw in both is composite and moderately prolonged behind the concave articular groove for the distal end of the quadrate bone.

The vertebral column of Plesiosaurs only resembles that of birds in the large number of vertebræ included in the neck. The centrum differs in having the articular surfaces flat or concave in Plesiosaurs. In birds the atlas and axis are not anchylosed, the cervical vertebræ have no separate ribs, and the neural spine is suppressed, while the vertebral artery is often carried through a ring on the side of the centrum in birds as it is in some mammals; and no such condition is seen in *Plesiosaurus*. In the dorsal region of birds there is a quadrate neural spine similar to to that of Plesiosaurs, only shorter, and transverse processes to the neural arch, which are horizontal laminæ and not subcylindrical processes; the ribs in birds are articulated to the side of the centrum on a concave facet, and only touch the underside of the transverse process with the posterior tubercle, while in *Plesiosaurus* the rib is exclusively articulated with the transverse process. The dorsal centrum in many birds has a prominent hypapophysis similar to that of serpents; but nothing of the kind is seen in *Plesiosaurus*. Plesiosaurs have no sacrum; and if in birds the postfemoral vertebræ were put into the tail, that region would be relatively as long as in Plesiosaurs. Plesiosaurs want the terminal caudal style of birds; but the ordinary caudal vertebræ of water-birds are not dissimilar to vertebræ of *Plesiosaurus*, except in the massive or bifid neural spine; and the length and form of the centrum, as well as the absence of chevron bones, make the tail-vertebræ of such birds as the Penguin or the Swan more like the neck- than the tail-vertebræ of *Plesiosaurus*. The caudal vertebræ of the Gannet only differ in size from vertebræ of Plesiosaurs. The dorsal ribs of birds are always more compressed than those of Plesiosaurs, and usually differ in having an epipleuron anchylosed to the middle of the posterior margin of several.

The pectoral and pelvic arches have nothing in common. The difference in the pelvic region is presumably largely due to the extension of the ilium along the whole length of the sacrum in birds, while in Plesiosaurs it is a short conically tapering rod which only meets one vertebra. The difference of the pectoral arch is presumably largely due to the great development of the sternum in place of the system of abdominal ribs. If the scapulæ were to be drawn forward to meet in front of the coracoid bones, the coracoids would themselves be drawn together; and it is not improbable that with such a plesiosaurian modification the muscular attachments would move forward, and the sternum of a bird would lose its continuous osseous character and large size.

Neither humerus nor femur has much in common with *Plesiosaurus*. If the shaft of the humerus is compressed in the Penguin, its distal end is not expanded, and its proximal articulation is expanded too much. In the femur, if the hemispherical head is directed inward, the trochanter external to it is too wide, while the distal end is very dissimilar.

The other bones of the extremities in *Plesiosaurus* have no avian characters.

§ 3. *The Crocodilian Characters of* Plesiosaurus.

In outline and in the depressed character, the skulls of typical crocodiles and Plesiosaurs are similar. The nares, however, in Plesiosaurs are far back on the skull, and only parted from the orbit by the lachrymal bones, while in crocodiles they are single and terminal.

The orbits are not dissimilar in character, but in Plesiosaurs they are in the middle of the skull, while in crocodiles they are in the hinder third. The temporal fossæ are much larger than the orbits in *Plesiosaurus*, while in crocodiles they are smaller. These differences in the positions of organs and regions of the skull necessitate proportionate differences in the length and form of the cranial bones. But in crocodiles the postfrontal is not usually divided so as to exclude the frontal from the orbit; and in Plesiosaurs the postfrontal is divided from the squamosal by the malar and quadrato-jugal, and thus the temporal fossa is enlarged. The quadrate bone is similar in form, similarly placed in the skull, except that in Plesiosaurs the pterygoid bone meets it on the inner side; and usually it is similarly directed backward. The occipital condyle is similarly formed in the two groups; and the occipital bones are not dissimilar. The palate is similarly closed, except that in Plesiosaurs the posterior nares are not carried so far back, being surrounded by the palatine, transverse, and pterygoid bones, and that the transverse bones are more anterior, and larger, and close the palatine foramina in front. The teeth are exceedingly similar, and are similarly placed in sockets, in all crocodiles except the Black Alligator. The lower jaw appears to be similar in the proportions taken by the dentary, angular, and opercular bones, in the form of the concave articulation, and in the extent of the postarticular keel; but in Plesiosaurs its side is not perforated posteriorly. The cranial bones of *Plesiosaurus*, though not always smooth, are never pitted as in crocodiles.

In no known *Plesiosaurus* does the tail include so large a proportion of vertebræ, or the neck so few as in crocodiles. In Plesiosaurs the centrum is rarely, if ever, so long as in crocodiles; and the articular surfaces are never procœlous, but flat or slightly concave at both ends. The neural arch is similar, except that, like the centrum, it is longer from front to back than in Plesiosaurs; the zygapophyses are more projecting; and the transverse process of the dorsal vertebræ is lamellar and not cylindrical. The caudal vertebræ, besides differing from *Plesiosaurus* in their length, differ in the lengths of the chevron bones, which are not attached each between two vertebræ in crocodiles, but to the basal hinder articular margin of its own vertebra. The short cervical vertebræ of Plesiosaurs have a hatchet or ⊥-shape, similar to that seen in crocodiles; and the articular head is sometimes divided to articulate with two facets on the centrum, but never so deeply divided as in the crocodile, where the upper head articulates with a tubercle on the neural arch, while the lower head remains on the centrum, in all the pectoral vertebræ and all the cervicals after the first two.

The dorsal ribs differ from those of *Plesiosaurus* in their compression from above downward, and in the articular end uniting with the transverse process by two heads.

The pectoral girdle is not similar; for in the crocodile the coracoids are divided by the sternum, and they have but little antero-posterior extension, corresponding only with the thick anterior part of the coracoid in *Plesiosaurus,* and the scapulæ are directed towards the back instead of converging forward in the same plane with the coracoids. Nor are the pelvic girdles similar. For the ilium of the crocodile has a vertical expansion very unlike the subcylindrical tapering form seen in Plesiosaurs. The backward direction and symphysial elongation of the ischium is similar; but the small elongated triangular pubis of the crocodile is very unlike the broad reniform bone convex in front seen in *Plesiasaurus.*

The limb-bones of the two groups have no character in common.

§ 4. *The Chelonian Characters of* Plesiosaurus.

There is considerable resemblance of form between the outlines of the skulls of some Plesiosaurs and some chelonians. And in both the temporal fossæ are large(except in marine Chelonia), and only divided from the circular orbits by a narrow post-frontal bone. The orbits of chelonians are more vertical, and are wanting in superorbital and lachrymal bones. The anterior nares are near to the orbit; but they have a single termination, and the skull has no extension anterior to them; so that all the preorbital part of the chelonian skull is unlike, and not comparable with the plesiosaurian; the part behind the temporal fossa is also dissimilar—Plesiosaurs having no auditory excavation of the quadrate and squamosal, or median backward prolongation of the parietal and superoccipital. Most living chelonians differ from Plesiosaurs in not having nasal bones.

The vertebral column has but little in common in the two types, either in the form of the centrum, the condition of its articular ends, the form of the neural arch, the attachment of the dorsal ribs, or the proportional lengths of the different regions; so that in no region of the column, either as a whole or in the separate vertebræ, is there any resemblance to *Plesiosaurus*, the chief differences being :—that in chelonians the cervical vertebræ are opisthocœlous, procœlous, and biconvex, but never biconcave; that the neural arch has no neural spine, no cervical ribs, and has the zygapophyses long and directed outward; while the under surface of the centrum is compressed, whereas in Plesiosaurs it is wide; the dorsal vertebræ are elongated, with flat articular ends, and have the rib articulating by a single head directly with the centrum, either between two vertebræ or at the anterior end; the caudal vertebræ have no neural spine in chelonians, and are procœlian or opisthocœlian.

The chelonian scapular arch has, at first sight, nothing in common with *Plesiosaurus*; but if the interspace between the coracoid and precoracoid were ossified in *Chelone*, two expanded coracoids meeting mesially would be formed, having a great resemblance to those of *Plesiosaurus*. And such a result might also be attained by continuous ossification of the coracoids with the hyosternal elements. Next it would be necessary to draw the scapulæ forward to be in the same plane with the coracoids. These, in the same way, might become continuously ossified with the clavicles; and the backward angle of the clavicle might be represented by the outer backward process sometimes seen on the plesiosaurian scapulæ. These bones would then take up the interclavicle between them inevitably in the position seen in *Plesiosaurus*, with its posterior angle internal to the coracoids, as it is internal to the hyosternal bones in chelonians.

The pelvic arch is more like that of *Plesiosaurus*. The ilium is similar, except that it is curved and the sacral end is more expanded. The pubis has a similar large expansion in *Chelone*, but not a kidney-shape. In the Tortoise the pubis meets the ischium in the symphysis as in *Plesiosaurus*, and the ischium has a subtriangular form and is directed backward; but it is not in the same plane with the pubis, being directed somewhat downward.

As with the fore limb, so here the pubis might be supposed to combine with the hyposternal, the ischium with the xiphosternals. The plesiosaurian limbs are only comparable with the marine type. The chelonian femur differs chiefly in being shorter, less expanded distally in antero-posterior extent, and in having a large trochanter behind the proximal articulation. The humerus is somewhat similar distally, but not enough expanded; the bone is too short, and the trochanters at the proximal end are dissimilar. The tibia, fibula, ulna, and radius in chelonians are elongated, and so are incomparable. The carpal and tarsal bones are not dissimilar individually; but their arrangement is not like that in *Plesiosaurus*. The phalanges are not dissimilar in form, except that in *Chelone* the bones are vastly more elongated and much less numerous; but the hour-glass shape and flattened articular ends are similar.

§ 5. *The Lacertian Characters of* Plesiosaurus.

The general outline of a lizard's skull is the same as that of *Plesiosaurus*; and in such a lizard as *Iguana* the orbits and temporal fossæ are similarly placed. But in *Plesiosaurus* the nares are further back and smaller; and thus the nasal bones are narrowed to extend between them, and the premaxillary bones enlarge to form the prenasal part of the skull. In *Iguana* the postfrontal is divided, but the superorbital part does not exclude the frontal bone from the orbit as in *Plesiosaurus*; but the back of the orbit is similarly formed by its postorbital part. In lizards the maxillary bone is not admitted into the base of the orbit as it is in *Plesiosaurus*. The parietal is similarly compressed into a longitudinal ridge, and similarly sends off processes behind which diverge outward and backward. The processes in *Plesiosaurus* appear to be overlapped by the squamosal bones, while in lizards the squamosal bones are overlapped by them. In lizards the quadrate bone is naked at the sides; but in *Plesiosaurus* it is covered by the squamosal and quadrato-jugal. And in Plesiosaurs the occipital segment of the skull is not prolonged beyond the parietal segment.

The teeth differ from those of lizards in being placed in sockets and in the series being similar from the back of the jaw to the front.

The palate of lizards differs in not being entirely closed mesially, in the totally different condition of the posterior nares, in the small size of the transverse bone, in the teeth on the pterygoid bone &c., and by the pterygoid bones not meeting to cover the basisphenoid. The occipital condyle is made to a less extent in lizards by the basioccipital bone than in Plesiosaurs.

The Plesiosaurian lower jaw has not the prominent coronoid process or the inward extension of the articular bone of Lizards.

The vertebral column of lizards like the *Monitor* includes as many vertebræ as in *Plesiosaurus*; only, instead of being chiefly in the neck and tail, they are chiefly in the tail, and the neck has only about half a dozen.

In *Monitor* and all lizards except the Gecko the centrum differs in its elongation and procœlous articulation. [The skeleton of a Gecko I have not seen.] The cervical vertebræ moreover differ in often having a strong hypapophysis. The dorsal vertebræ differ in the lateral extension of the zygapophyses, the absence of transverse processes, and the articulation of the ribs to the side of the centrum. The caudal vertebræ differ in having the chevron bones attached to the base of the centrum or its posterior margin, though there are a few Plesiosaurs (of undescribed species) in which this character is seen. The dorsal ribs of lizards are very like those of *Plesiosaurus*; but no lizard has similar abdominal ribs.

Neither pectoral nor pelvic arches have much in common with *Plesiosaurus*. In order to make the pectoral arch like that of a Plesiosaur, it would be necessary to blend the clavicles and interclavicle and contract the triradiate limbs of the latter bone till the scapulæ were nearly drawn together anteriorly, and the acromion became a terminal process at the free end of the bone. Then, by suppressing the sternum, the coracoid bones would come together mesially, and it would only be necessary to make a continuous ossification over the interspaces of the coracoid to have a pelvic arch essentially that of a Plesiosaurian.

In the same way, by expanding the lizard-pubis on its anterior border to a convex outline which should make the bone reniform and lie in one plane, and by then drawing the bone back to meet the ischium at the symphysis and rounding off the angles and ridges of the ilium, the pelvic arch would approach the plesiosaurian type.

In the limbs there is nothing in common.

§ 6. *The Rhynchocephaloid Characters of* Plesiosaurus.

The skull of *Hatteria* has much such an outline as that of *Plesiosaurus dolichodeirus*; and in the parietal and frontal regions there is a similarity of form; but in *Hatteria* the postorbital bone meets the squamosal, and forms an upper bar to the side of the temporal fossa, which does not occur in *Plesiosaurus*. The orbits in *Hatteria* are larger and more vertical than in *Plesiosaurus*, while the nares are lateral, and the premaxillary bones are developed anterior to them only to a small extent; the skull also appears to differ from that of *Plesiosaurus* in having all the median roof-bones double. The under surface of the palate differs from that of *Plesiosaurus* in not being closed in the median line, in not including divided nares at the back of the palate, in the large development of the pterygoid bones, which do not cover the basisphenoid, but extend along the inner wing of the quadrate bone, and extend forward to meet the vomers, while the palatine bone occupies the same lateral position between the pterygoid and maxillary which would entitle it to be considered homologous with the transverse bone in *Plesiosaurus*. The teeth are utterly unlike those of *Plesiosaurus* in form, in being blended with the jaw, in being also carried on the palatine bones.

The vertebral column differs from *Plesiosaurus* in the fewness of the vertebræ; though each vertebra agrees in having a not dissimilar form and a biconcave centrum. The atlas and axis are not like those of *Plesiosaurus*, the latter bone having an extended neural spine and an odontoid process. The fourth vertebra has a divided attachment for the ribs such as is sometimes seen in the cervical vertebræ of Plesiosaurs; but the cervical ribs have not the hatchet-shape. In *Hatteria* the intervertebral wedge bones are continued down the neck, which does not happen in *Plesiosaurus*. It has seemed to me to be not improbable that the conversion of amphicœlous vertebræ into procœlous or opisthocœlous vertebræ has been determined by the anchylosis of the intervertebral wedge bones to the anterior or posterior margin of the centrum. In the dorsal region the ribs are supported by single heads, as in *Plesiosaurus*, but not from transverse processes. The caudal vertebræ carry chevron bones: the centrum differs from that of *Plesiosaurus* in being ossified in two parts. The cervical and early dorsal ribs differ from those of *Plesiosaurus* in carrying an epipleuron, though the superior process which gives the cervical rib its hatchet-shape in *Plesiosaurus* may be regarded as an anchylosed epipleuron. The abdominal ribs of *Hatteria* are like those of *Plesiosaurus*; and in one species (for two species seem to me to be typified by the abdominal ribs figured by Dr. Günther) the median Λ-shaped bone is overlapped by a splice from a bone external to it. In another species this splice is replaced by a joint, and the external piece has a squamous expansion on the middle of its anterior and posterior margin, unlike any thing seen in *Plesiosaurus*. But, as in *Plesiosaurus*, other bones are introduced between these elements, so as to make the abdominal ribs nearly twice as many as the costal ribs.

The pectoral girdle differs from that of *Plesiosaurus* in having a sternum and clavicles. Between these the interclavicle is anchylosed. The coracoid differs in its great extension in front of the acetabulum, in its small size, in its connexion with the sternum, in its wide union with the scapula. And only by revolving the scapulæ forward till they meet in front and are in the same plane with the coracoids, and at the same time causing them to grow distally at the expense of the sternum so as to obliterate it, could the rhynchocephalous pectoral arch be brought into harmony with that of *Plesiosaurus*.

The pelvis differs chiefly in its smaller size, in the ischium of *Hatteria* having a prominent posterior tuberosity, in the small size of the os pubis, which has not a reniform outline or a convex anterior margin, and in the compression of the ilium.

§ 7. *The Ophidian Characters of* Plesiosaurus.

The points of resemblance between serpents and Plesiosaurs are so trifling that they may be neglected. In *Python* there is a parietal crest. A superorbital bone excludes the frontal from the orbit; and a narrow nearly vertical postfrontal makes the boundary of the orbit behind, as in *Plesiosaurus*. There are remarkable differences in that the squamosal and quadrate bones are loose, and that the bones of the face and palate are loose. The malar and quadrato-jugal bones are absent, and the side of the quadrate bone is naked; the premaxillary is minute, and the skull has no extension anterior to the nares; a considerable interval separates orbit and narine; and there is no temporal fossa; the maxillary bones are very long, and on their inside the pterygoids run parallel with them at the hinder part; the palate is mesially open. There is no resemblance in the vertebral column.

§ 8. *The Urodelan Characters of* Plesiosaurus.

The skull of the *Menopome* or of the Salamander has no striking resemblance to *Plesiosaurus* in any region; while the absence of a prenasal extension, the confluence of the orbit and temporal fossa, the two occipital condyles, the median bone (parasphenoid) at the base of the skull, the absence of covering bones from the quadrate bone, and the absence of socketed teeth would readily distinguish them.

The vertebræ agree in having the centrum biconcave; but the Urodelan centrum is much longer, and its neural arch wants the long compressed neural spine of *Plesiosaurus*. The cervical vertebræ are very few, and have transverse processes, which are not seen in *Plesiosaurus*, while the amphibians have usually no atlas.

The dorsal vertebræ agree with Plesiosaurs' in having transverse processes, which, however, are not given off exclusively from the neural arch, are compressed and directed obliquely backward. At their termination in some types the parts contributed by the neural arch and by the centrum divide so as to make a double attachment for the rib. The costal ribs differ in being double-headed and extremely short, while no sternal or abdominal ribs are developed. The caudal vertebræ differ additionally in having their chevron bones anchylosed to the base of the centrum.

The pectoral girdle differs in having the scapula and coracoid united in one ossification, and in the coracoid portions being divided by a wide cartilage. The scapulæ have no tendency to approximate anteriorly.

The ilium is not unlike that of *Plesiosaurus*. The bone inferior to it is usually named the ischium; but if these bones were revolved forward so that the median line became anterior, and the bones met mesially at their posterior borders, then they would have the position, as they already have the shape, of the pubic bones of *Plesiosaurus*.

In the limbs there is some resemblance; but the shaft of the humerus and femur is not sufficiently expanded, and the proximal trochanter should not have been severed from the head of the bone, the forearm and foreleg are too long; and the ulna and tibia are not reniform; the carpals and tarsals are more irregular in size, and have a tendency to form three rows; while the bones of the digits differ chiefly in the small number of bones in each, and in there being four digits on the hand and five on the foot.

The Anatomy of two Parasitic Forms of the Family Tetrarhynchidæ. By FRANCIS H. WELCH, F.R.C.S., Surgeon, Army Medical Department, and Assistant Professor of Pathology, Army Medical School, Netley. Communicated by Professor BUSK, V.P.L.S.

[Read May 6, 1874.]

(PLATES XXIV.–XXVI.)

THESE two forms of the Tetrarhynch family, suborder Cestoda (*Cobbold*), among parasites, were obtained from the stomach of a Shark (*Carcharias* —— ?), and transferred to me by Dr. Macdonald, R.N., F.R.S. Of the larger form there were three specimens, of the smaller five; and with them was a portion of the shark's stomach, to which one of the larger forms was attached, the rest of the parasites being loose in the alcohol in which the whole mass was preserved.

The mucous membrane of the stomach was irregularly superficially ulcerated in spots to the size of a shilling; and narrow channels diverged from the surface of the ulcer into the subjacent tissues to the depth of $\frac{8}{100}$ to $\frac{15}{100}$ of an inch, these channels generally being arranged in pairs and evidently produced by the proboscides of the parasites for anchoring themselves; while with some there was also a broader pit, from which the channels diverged, produced by the partially immersed head of the creature. Around these channels for at least $\frac{1}{2}$ an inch there was marked dark discoloration of the tissues from blood-extravasation and disintegration. One of the larger forms was still attached; but since the stomach had been cut into pieces it had moved; for it was now anchored to the fresh incised surface. No part of the head of the parasite was inserted into the stomach-coats, so that the suckers were not called into action; but the proboscides diverged from each other into the tissues, having a broad base of attachment; and a considerable application of force relative to the size and strength of the tissues of the creature was used without the anchors giving way.

Whether these forms of animal life are new to science or have been already described and named, I cannot clearly ascertain; but as far as I have been able to follow the literature of the subject, I can find no mention of them; this, however, is far from proving them to be novelties. Considering the wide-spread field of knowledge at the present day, it is unquestionably far from easy to find out all the written matter on any given subject; and as regards helminthology, the difficulties of connecting one form with another under right classification appear extra plentiful, and notably with the Tetrarhynch family; so that I am somewhat diffident in making statements which may be shown to be incorrect by those who have made the subject an especial study, or who have an extensive special literature to fall back upon. The description of these parasites is entirely based on my personal observations of their anatomy; but as it is necessary to affix to them some designating term for identification, I have appended to each a *provisional name* based on the chief characteristic features present and qualified by the genus of the animal upon which they preyed. It is quite clear that while both belong to the Tetrarhynch family among Cestode parasites, the divergencies from each other in general outline, on the point of suckers, in the arrangement and shape of proboscides, and in internal structure indicate them as belonging to different genera. The larger one comes under the genus *Tetrarhynchus*, while for the smaller one I can find no place; and as it is especially distinguished by the absence of suckers, I apply the generic term *Abothros* (α, βόθρος), qualifying the generic designation of both by affixing to them the adjunct *carcharias* for specific differentiation.

The anatomical details of these forms are as follows:—

Tetrarhynchus carcharias.—This animal, in natural size and shape, is depicted in figs. 1 and 2, from which it will be seen that the parasite consists of a head and a linear series of segments much resembling a body, the two joined at a constricted portion, the neck. The total length equals $1\frac{6}{10}$ inch. The head (*a*, figs. 1 and 2) is ovoidal, flattened from before backwards, edges rounded off, surface perfectly smooth, structure firm, opaque, white in colour, with two fossettes, or suckers, and four proboscides; in dimensions $\frac{25}{100}$ inch long by $\frac{18}{100}$ broad, by $\frac{12}{100}$ thick. The neck (*b*, fig. 2) is a mere constriction, the limiting point of the cephalic structures on the one hand, and the point from which the segments progress on the other, $\frac{13}{100}$ inch broad by $\frac{5}{100}$ thick. The zooid colony (*c*, fig. 2) diverging from the neck, and somewhat in excess of it in all dimensions, follows the Cestoid order of worms in being flat, narrow, and thin, and measured $1\frac{3}{10}$ inch in length by $\frac{18}{100}$ broad and $\frac{6}{100}$ thick; yellowish white in colour, firm but flexible in structure, with closely approximated delicate transverse furrows (somewhat under 100 in the space of an inch) mapping off the component segments, and deeper longitudinal wrinkles on the flat anterior and posterior surfaces, giving a trilobar arrangement to the body-constituents of the zooid (as seen in fig. 3, a transverse section). It will be observed that the lower segments contract somewhat instead of increasing in breadth, as in the tapeworm colonies, and terminate in a sort of tubercle or nodule (*d*, fig. 2); this was the case in two out of the three specimens at my disposal, while the third, although somewhat contracting towards the lowermost segments, yet presented a flat end—a feature apparently dependent upon these parasites being in the early period of growth of the mature stage.

On the broad surfaces of the head, within the upper half, are seated two oval depressions, bothria, fossettes, or suckers (fig. 2, *e*). These extend from the base of the proboscides in long diameter downwards, in dimensions $\frac{9}{100}$ inch long by $\frac{6}{100}$ broad by $\frac{3}{100}$ deep, but subject to variations in size in individuals and according to condition of tissues. A ridge slightly projecting into the hollow occupies the centre of the inner wall of each sucker lengthwise, rendering it partially bipartite, and above branches into two, one to each base of the double proboscis of its side. The head is thicker at its free end as compared with that adjoining the neck; and upon this free end from before backwards, from the upper end of one sucker to the other, in the centre, is an oblong platform with a deep furrow on each lateral side mapping it off from the rounded-off edges of the head, while at each end of the platform are situated the proboscides, four in all, but arranged in couples, one anteriorly, one posteriorly, each couple closely contiguous to the upper end of the sucker of its side (fig. 1). To the naked eye these proboscides, when exserted, look like small clubshape fringed projections placed in couples in lateral apposition to each other, but diverging at their free end, and give an extremely rough feel to the finger when drawn against them.

The more minute anatomy of the parasite is as follows, commencing with the structure of the colony for facility of description.

Fig. 3 is a transverse section through a segment at the middle of the colony; and it is at once apparent that there is a distinct separation of the visceral space (*f*) from the encircling body-constituents, the latter consisting of a cutaneous envelope and parenchyma compounded of a soft albuminoid material, muscular fibres, and inorganic nodules. The cutaneous envelope (fig. 3 *a*, fig. 5 *a*) averages $\frac{1}{7000}$ inch in thickness, consisting of a thin transparent chitinous layer externally, and a dark granular productive layer beneath. The parenchyma extends from the skin externally to the fibrous boundary of the visceral space internally, and is arranged as follows:—Next to the granular layer of the skin is a circular layer of involuntary muscular fibre, which for the space of $\frac{1}{770}$ inch is free from all intercepting fibres (fig. 5, *c*), but beyond that is intermingled with transverse muscular fibres, forming a continuous layer for about $\frac{1}{700}$ inch (fig. 5, *d*), after which they are both thickly studded with "calcareous particles," forming a well-defined layer of $\frac{1}{60}$ inch thickness, and following the contour of the body-surface (fig. 3, *c*; fig. 4, *c*; fig. 5, *e*). The transverse fibres, although forming a continuous layer outside the inorganic granule layer, yet on the inside of it are collected into uniform thin bands, which form a meshwork enclosing the soft albumenoid material and the longitudinal muscular bands of the body (fig. 3, *d*; fig. 6, *a*); and this meshwork is continued on to the fibrous boundary of the visceral space. The longitudinal muscular bundles (fig. 4, *d*) pass continuously, for the major part, from one segment to the other throughout the colony.

As regards the inorganic accretions ("calcareous particles") (fig. 7), these are oval spherical or somewhat irregular in outline, homogeneous, or made up of concentric laminæ arranged around a nucleus, pale yellow or brownish in colour; average size $\frac{1}{1000}$ inch. The major number are composed of lime carbonate, the minor (generally irregular in outline) of phosphates or inspissated fat compounds. The use and mode of arrangement in particles of this inorganic layer is apparently, as I have elsewhere more fully stated *, for the purpose of giving a firmness to the body-structure while allowing at the same time of pliability and movement of the one part upon the other.

A distinct fibrous layer divides the body-parenchyma from the visceral substance; it is connected to the inner surface of the cuticle at the lateral edges of the zooid (fig. 3, *e*), and is continued longitudinally from one segment to the other, passing up

* Quarterly Microscopical Journal, January 1875, p. 6.

through the neck into the head, as will be subsequently detailed. The visceral space averages $\frac{1}{40}$ inch in thickness, and occupies the centre of the segment (fig. 3, *f*; fig. 4, *f*). It contains a granular homogeneous albumenoid material with a few interspersed inorganic particles; and although not presenting, in the segments of any of the three parasites from which these details are taken, any trace of viscera, yet, following by analogy the developmental process in the allied family of Tapeworms, it is within this, and from this, that the generative viscera are produced. At each lateral end of the visceral space, at a distance from the sides of the segment of $\frac{1}{20}$ inch, is seated the cut lumen of the longitudinal water-vascular canals (fig. 3, *g*). These canals, $\frac{1}{150}$ inch in diameter, are mere channels in the substance lined by a delicate fibrous-tissue layer; the longitudinal ones pass from one segment to the other, and, as in the *Tænia mediocanellata*, are met by a transverse branch special to the segment, seated in the lower portion of the visceral space of each zooid—the combination of the two series of tubes giving to the system of vessels of the colony the aspect of a ladder. The transverse branches are oval in outline, and smaller than the longitudinal branches; they necessarily approximate closely in the front segments of the colony (fig. 4, *g*), and diverge more and more from each other in the progressive development towards maturity.

The only other feature of the segments to be noted is the contracted bulbous condition of the lowermost one above referred to. On section under the microscope this gave the structure and appearance of a collapsed vesicle thickly studded with "calcareous corpuscles;" and the inference drawn from it and the lower end of the colony is, that these parasites were in the early progress of growth towards maturity from the larvæ recently introduced into the stomach of the shark, and that the nodular free end was the remnant of the original vesicle not yet, in two of the parasites, thrown off, while in the third, as above mentioned, this had ensued. I may here state, too, another feature which appears to bear out this deduction. In one of the animals one of the divergent petaloid appendages of the head arranged in a circle at the base of the proboscides was present, while in the other two animals there was no trace of them nor of the three others in the same parasite. These four appendages appear to be common among the mature Tetrarhynchs, and more especially among the larvæ; and the existence of one under the circumstances mentioned would appear to indicate that not only were these forms in the Shark at an early stage of mature condition of cestoid life, but that these appendages in some forms of the Tetrarhynchidæ, although present in the larval condition, are thrown off when the creature reaches the nidus requisite for full development.

The constricted portion of the parasite colony (the neck) is similar in structure to the other segments; the body-constituents, the fibrous visceral boundary, and the longitudinal water-vascular canals pass through it to the head, there to be modified to the special requirements of this part of the parasite.

The head is composed of two suckers, four proboscides, with four bulbs and adjuncts for extrusion and withdrawal of the proboscides situated within an expansion of the visceral boundary continued through the neck and with a stratum of parenchyma between them and the cuticular surface. In the upper half of the head are the suckers and proboscides, in the lower half the bulbs (fig. 1, *b*). The naked-eye aspect of the fossettes or suckers I have already given; and to this must be added that the chitinous layer of the skin forms the lining membrane, and that within this are special layers of muscular fibres for the regulation of the function, these being retained within a fibrous capsule following the contour of the sucker at a distance of $\frac{1}{90}$ inch, and separating the special muscles from the general parenchyma of the head (fig. 9, *e*, and fig. 12, *b*). Among the special muscles are radiating fibres which pass from the cuticular lining of the sucker to the capsule (fig. 9, *c*); and these would by their action induce the function: others pass from one side of the sucker to the other, encircling it both laterally and vertically; and these would contract the cavity of the hollow and so put a stop to the sucking function, the lateral fibres especially running in a separate layer from the rest (fig. 9, *d*). From the inside of the fibrous capsule of the sucker diverging muscular fibres pass into the general parenchyma of the head; and these would render the capsule firm for the special radiating fibres to act from (fig. 12, *c*).

Fig. 11 illustrates an exserted proboscis, magnified, and fig. 12 one all but retracted, a slight eversion of the hooklets at the base being preseut. The exserted proboscis is short, thick-set, club-shaped, somewhat broader near the free end than at the base, $\frac{5}{100}$ inch long by $\frac{3}{100}$ inch thick. It is closely studded with hooklets with points directed downwards; the number and arrangement of them it is impossible to determine accurately, from the close apposition of one to the other; there cannot, however, be less than one thousand on each proboscis; and the rows of them appear to wind spirally to the top. When the proboscis is retracted, the tips of the hooklets point upwards and converge towards each other in the centre of the hollow cylinder then formed. This will be apparent on comparing fig. 12 with 11, and on remembering that the evolution of the proboscis is similar to the drawing-out of the inverted finger of a glove; the simile will render lucid also the process of boring into the tissues, and how in the gradual unfolding of the armed projectile the rows of hooklets come into play, those near the base being firmly fixed before the coming into action of those nearer the tip. The hooklets differ somewhat in shape and size according to situation upon the proboscis, whether towards the base or near the free end; if the former, then the characters are seen in fig. 10; but towards the free end the claw is lengthened out and straighter, clearly for the purpose of giving these a wider range of action; their average length is about $\frac{1}{100}$ inch. Their tip is very sharp, the limb is curved, the base is extended out and flat; the structure is transparent, and apparently consists of a very dense outer sheath and a soft granular internal core; the base is firmly attached to the surface of the proboscis. I am inclined to consider, from the facts of acids having no influence on them, and prolonged immersion in strong liquor potassæ and glycerine rendering them soft and pliable, that the composition of the hooklets is chitinous, similar to the claws of rapacious birds. Fig. 12 shows the proboscis to be muscular in structure, contained within a special thick sheath separating it from the general parenchyma of the head. Immediately within the sheath is seen a layer of muscular fibre forming an outer cylinder (fig. 12, *e*), the fibres directed vertically; these appear to arise low down from the inside of the sheath, and, passing upwards to the base of the proboscis, curve (in the inverted condition) inwards and downwards, but in the exserted state are continued up, forming the outer stratum to which the base of the hooklets is attached, and eventually merging into the strong circular muscle for the retraction of the proboscis (fig. 12, *g*). Commingled with this outer layer, where it is in contact with the hooklets (*i. e.* where it helps to form the proboscis), is a circular layer of fibres entirely limited to the proboscis (fig. 12, *f*), while from the most inverted end of the proboscis (or forming the core of it when exserted) a strong circular muscle passes downwards and terminates in a tendon (fig. 13) which is continued on to the bulb (figs. 14 & 16). The action of these layers is apparent from the direction of the fibres; the outer cylindrical layer evolves the proboscis; the circular layer gives it stability and firmnesss; the thick circular basal muscle retracts it. These muscular layers are made up of solid cylindrical fibrillæ arranged parallel to each other and of an exquisite delicate yet decided texture; moreover there are transverse markings upon them which are not sufficiently regular to be pronounced striæ, yet unquestionably they closely approximate voluntary vertebrate muscular tissue*. The sheath of the proboscis is kept *in situ* by muscular bands and fibrous tissue which diverge from it into the surrounding head-substance; and at the point where it contracts with the tendon of the muscle (fig. 13, *d*), there the fibres are very strongly pronounced. The retractor muscle is $\frac{8}{100}$ inch in length by $\frac{2}{100}$ inch in diameter; and its tendon passes down for a short distance, and merges into the muscular layers of the bulb.

These bulbs are four in number, one to each proboscis; they are elongated ovoidal structures, in shape markedly resembling a sausage, $\frac{5}{100}$ inch in length by $\frac{1}{100}$ inch in diameter; they are arranged side by side within the expansion of the fibrous visceral boundary of the colony, passing through the neck to merge in the cuticular layer of the free end of the head (fig. 8, *d*; fig. 16, *d*). In structure they are composed of planes of muscle whose fibres cross each other in all directions; these planes form an outer stratum covered externally by a prolongation of the sheath of the proboscis; and within this outer stratum are enclosed the special fibres connected with the retractor tendon (fig. 14). These special fibres are seen to pass on one side of the bulb (fig. 14, *a*, *b*) to its bottom and then to curve upwards on the other side to the top, near where they enter, apparently there merging in the fibres of the outer stratum. That this intricate arrangement of muscular bands is connected with the retraction of the proboscis cannot be questioned, and would appear to be dependent on the shifting position of the central tendon in the exserted or retracted state of the proboscis; for in the process of *inversion* (accomplished by the upper fibres of the central tendon, retractor

* The recent observations of Mr. Schaefer on the structure of muscular fibre (voluntary) seem to me to throw light on this point and also receive light from these details.

proboscidis muscle) the presence of the bulb fibres would be necessary to withdraw the tendon, shifted gently upwards during evolution, and so to give a moveable yet firm point from which the upper fibres could operate. The bulbs are firmly fixed by their lower end; and as the process is better exemplified in the succeeding parasitic form, the subject is there entered upon.

The parenchyma of the head has the same components as that of the segments, only differently arranged. Internal to the chitinous skin are the circular fibres; and succeeding these is the inorganic stratum, much more sparsely amassed. The radiating fibres are not collected into a network, but pass generally dispersed from the skin to the fibrous layer encircling the bulbs, and are equally intercepted by the longitudinal fibres which extend from the head throughout the entire colony. In the neck the longitudinal water-vascular canals are clearly present (fig. 8, *c*), only reduced in calibre; but what becomes of them in the upper part of the head I cannot state, not having been able, from the limited number of parasites at my disposal, to accurately trace them out.

Abothros carcharias.—In the description of this parasite I shall mainly limit the anatomical details to those points in which it diverges from the former species.

Fig. 15 gives an outline of the animal form, natural size—in which are distinguishable the head, the segmented colony, and the apparent junction between these. The head (*a*) is in shape an elongated ovoid slightly flattened from before backwards, $\frac{34}{100}$ inch long by $\frac{8}{100}$ broad by $\frac{5}{100}$ thick, bevelled off towards the free end, from which at the extreme point the proboscides emerge. A few longitudinal furrows are present; otherwise its surface is uniform and smooth, in colour a dark red, more intense towards the free end, where it it is often black; there are no fossettes or suckers. The extent of the colony attached to the head in any one of the specimens did not measure more than 2 inches in length, the delicate striated band of zooids $\frac{7}{100}$ inch broad by $\frac{1}{100}$ inch thick, having suffered rupture in every instance; yet at least 200 segments were present. The milk-white colour of the colony strongly contrasted with the dark red head. At the apparent point of junction of the head and colony (fig. 15, *b*) there was no constricted portion to call a neck; but the upper end was invaginated in the head to the extent of $\frac{13}{100}$ of an inch, or, to put it in other language a gradually thinning cylinder of tissue from the head enveloped the first part of the colony to this extent (fig. 17, *b*). There was no trace of genital orifices in any of the segments.

A vertical section through the head is seen in fig. 16, and a transverse section in fig. 19, showing the arrangement for the movements of the proboscis to be similar in both parasitic forms. From the bottom of the bulbs a dense mass of fibres pass, which form a circular band traceable through the centre of the head downwards (fig. 16, *e*); these are evidently for the retention of the bulbs in their normal vertical position in the head. The proboscides in this species are narrow and elongated, $\frac{1}{300}$ inch long by $\frac{1}{3000}$ inch in diameter; the hooklets are of one shape and not so thickly studded, arranged in parallel spiral lines, along each of which on the side of the proboscis in view under the microscope five can be counted; and this would give to each proboscis about 400 hooklets in all (fig. 18); the average size of the hooklets is $\frac{1}{1000}$ inch. The proboscides emerge from the free end of the head in separate circular apertures placed at equal distances from each other; and these are mere orifices with no appendages. Immediately beneath the skin of the head is an immense quantity of dark, black pigment in the form of minute oval masses often arranged linearly, and also oval masses about $\frac{1}{3000}$ inch in diameter of a beautiful purple colour; and these give the special tinge to this part of the parasite. Surrounding the bulbs is a delicate fibrous layer; and in the parenchyma external to it are a few inorganic calcareous nodules arranged at definite intervals, and radiating and circular and longitudinal muscular fibres regularly penetrating it.

In fig. 17, a vertical section, is seen the mode of junction of the colony with the head. A distinct transverse band of fibrous tissue (*d*) forms the boundary line; and from this strong radiating bands (*c*) diverge upwards into the head, forming the link of the one to other. The structure of the enveloping cylinder of the commencement of the colony is similar to the parietes of the head; the cuticle at the free thin end is reflected upwards and inwards as a delicate layer to the level of the junction of colony and head, and is there continuous with the skin of the former. The first segments of the colony are very delicate in aspect and of great tenuity; and the collar prolongation from the head would act as a protection against external harmful influences.

The colony is distinctly segmented at intervals of about $\frac{1}{100}$ inch for the first $1\frac{1}{2}$ inch, and, to the naked eye, more approaches in form the young segments of tapeworms generally than that of the former parasite. In the structure of the segment we get the chitinous skin, subjacent granular layer, body parenchyma, visceral space, and water-vascular canals. The muscular layers of the parenchyma are transverse, circular, and longitudinal; and, as will be seen in fig. 21, the transverse fibres uniformly radiate between the skin and visceral boundary instead of forming a meshwork. The inorganic nodules are few, but similarly arranged and similar in composition and structure. Within the visceral space is the longitudinal water-vascular canal; and, as seen in fig. 20, this system is the counterpart of that in the former parasite. In the upper segments the granular visceral material is, as usual, with no trace of differentiation; but in the lowermost segments present in these parasites (about the 200th) there is a distinct separation of it into spherical masses, apparently ovarian vesicles (fig. 21, *d*), as far as can be traced, the process of development of the early zooids closely approximating that detailed as observed in the *Tænia mediocanellata* *.

Remarks.—These parasitic forms (Tetrarhynchidæ) are limited to water-residents, the larvæ being developed from ova taken in by certain among them, and the mature creature reached in the bodies of the predaceous species of fishes, mainly or wholly, which make the larval hosts their food, the cycle of changes being similar to that observed in the allied family of tapeworms. The strong resemblance of the colonies of the parasites of the Shark to that of *Tæniæ* is evident, the one, as in the other, being a series of semi-independent hermaphrodite zooids without alimentary canal, and with a water-vascular system closely connected in all. It is at the head end that the mature Tetrarhynchs mainly diverge from the *Tæniæ*, though here there are the same elements, only in a modified form, the limited rows of hooklets on a rostellum in the *Tæniæ* being developed in the Tetrarhynch into an armed lengthened proboscis, while the four or bipartite two suckers of the latter family are apparently similar in structure and function to those of the tapeworm. By the proboscis these parasites of the Shark are linked to the tape-worms armed with hooklets, while by the suckers the larger form shows its relation to the *Bothriocephalus* family. It is interesting to note the absence of suckers in the smaller form, although placed under the same conditions for maturity as the larger, inasmuch as in the other cestode

* Quarterly Microscopical Journal, January 1875, p. 16.

families the suckers are the constant feature, and the hooklets the variable, but reversed in the Tetrarhynchs; possibly the addition of the bothria or suckers in the one is connected with the extra weight of material to be anchored in the shape of breadth and thickness of colony as compared with the other. It will be observed that I have made no mention of nerve-centres in the anatomy of these animal forms, and for the reason that, though doubtless present, I am unable to distinguish any such among the components of the zooids. Considering the very intricate arrangement of fibres and granular material making up the parenchyma of the cephalic mass, the identification and tracing the method of arrangement and dispersion of nerve-fibres and ganglia must be a matter of extreme difficulty; and, in spite of a very careful and prolonged scrutiny, I cannot lay claim to any elucidation of this portion of the subject. The same may be said of those centres undoubtedly present (by inference) in each segment of the colony.

EXPLANATION OF THE PLATES.

Plates XXIV.–XXVI.

Tetrarhynchus carcharias. Figs. 1–14.

Fig. 1. Natural size: *a*, bird's-eye view of the free end of the head; *b*, section through the head, from before backwards, to show the position of suckers and bulbs.

Fig. 2. Natural size. Flat surface of the parasite: *a*, head; *b*, neck; *c*, colony; *d*, nodule at its free end; *e*, anterior sucker; *f*, anterior pair of proboscides.

Fig. 3. Magnified 15 diameters. Transverse section through a zooid at the centre of the colony-length: *a*, skin; *b*, circular and transverse muscles; *c*, inorganic layer; *d*, meshwork arrangement of transverse muscles; *e*, fibrous visceral boundary; *f*, visceral space; *g*, cut lumen of each longitudinal water-vascular canal.

Fig. 4. Magn. 15 diam. Vertical section, from before backwards, of several zooids in continuity about the centre of the colony: *a*, skin, showing the indentations at the junction of the several zooids; *b*, muscular layers, circular and transverse; *c*, inorganic layer; *d*, parenchyma with the longitudinal muscular bands; *e*, visceral boundary; *f*, visceral space; *g*, transverse water-vascular canals closely abutting upon each other.

Fig. 5. Magn. 200 diam. Transverse section through the body-parietes: *a*, chitinous layer of skin; *b*, granular layer; *c*, circular muscular fibres; *d*, transverse muscular fibres; *e*, inorganic layer.

Fig. 6. Magn. 200 diam. Continuation of former section to the visceral boundary: *a*, meshwork formed by the transverse muscular fibres beyond the inorganic layer enclosing *b*, the cut ends of the longitudinal muscular bands and the granular albumenoid material of parenchyma; *c*, fibrous boundary of the visceral space.

Fig. 7. Magn. 350 diam. Inorganic nodules "calcareous particles:" *a*, concentric laminated nodules of lime carbonate; *b*, homogeneous granules partly lime carbonate, partly phosphatic; *c*, inspissated fat compounds.

Fig. 8. Magn. 15 diam. Transverse section at the junction of head with neck at the lower ends of the bulbs: *a*, body-constituents, similar to fig. 3, *a–d*; *b*, expanded visceral boundary forming a capsule to *d*, the bulbs connected with the proboscides; *c*, longitudinal water-vascular canals.

Fig. 9. Magn. 100 diam. Transverse section through a portion of a sucker adjacent to the skin: *a*, cuticular lining to sucker; *b*, cuticle of skin of head; *c*, radiating muscular fibres special to sucker; *d*, transverse encircling band; *e*, fibrous capsule separating the special muscles from *f*, the general parenchyma of the head.

Fig. 10. Magn. 100 diam. A hooklet near the base of proboscis, showing the double contour and granular internal core.

Fig. 11. Magn. 40 diam. Exserted proboscis as seen from the flat surface of the head of the parasite.

Fig. 12. Magn. 40 diam. Vertical section carried from before backwards through an all but inverted proboscis: *a*, sucker; *b*, its fibrous capsule; *c*, the radiating bands of muscle from the capsule into the general parenchyma of head; *d*, sheath of proboscis; *e*, cylindrical layer of muscle for protrusion and evolving of proboscis; *f*, circular layer limited to region of hooklets; *g*, retractor muscle of proboscis.

Fig. 13. Magn. 40 diam. Continuation downwards of former section to show the termination of (*a*) the retractor muscle in the central tendon (*b*): *c*, sheath; *d*, radiating strong bands at the contraction of the sheath.

Fig. 14. Magn. 40 diam. Further continuation of section into the upper end of a bulb, to show the connexion of the fibres from the lower end of central tendon with the bulb: *a*, special muscular band from central tendon passing to the lower end of bulb and curving up on the opposite side (*b*) to merge into the outer strata.

Abothros carcharias, figs. 15–21.

Fig. 15. Natural size. *a*, head; *b*, point to which the outer cylinder of tissue from the head covers the first segments of the colony, *c*.

Fig. 16. Magn. 20 diam. Vertical section through upper part of the head: *a*, skin; *b*, inorganic layer; *c*, parenchyma with strong longitudinal muscular bands; *d*, bulbs for retraction of proboscides, *f*; *e*, strong band connected with the retaining *in situ* of the bulbs.

Fig. 17. Magn. 20 diam. Vertical section through lower half of head: *a*, colony of segmented zooids; *b*, prolongation of the substance of head as a cylinder of protection over the upper zooids; *c*, radiating bands connecting the colony with the head; *d*, fibrous boundary dividing the one from the other.

Fig. 18. Magn. 200 diam. About one third of free end of proboscis: *a*, central retractor muscle.

Fig. 19. Magn. 15 diam. Transverse section through the head: *a*, body-constituents; *b*, fibrous capsule around the bulbs, *c*.

Fig. 20. Magn. 20 diam. Front view of a segment about centre of the colony: *a*, the line of distinction between one and the other, immediately above

which is a light-shaded canal, the transverse water-vascular canal, which joins with the longitudinal water-vascular canal (*b*) at each lateral edge of segment.

Fig. 21. Magn. 65 diam. Transverse section through a part of one of the lowest zooids of the colony: *a*, skin; *b*, layers of muscular fibre and inorganic nodules; *c*, fibrous boundary of visceral space; *d*, ovarian vesicles in visceral space; *e*, lumen of longitudinal water-vascular canal.

Notes on the Lepidoptera of the Family Zygænidæ, with Descriptions of new Genera and Species. By Arthur G. Butler F.L.S., F.Z.S.

[Read May 6, 1875.]

(Plates XXVII. & XXVIII.)

In the present paper I propose to correct errors in the synonymy of the Family, chiefly occurring in Mr. Walker's lists. I shall not, however, pay much attention to the genera *Zygæna*, *Procris*, and other European groups, as I have not deeply studied them, and should possibly do more harm than good in sinking many of what seem to me undistinguishable species, but which may (for any thing that I know to the contrary) differ in their earlier stages. I have lately been made aware of the painful fact that species which in their perfect state are almost identical in every respect, are, in the larval condition, so dissimilar as to leave no doubt of their being distinct. This fact is perhaps in no instance better exemplified than in our *Chærocampa elpenor* and its Japanese representative *C. Lewisii*, mihi.

I find that in the Zygænidæ the neuration of the wings has been much neglected, so that in the groups Syntominæ (*Syntomides*, part., Herrich-Schäffer), Euchromiinæ, and Eunomiinæ I shall have to diagnose many new genera; when I do so I shall refer to them all the species described by Walker and appertaining to them. As regards the Charideinæ (Charideoidæ, *Wallengren*), as they are, to my mind, clearly a slightly aberrant group of Arctiidæ, and not Zygænidæ, excepting in external appearance, I shall retain them for a distinct paper.

I have paid most careful attention to the neuration of the wings in this highly interesting group, and I find the neuration of the Charideinæ to agree closely with *Phragmatobia* and other unquestioned genera of Arctiidæ; the only character that has been proposed, to my knowledge, by which any of them can be separated, is their metallic coloration—a poor character when we take into consideration the fact that many true Zygænidæ are destitute of it.

Subfamily ZYGÆNINÆ.

(Anthroceroidæ, *Wllgr.*)

Genus Zygæna, *Fabricius.*

Z. negamica of Walker has been referred by Wallengren to his *Arichalca erythropyga.* I will not attempt (with my present small knowledge of the Zygæninæ) to consider its right to be treated as a distinct genus; to all appearance it is a *Zygæna. Procris contraria,* Walker, is a *Neurosymploca* (*Euctenia,* Felder), and therefore not (as Walker suggests) congeneric with *Z. concinna,* Dalman; it is identical with "*Zygæna pectinicornis*" of Shaufuss. *Cf.* Lep. Het. vii. p. 159, and Nunquam Otiosus, i. p. 11.

Genus Procris, *Fabricius.*

Zygæna acharon of Fabricius is referable to this genus; *Amycles acharon* of Walker may therefore take the name *A. phœnicotelus.*

P. nebulosa, Klug (Lep. Het. i. p. 110) is = *P. nebulosa,* Herrich-Schäffer (Lep. Het. vii. p. 1591).

P. rufiventris, Walker (n. 11), is not a *Procris,* but probably a new genus near *Pollanisus.*

P. infausta, Linn., is a distinct genus (type of *Aglaope,* Latr.), *cf.* Staudinger, Cat. der Lep. p. 44.

P. subdolosa, Walker, Suppl. p. 62, is a *Pollanisus.*

Subfamily SYNTOMINÆ.

Genus Syntomis, *Ochsenheimer.*

I have no doubt whatever that *S. Schœnerri* (*sic*), Boisduval, and *S. cyssea,* Cramer (both described from Bengalese specimens) are identical. Cramer's figure is, indeed, rough, but it presents all the important characters of Boisduval's insect. Among the specimens in the National collection I detected an example of *S. bicincta,* Kollar (letter *c* of Walker), and a third species (*g, h,* Walker) from Nepaul (*S. lucina,* Butl.). The examples referred to by Mr. Walker under *S. Latreillii,* Boisd., are referable to *S. creusa,* Linn.; we, however, possess Boisduval's species from Southern India.

S. Khulweinii, Lefebvre.—Mr. Walker (n. 10) places *Sphinx minceus* of Cramer with a ? as a synonym of this species; but at n. 25 he repeats the latter as a distinct species; it is the type of a distinct genus *Eutomis*, Hubner (Pl. XXVIII. fig. 12). We possess *S. Khulweinii* from Natal.

S. passalis, Fabricius (n. 12), is identical with *S. creusa*, Linn. (n. 13).

S. polydamon, Cramer, appears to me to be referable to a distinct genus, as subsequently suggested by Walker (Lep. Het. vii. p. 1592); but I have not seen specimens.

The examples referred to (n. 19) as *S. Hübneri*, Boisduval, and *S. Walkeri* of Moore belong to Walker's genus *Artona*, Lep. Het. p. 439, gen. 60.

S. diaphana, var. ?, Walker (nec Kollar), is a distinct species, and may be named *S. œnone*.

The examples referred to under *S. imaon* are referable to two or three distinct species; the same may be said of *S. atereus*, which is moreover not a *Syntomis*.

S. simplex, Walker (n. 27), and *S. nostalis*, Walker (n. 28), are identical, the first being the female, the second the male; but the examples referred to under *S. simplex* as from Congo are distinct.

S. subcordata of Walker has pectinated antennæ, and therefore must be removed from the genus.

S. diptera of Fabricius is clearly not a *Syntomis*.

S. diminuta (*cf.* Lep. Het. i. p. 230, and vii. p. 1592) has pectinated antennæ, and consequently is not a *Syntomis*; its neuration is peculiar, so that it will form the type of a new genus.

S. subaurata (*cf.* Lep. Het. i. p. 149, and vii. p. 1593) also has pectinated antennæ, and, with *S. pravata*, Moore, will form another new genus.

S. humeralis is = *Trypanophora semihyalina* (*cf.* Moore's Cat. Lep. E. I. C. ii. p. 322).

S. Crawfurdi of Moore is a *Phacusa*.

S. dolosa, *strigosa*, and probably *glaucopoides* and *expansa* will form a new genus with pectinated antennæ and peculiar neuration.

S. xanthomela (Suppl. i. p. 65) appears to be identical with *S. contermina*; and *S. intermissa* is probably a slight variety of *S. transitiva*.

S. fenestrata (p. 73), being distinct from *S. fenestrata*, Drury, must be renamed; I propose to call it *S. midas*.

S. monedula, Wallengren, is identical with *S. nostalis*, Walker.

S. germana, Felder, is the *S. thelebus* of Fabricius.

S. cuprea, Prittwitz (Stett. ent. Zeit. 1867, p. 277), but not of Walker, is fortunately the *S. cyssea* of Cramer, so will not require renaming.

Tipulodes ? *apicalis*, Walker, is scarcely specifically distinct from *Syntomis flaviplaga* of the same author.

The following species must be removed to Walker's genus *Hydrusa*:—*S. annulata*, Fabr.; *aperta*, Walker; *fulvescens*, Walker; *confinis*, Walker; and *bivittata*, Walker. The following are also probably referable to the same genus—*S. vitrea, fusiformis, teneiformis, penangæ, guttulosa, diversa, vacua, linearis, octomaculata, basigera.*

S. myodes of Boisduval appears to me to belong to Walker's genus *Byblisia*, and *S. minuta* to *Artona*; the drawing of the antennæ may be incorrect.

S. bogotata of Walker is almost certain to prove generically distinct; the genus *Syntomis* seems to be a purely Old-World group.

S. longipes of Herrich-Schäffer seems to be a *Byblisia*; *S. amazona* an *Epitoxis*.

New species of *Syntomis*.

1. SYNTOMIS GEORGINA, n. sp.

Closely allied to *S. cyssea* (*S. schœnerri*, Bdv.), but with the frons black instead of bright yellow; all the hyaline wing-spots smaller, especially the two upper spots of the discal series: expanse of wings 23 to 30 millims.

S. India (*A. F. Sealy*), Ceylon (*Templeton*). Type, B.M.

Also in Mr. Moore's collection.

2. S. LUCINA, n. sp.

Allied to *S. cyssea*, but with the frons cream-coloured, three lateral segmental yellow spots connecting the abdominal bands, and the hyaline wing-spots more yellow in tint: expanse of wings 32 to 33 millims.

Nepal (*Hardwicke*). Type, B.M.

S. lucina is in Mr. Moore's collection from Calcutta.

3. S. KHASIANA, n. sp.

Nearly allied to *S. lucina*, but the tegulæ spotted with golden yellow, the lateral spots of abdomen continued almost to the middle of dorsum: primaries with the subcostal spot towards apex small and round, discal and other spots rather smaller than in *S. lucina*; fringe at apex white, all the hyaline spots much whiter: expanse of wings 31 millims.

Khasia hills (*G.-Austen*). Type, coll. F. Moore.

4. S. CYSSEOIDES, n. sp.

Nearly allied to *S. cyssea*, but the frons black, and the hyaline spots of secondaries smaller and widely separated: expanse of wings 27 millims.

Neilgherries. Type, coll. F. Moore.

Larger form, rather darker.

Mynpuri, N.W. provinces, and Bombay (*Leith*). Coll. Moore.

5. S. EDWARDSII, n. sp.

Nearly allied to *S. lucina*, but more bluish in tint, the frons black; collar orange; bands on addomen and lateral spots orange-yellow; primaries with all the hyaline spots rather larger; secondaries with the hyaline spots connected, none of the spots, excepting that on abdominal margin of secondaries, tinted with yellowish, as in *S. lucina*: expanse of wings 29 millims.

Formosa. Type, coll. F. Moore.

I have named this species after the indefatigable collector and entomologist, H. Edwards, of San Francisco.

6. S. FORMOSÆ, n. sp.

Nearly allied to *S. annetta* from China, but with the collar orange, the two bands on the abdomen and the spots on the pectus orange instead of yellow, all the spots on the primaries smaller, a hyaline spot near apex of secondaries uniting with the hyaline basal area, thus rendering its margin zigzag: expanse of wings 25 millims.

Formosa. Type, coll. F. Moore.

7. S. HYDATINA, n. sp.

♂. Body greenish black, frons creamy yellow; a spot on metathorax, a semicircular spot on basal segment of abdomen, the fourth segment above and below, and two large lateral spots on the pectus golden-yellow: antennæ greyish at the tips: wings greenish black; primaries with a small square spot near the base, two large divergent spots across the middle, a small oval spot just below base of subcostal fork, and a bifid spot (cut by the third median branch) upon disk, hyaline white; secondaries with a large spot (occupying the greater part of the wing) on abdominal margin hyaline white: expanse of wings 23 millims.

Calcutta (*Dick.*). Type, coll. F. Moore.

Allied to *S. annetta*.

The female is browner than the male, and has the hyaline spots rather larger, especially the subcostal and discal spots of primaries.

8. S. ELISA, n. sp.

Allied to the preceding species, but with the wings much longer, only five (more or less oval) spots on primaries, one near the base, two transversely near the middle, and two on the disk of the wing; frons snow-white, abdominal yellow bands broad, lateral yellow spots as in *S. lucina*: expanse of wings 32 to 39 millims.

Sarawak (*Wallace*). Four examples, B.M.

9. S. ANNETTA, n. sp.

Syntomis atereus? Walker (nec Cramer), Lep. Het. i. p. 128, n. 24 (1854).

China (*Lay & Bowring*). Type, B.M.

10. S. ATKINSONII, Moore.

Alled to the preceding and to *S. imaon*; from the latter it diffeis in its smaller size, blacker body and wings, the frons cream-coloured instead of yellow, the collar black instead of yellow; the primaries with a small subquadrate hyaline spot near the base, beyond this two large transverse central spots, only separated internally by the median nervure, and two large discal spots, each crossed by a black nervure, the upper one near its upper outer edge, the lower through the centre, marginal fringe creamy whitish near apex; secondaries with basal half hyaline, apical half black: expanse of wings 29 millims.

Moulmein (*Clerck*). B.M.

I have compared our example with Mr. Moore's type: the latter has no locality attached.

11. S. ARTINA, n. sp.

Allied to *S. libera*, smaller; frons white instead of yellow; secondaries much more narrowly bordered with black; hyaline spots of primaries all smaller, the three forming a patch upon median area much more distinctly separated by the black nervure and its first branch; the divided central discal spot not touching the margin; the subapical spot more completely divided, considerably smaller, placed halfway between the cell and apex: expanse of wings 30 millims.

Calcutta (*Rothney*). Type, B.M.

This is a very distinct little species.

12. S. CUPREIPENNIS, n. sp.

Nearly allied to *S. artina* and *S. libera*; body chocolate-brown; frons with a creamy white spot; collar, basal and fifth segments of abdomen, and two lateral spots on the pectus golden yellow; wings cupreous brown; primaries with hyaline areas as in *S. approximata*, seconda-

ries hyaline-white with the costal and outer margins cupreous-brown; abdominal edge yellowish: expanse of wings 31 millims.
Calcutta (*Dick.*). Type, Coll. F. Moore.

Easily distinguished from its allies by its copper-brown tint.

13. S. MARINA, n. sp.
Allied to *S. natalii*, much smaller, body entirely dark bronzy green, tarsi white at base: wings purple, greenish at base; primaries without a subbasal hyaline spot, the remaining five spots arranged as in *S. natalii*; secondaries with a hyaline spot on the abdominal margin near the base, and a second rounded spot between the median nervules: expanse of wings 26 millims.
Congo (*Richardson*). Three examples, B.M.

Mixed up by Mr. Walker with examples of *S. nostalis*.

14. S. JOHANNA, n. sp.
Allied to *S. cerbera*, more purplish in tint; the three abdominal bars more slender, and yellow instead of scarlet; no spot at base of abdomen; hyaline spots enlarged, especially the lower spot of the central pair, which almost touches the subbasal spot; pectus with a cream-coloured instead of a scarlet lateral spot: expanse of wings 33 millims.
Knysna (*Trimen*). Type, B.M.

15. S. ANNA, n. sp. (an præc. var.?).
Nearly allied to *S. cerbera*, males more purple in tint; hyaline wing-spots the same in every respect; bands on abdomen and the spot at base, as also the spot on pectus, orange in the male, yellow in the female (not scarlet): expanse of wings 29 to 34 millims.
Knysna (*Trimen*). Type, B.M.

I think it quite likely that this is only a variation of the preceding species.

16. S. ALICIA, n. sp.
Allied to *S. cerbera*, but larger, the wings narrower; the bands on the abdomen orange, two large lateral spots on the pectus; the hyaline wing-spots noticeably smaller, the two central spots of primaries more widely diverging: expanse of wings 37 to 39 millims.
Abyssinia (*Harris*). Type, B.M.

17. S. TOMASINA, n. sp.
Allied to *S. cerbera*, much smaller, scarlet abdominal bands broader; hyaline spots considerably smaller, and consequently well separated; pectoral scarlet spot large; base of tarsi distinctly white: expanse of wings 24 to 28 millims.
Sierra Leone (*Foxcroft*). Six specimens. Type, B.M.

18. S. FRANCISCA, n. sp.

♀. Allied to *S. cerbera*, larger; hyaline spots very small, nearly as in *S. creusa*, but the secondaries with a large oval spot near the base between the cell and abdominal margin: expanse of wings 39 millims.

Sierra Leone (*Foxcroft*). Type, B.M.

We have two examples of this species in the collection; it is probably the western representative of *S. cerbera*, although (excepting in the banding of the abdomen) it more nearly resembles *S. creusa*.

As an instance of the strong sexual instincts of this family, it may be mentioned that the type of this species was taken *in copulâ* with a male of *Tascia instructa*, Walker, which led the collector to suppose them to be sexes of one species; it is not, however, at all an uncommon occurrence in this family to find two males coupled together.

19. S. FANTASIA, n. sp.

Closely allied to *S. cerbera*, but the three discal hyaline spots of primaries united by the introduction of a fourth spot between them, so that together they form a quadrifid hyaline band; the central spots also more divergent, the lower one being lengthened at each end and extending transversely beyond the submedian nervure; basal spot longer: expanse of wings 36 millims.

Cape of Good Hope (*Drège*). Type, B.M.

Perhaps a curious aberration of *S. cerbera*, tending towards the *S. pactolina* group.

20. S. MONTANA, n. sp.

Closely allied to *S. latreillii*, but with all the hyaline spots, excepting the two nearest to apex of primaries, much enlarged, giving it much the appearance of *S. thelebus*: expanse of wings 40 millims.

India (*Elliott*). Type, B.M.

Differs from *S. thelebus* and *S. fenestrata* in having the subapical spots of *S. creusa* and *S. latreillii*: it is in Mr. Moore's collection from Bombay.

21. S. MANDARINIA, n. sp.

Head black, frons with an orange spot; thorax black, with a large spot on prothorax and a smaller semicircular spot on metathorax orange; abdomen orange, segments narrowly edged with black: primaries black, with six testaceous hyaline spots arranged as in *S. thelebus*; secondaries black, with a large, rounded, orange-edged, testaceous, hyaline patch cut by the median nervure, its first branch, and the submedian nervure; pectus black, with two large lateral orange spots; abdomen orange, the segments rather broadly edged with black; anus black; wings as above: expanse o wings 36 millims.

Shanghai, China. Type, coll. F. Moore.

Most nearly allied to *S. thelebus*, but easily distinguished by its black head, the broader black bands between the hyaline spots of primaries, and the smaller and more regular hyaline patch of secondaries. The type was labelled as the *S. fenestrata* of Herrich-Schäffer; this may be the case, but it is quite distinct from the *S. fenestrata* of Drury.

22. S. FLORINA, n. sp.

Head yellow, eyes, basal four fifths of antennæ, and a triangular central spot on the collar dark brown; thorax brown, with the tegulæ and two large oval spots yellow; abdomen yellow, banded with chocolate-brown; anus brown: wings yellow at base; primaries with basal half hyaline, veins and apical half chocolate-brown; a bifid elongated spot beyond the cell yellow, and a hyaline white spot, cut by the third median branch, upon the disk; secondaries with the costal and outer margins brown; a small oval subapical hyaline white spot: body below yellow banded with brown; wings as above: expanse of wings 27 millims.

Sarawak (*Wallace*). Type, B.M.

Allied to *S. xanthomela* and *S. tetragonaria*, but in some respects more like *S. fenestrata*.

23. S.? MARELLA, n. sp.

Head wanting; collar orange; thorax brown; abdomen orange banded with black (six bands), anus blackish brown: wings hyaline, with a tawny tint; primaries with the margins, veins, apex, external angle, and an irregular band crossing end of cell from costa to external angle black-brown; secondaries with outer margin rather broadly black-brown: body below black-brown, narrowly banded with orange: expanse of wings 34 millims.

—— ? Type, B.M.

Appears to be allied to *S. decorata* and *S. pactolina*, but may belong to the genus *Hydrusa*.

24. S. EMMA, n. sp.

Head black; antennæ grey at the tips; collar yellow; thorax black-brown; abdomen brown, with a broad basal yellow band, four slender yellow bands on central segments, a broad preanal testaceous band; body below slaty black, pectus streaked with yellow; a single yellow abdominal band, being a continuation of the fourth slender band of the upper surface: wings black-brown, with hyaline spots, almost exactly as in *S. thelebus*; primaries with a small subquadrate spot at base; two slightly diverging large spots across the middle, and two on disk (the lower one bifid and touching the centre of outer margin), apex white-tipped; secondaries hyaline, with the margins irregularly black-brown: expanse of wings 28 millims.

China, Foo-choo-foo (*Lay*). Type, B.M.

Most nearly allied to *S. aperiens*.

It appears to me that the Syntominæ would be most conveniently restricted (by the character of simple filiform antennæ) to the genera *Syntomis* (including *Cœnochromia* of Hübner), *Burlacena*, *Byblisia*, *Melisa*, and *Naclia* (or *Dysauxes*); the African representatives of the last-mentioned genus have pectinated antennæ and the hind-wing neuration of *Eutomis*; *N. puella* and *gnatula* may therefore be referred to the next subfamily under the generic name of *Pseudonaclia*. The following genus may be added:—

CALLITOMIS, nov. gen. Pl. XXVII. fig. 1.

Allied to *Syntomis*, but antennæ with fewer articulations, the latter more pronounced, and bearing minute hairs, but not serrated or pectinated; wings much broader, venation almost as in *Hydrusa*. Type *C. syntomoides*, n. sp.

1. CALLITOMIS SYNTOMOIDES, n. sp.

Body blue-black; abdomen with a spot at the base, and the fifth segment orange; pectus with two lateral orange spots; primaries dull dark green; an interno-median subbasal dot, a large subquadrate spot near the end of discoidal cell, a transverse litura below it, and a small bifid spot crossing the base of the third median branch ochreous; secondaries dull brown, discocellular region slightly greenish: wings below, brown; primaries spotted as above; secondaries with two diffused ochreous spots near the base, one interno-median, the other abdominal: expanse of wings 34 millims.

Cashmere. Type, coll. F. Moore.

2. C. LEUCOSOMA, n. sp.

Body ochreous, antennæ and legs greenish black: wings dull semitransparent brown; primaries with ochreous spots almost as in the preceding species; secondaries with the base and the interno-median area from the origin of the first median branch to the base pale ochreous; an ochreous spot on the first median interspace: below as above: expanse of wings 30 millims.

Cashmere. Type, coll. F. Moore.

If the sexes of the Syntominæ were subject to great differences of colour, *C. leucosoma* might be the female of the preceding species; but as this is not the case in any other instance with which I am acquainted, I do not think it at all probable.

Subfamily THYRETINÆ.

Antennæ always more or less strongly pectinated, more strongly in the males than in the females, neuration and coloration frequently partaking of the character of the preceding subfamily; anal segment of the males terminally slightly pilose.

Genus Hydrusa, *Walker*.

This genus is most nearly allied to *Syntomis*, the antennæ of the males in the typical group being armed with rather short pectinations, and the females with mere serrations.

1. Hydrusa cingulata, n. sp.

Nearly allied to *H. annulata*, but smaller, the head narrower, of a brighter orange colour, the crest more narrowly banded with orange; primaries with the spot at end of cell smaller, narrower than long, the subapical spot bifid, much more elongated, the discal bifid spot subtriangular, no pale tawny dot connecting the discal and subapica spots; secondaries with the base more narrowly orange (the orange area only occupying the basal third of the wing), discal oval spot smaller, less distinctly divided: body below brighter in colour, abdomen banded with orange down to the anus; wings below nearly as above: expanse of wings 37 millims.

Moreton Bay (*Gibbons*). Type, B.M.

The type of *H. annulata* is in the Banksian cabinet, and agrees with an example which we have from Sidney.

We have two examples, registered "N. E. coast of Australia," which seem to be referable to *H. cingulata*.

2. H. humeralis, n. sp.

Allied to the preceding species, but smaller; head orange, with a furcate spot on the crest; thorax blackish, tegulæ orange; abdomen orange, the segments edged with black; primaries as in the preceding species; secondaries with the basal half pale orange, apical half black-brown, a large bifid subapical pale orange spot scarcely separated from the basal area: wings below as above; expanse 29 millims.

N. Australia (*Elsey*). Type, B.M.

3, H. nigriceps, n. sp.

Nearly allied to *H. annulata*, same size and general appearance; head entirely black above, frons orange; thorax black, abdomen black narrowly banded with orange: wings black, spotted with pale tawny hyaline; spots of primaries almost precisely as in *H. annulata*; secondaries with only the basal two fifths pale tawny, no black dot below origin of first median branch; postcellular bifid spot very large: abdomen below having all the segments banded with orange as above; wings as above: expanse 44 millims.

Hunter River (*Macgillivray*). Type, B.M.

As this occurs almost at the same spot with *H. annulata*, it is possible that it may be a curious modification of that species.

4. H. INTENSA, n. sp.

Allied to the preceding, much smaller, wings narrower, coloration altogether darker; all the wing-spots deeper tawny and considerably smaller: expanse of wings 29 to 36 millims.

Sidney (*Lambert*), Australia (*Hunter, Macgillivray, &c.*). Type, B.M.

This is one of the most distinct-looking species of the *H. annulata* group; we have seven specimens in the British Museum.

5. H. INSULARIS, n. sp.

Head deep orange, crest with a transverse brown line; antennæ black, greyish at the tips; thorax black; abdomen orange, with the anus and six transverse bars black; wings black; primaries with five orange spots arranged much as in *H. intensa*, but smaller, opaque, the two below median nervure only separated by a slender brown streak; the lower discal spot bifid; secondaries with basal third, and a small spot above end of cell, deep orange: below as above: expanse of wings 35 millims.

Barnard Isles (*Macgillivray*). Type, B.M.

This species is more nearly allied to the type *H. bicolor* of Walker than are any of the other species of this group.

The arrangement of the genera of Thyretinæ seems to be *Eutomis*, *Epitoxis*, *Pseudonaclia*, *Asinusca*, *Hydrusa*, *Psichotoe*, *Trianura* (n. gen.), *Procotes* (n. gen.), *Notioptera* (n. gen.), *Thyrassia* (n. gen.), *Balatæa*, *Artona*, *Bintha*, *Tascia*, *Saluinca*, *Phacusa*, *Thyretes*, ? *Apisa*. The last-mentioned genus differs from the others in its more hairy body and longer palpi, which, together with its pale greyish coloration, induced Walker to place it at the end of the Liparidæ; but in all other respects it resembles *Thyretes*. See also South-American genera (*postea*).

TRIANEURA, n. gen. Pl. XXVIII. fig. 3.

Nearly allied to *Hydrusa*, but at once distinguished by the arrangement of the branches of the median nervure in secondaries, the third median (of *Hydrusa*) having passed round to the discocellular nervure, thus forming a radial nervure and leaving only two true median branches. Type, *T. subaurata*, Walker.

1. Trianeura subaurata = Glaucopis subaurata, *Walker, L. H.* p. 149.

Syntomis subaurata, *Walker*, p. 1593.

2. T. pravata = Syntomis pravata, *Moore.*

3. T. Moorei, n. sp.

Dark brown, an orange band at base of abdomen, and two orange lateral spots on pectus: primaries with a large spot within cell, a smaller oval spot below median nervure and between the first and second branches, and an elongate interno-median patch hyaline white; two bifid discal spots, the upper one cut by the subcostal fork, the lower by the third median branch; secondaries with a trifid (nearly central), hyaline white spot, resting upon the abdominal margin at its lower extremity: expanse of wings 22 millims.

Bombay (two specimens). Type, coll. F. Moore.

This pretty little species differs from the other two in the genus in the angulated character of the discocellular. It somewhat repeats the colour-characters of *Syntomis.*

Genus Psichotoë, *Boisd.* Pl. XXVIII. fig. 7.

Allied to *Hydrusa*; head small, antennæ minutely serrated; thorax and abdomen broad, the latter hairy behind; wing semi-hyaline, neuration almost as in *Hydrusa.* Type, *P. duvaucelii.*

1. Psichotoë Duvaucelii, *Boisd. Zyg.* pl. 8. fig. 5 (1829).

Body black, abdomen with a spot at base and the fifth segment orange-yellow; front of pectus below testaceous: wings greyish hyaline, the veins, costæ, and bases brown; extreme outer marginal edge black: expanse of wings 19 millims.

Calcutta. Coll. F. Moore.

There is a large example of what I take to be this species in Mr. Moore's collection from Scinde; it is in the collection of the British Museum, from Darjeeling, with Walker's MS. name *S. nigrita* attached.

2. P. incipiens.

Syntonis incipiens, *Walker, Lep. Het. Suppl.* i. p. 68 (1864).

S. India (*Walhouse*). Type, B.M.

The genus *Tasema*, Walker, placed by that author next to *Psichotoë*, seems closely allied to *Procris*; the antennæ are of the same construction.

Procotes, n. gen. Pl. XXVIII. fig. 1.

Wings narrow, cell of secondaries wide, partially divided by a recurrent nervure; one radial; discocellulars forming a continuous concave angular line, and equal in length; second median branch trifurcate, the forks emitted from its lower margin at regular intervals, thus dividing it into three almost equal lengths. Type, *P. diminuta*, Walker.

1. Procotes diminuta, *Walker* = Euchromia (Endera) diminuta, *Walker, L. H.* p. 230.
Syntomis diminuta, *Walker, l. c.* p. 1592.

Notioptera, n. gen. Pl. XXVIII. fig. 2.

Wings moderately broad, cell of secondaries wide, partially divided by a recurrent nervure emitted from the middle of the lower discocellular; one true radial, the lower radial being placed at the end of the median nervure, thus forming a fourth median branch; upper discocellular short, oblique, lower twice as long, angulated in the middle, the two together forming a zigzag line. Type, *N. dolosa*, Walker.

1. Notioptera dolosa = Syntomis dolosa, *Walker, Lep. Het.* p. 1594.

2. N.? glaucopoides = S. glaucopoides, *Walker, Lep. Het. Suppl.* p. 69.

3. N. strigosa = S. strigosa, *Walker, Lep. Het. Suppl.* p. 69.

4. N.? expansa = S. expansa, *Walker, Lep. Het. Suppl.* p. 73.

Thyrassia, n. gen. Pl. XXVIII. fig. 6.

Nearly allied to the preceding, but with not only the lower radial but also the third median branch emitted near together from the lower discocellular; the continuous line of the discocellulars also less zigzag. Type *T. subcordata*, Walker.

1. Thyrassia subcordata = Syntomis subcordata, *Walker, Lep. Het.* p. 132.

Balatæa, *Walker*.

1. Balatæa ægerioides, *Walker, Lep. Het. Suppl.* i. p. 110 (1864).
Northern China. Type, B.M.

I rather doubt the propriety of separating this genus from the next; for though slightly different in coloration, its large palpi seem to be its chief structural distinction; the pattern of the wings is very similar: both sexes are in Mr. Moore's collection from North China. I think *Rhaphidognatha setiæformis* of Felder is the same species.

Genus ARTONA, *Walker*. Pl. XXVIII. fig 14.

Secondaries with two subcostal and three median branches ; a fine radial nervure equally dividing the discocellulars and recurrent within the cell to near the base of the median nervure ; the discocellulars together forming a distinct angle; connecting alary bristle very long: antennæ of male strongly pectinated, of female filiform, flattened below, and rather thick, with the apical segments attenuated and ending in a species of clavus.

1. ARTONA DISCIVITTA, *Walker, Lep. Het.* ii. p. 440, n. 1 (1854).
N. India (*Stephens*). Type, B.M.

In Mr. Moore's collection from S. India.

2. A. ZEBRAICA, n. sp.
Size of the preceding species, but nearly allied to *A. Walkeri*; from the latter it chiefly differs in its smaller size, the paler colour and smaller size of all the yellow spots and patches on the wings, and the yellow bands and streaks on the body, and the triangular form of the abdominal bands: the abdomen of the male below is nearly white: expanse of wings 16 to 20 millims.
Almorah (*Boys*), Massuri (*Leadbeater*), N. India (*Reid*). Type, B.M.

3. A. WALKERI.
Syntomis Walkeri, *Moore, P. Z. S.* pl. 60. fig. 10 (1859).
♂, ♀. Java. Type, B.M.

4. A. NIGRESCENS, n. sp.
♂. Closely allied to the preceding species, same size, and nearly the same pattern, but almost black, with the yellow markings very pale; the spots on primaries rather larger, and the streaks of secondaries united, semitransparent in front; also a yellow and hyaline-white spot upon the costal margin: expanse of wings 22 millims.
Punjab, hills. Type, coll. F. Moore.

Easily recognized, from the dark ground-colour of the body and wings and the very slender pale bands on the abdomen.

5. A. FULVIDA, n. sp.
♀. Like a small edition of *A. Walkeri,* but easily distinguished by the coloration of the abdomen, which is ochreous, with a black spot on each side at base and anal extremity: it also differs in having the sub-

apical spots of primaries united into a single large reniform spot: expanse of wings 21 millims.

Moulmein (*Clerck*). Type, B.M.

6. A. HAINANA, n. sp.

♀. Nearly allied to *A. Walkeri*, but the segments of the abdomen not edged with black; the usual subterminal black bar: expanse of wings 24 millims.

Hainan, China (*Swinhoe*). Type, coll. F. Moore.

Doubtless a local form of *A. Walkeri.*

7. A. CONFUSA, n. sp.

Syntomis Hübneri (*part.*), *Walker* (*nec Boisd.*), *Lep. Het.* i. p. 125. n. 19 (1854).

♀. Nearly allied to *A. Walkeri*, but the abdomen ochreous, with a broad terminal black band; anus fringed with ochreous hairs; spots towards apex of primaries connected, forming a large reniform spot, as in *A. fulvida*; secondaries sometimes without the subcostal black dash: expanse of wings 25 to 27 millims.

North India (*James*). Type, B.M.

The type of this species bears a label in Mr. Walker's handwriting with the name "*Hübneri*" inscribed thereon; the description (in Lep. Het.) does not, however, quite agree with it. *A. confusa* is very like *A. hainana.*

Genus BINTHA, *Walker.*

1. BINTHA GRACILIS, *Walker, Lep. Het. Suppl.* i. p. 127 (1864).

Japan (*Fortune*). Type, B.M.

Genus TASCIA, *Walker.*

1. TASCIA FINALIS = Euchromia (Aclytia) finalis, *Walker, L. H.* i. p. 245.

T. chrysotelus, *Walker, Lep. Het.* vii. p. 1600.

Port Natal (*Gueinzius*). Types, B.M.

2. T. VIRESCENS, n. sp.

Body dull dark green, with a lateral row of metallic green dots terminating in a carmine dot; anal segments orange, black at the sides: wings dark silky green; primaries with a large oval hyaline-white spot within the end of cell; a second large bifid white spot cut by the first median branch; a metallic dot at the base; secondaries with a large hyaline-white spot on the abdominal area: body below dark green, with a lateral row of metallic green dots terminating as above in a carmine dot: wings dark shining green, fringe purple; primaries with basal half purplish brown: secondaries with two subcostal metallic green spots, one near the base, the other just beyond the middle of the wing; otherwise as above: expanse of wings 35 millims.

Port Natal (*Gueinzius*). Type, B.M.

Allied to the preceding species, but very distinct.

3. T. PULCHRA, n. sp.

Body dull dark brown; crest, apex of antennæ, back of the eyes and collar, metallic steel-blue; second and third segments metallic green at the sides, below which all the segments have a line of carmine; wings dark brown, primaries with a quadrifid, slightly tapering, hyaline-white postmedian band or spot; secondaries hyaline-white at base; discoidal spot and a spot below centre of median nervure bright metallic blue: below dark dull brown, frons and thorax spotted with steel-blue; primaries with a dash of metallic blue in the cell; secondaries with basi-costal area and a subcostal spot beyond the middle metallic green; the hyaline abdominal area edged with blue; anal angle greenish: otherwise as above: expanse of wings 28 millims.

Congo (*Curror*). Type, B.M.

4. T. INSTRUCTA = Euchromia (Amycles) instructa, *Walker, Lep. Het.* i. p. 254.

Sierra Leone (*Morgan*). Type, B.M.

5. T. CUPREA = Syntomis cuprea, *Walker, Lep. Het.* vii. p. 1596.

India.

There is a species allied to this in Mr. Moore's collection.

6. T. QUADRICOLOR = Syntomis quadricolor, *Walker, Lep. Het.* vii. p. 1596.

India.

I have seen this species in Mr. Moore's collection.

Genus SALIUNCA, *Walker*. Pl. XXVIII fig. 17.

1. SALIUNCA THORACICA = Tipulodes? thoracica, *Walker, Lep. Het.* vii. p. 1626.

S. thoracica, *Walker, Lep. Het. Suppl.* i. p. 108.

Sierra Leone (*Foxcroft*), Africa (*Milne*). Types, B.M.

The examples placed by Walker under *Tipulodes* and *Saliunca* were described independently of each other.

2. S. STYX = Zygæna styx, *Fabricius, Sp. Ins.* ii. p. 166. n. 52.

Africa. Coll. Banks.

Closely allied to the preceding species. It has no connexion whatever with the species referred to it by Walker.

3. S. AURIFRONS, *Walker, Lep. Het. Suppl.* i. p. 109 (1864).
Sierra Leone (*Foxcroft*). Type, B.M.

One of the most beautiful of the Zygænidæ.

Genus PHACUSA, *Walker.* Pl. XXVIII. fig. 15.

1. PHACUSA TENEBROSA = Glaucopis (Phacusa) tenebrosa, *Walker, Lep. Het.* i. p. 150.
Syntomis tenebrosa, *Walker, Lep. Het.* vii. p. 1592.
India (*Stevens*). Type, B.M.

2. P. CRAWFURDI = Syntomis Crawfurdi, *Moore, P. Z. S.* 1859, pl. 60. fig. 11.
Java (*Horsfield*). Type, B.M.

Genus THYRETES, *Boisduval.* Pl. XXVIII. fig. 11.

1. THYRETES HIPPOTES = Sphinx hippotes, *Cramer, Pap. Exot.* iii. pl. 286. f. A.
Cape of Good Hope. ♂, ♀, B.M.

2. T. CAFFRA, *Wallengren, Kongl. Svenska. Vetensk. Akad. Handl.* v. p. 11.
South Africa.

Rather smaller in both sexes than the preceding species.

3. T. MONTANA, *Boisd. Voy. de Deleg.* ii. p. 597, *et Wallengren, op. cit.*
East Caffraria.

4. T. MONTEIROI, n. sp.
Body ochre-yellow, eyes, antennæ, centre of dorsum, and edges of abdominal segments black-brown, a line down each side of the abdomen of the same colour: wings dark brown; a testaceous hyaline band from centre of inner margin, round lower edge of cell, to lower radial nervure, cut by the median branches into four unequal parts; a semicircular spot of the same colour within the end of the cell, and another oval spot near apex; secondaries with the basal half irregularly testaceous hyaline; an oval bifid disco-submarginal spot of the same colour, cut by the third median nervure: below nearly as above: expanse of wings 30 millims.
Ambriz (*Monteiro*). Type, B.M.

A very pretty little species.

Genus APISA, *Walker.*

1. APISA CANESCENS, *Walker, Lep. Het.* iv. p. 917, n. 1 (1855).
South Africa (*Argent*). Type, B.M.

As I have already said, I feel somewhat uncertain as to the position of this genus, although I believe it to be allied to *Thyretes*.

Subfamily PHAUDINÆ *.

The genera *Phauda*, *Odozana*, and a new genus from Japan† will, I think, form a distinct subfamily; I shall not, however, go into this group in the present paper, excepting to enumerate the species of *Phauda*:—1. *P. flammans*, Wlk.; 2. *P. Fortunei*, H.-Sch. (*triadum*, Walk.); 3. *P. mahisa*, Moore; 4. *P. sumatrensis*, Wlk. 5. *P. tenœipennis*, Wlk.

The following genera would, I think, be best referred to the Thyretinæ as an American subgroup: they all have the primaries opaque, and have six nervures branching from the discoidal cell of secondaries, two subcostal branches, one radial, and three median, the latter four following at about equal distances from each other; one genus, *Aglaope* of Walker (nec Latreille), *Harrisina* of Packard, has radiating terminal brushes to the abdomen in the male, and a very slender body.

Genus Urodus, *Herrich-Schäffer*.

1. Urodus monura, *Herrich-Schäffer, Auss. Schmett.* i. fig. 219†.
Pará (*Bates*). B.M.

2. U. xylophila, *Herrich-Schäffer, Auss. Schmett.* i. fig. 220.
Venezuela.

I am doubtful as to this species being congeneric with the type.

Genus Pampa, *Walker* (restricted). Pl. XXVIII. fig. 13.

1. Pampa mystica=Euchromia (Pampa) mystica, *Walker, Lep. Het.* i. p. 239.
Honduras (*Dyson*). Type, B.M.

2. P. invaria=Euchromia (Pampa) invaria, *Walker, Lep. Het.* i. p. 240.
Santarem (*Bates*). Type, B.M.

Genus Harrisina, *Packard*. Pl. XXVIII. fig. 5.

Aglaope, *Walker* (nec *Latreille.*).

1. Harrisina americana=Aglaope americana, *Boisd. in Griff. An. Kingd.*
Georgia (*E. Doubleday*). B.M.

* Wings rather narrow and elongated, antennæ filiform or pectinated.

† Abdomen terminating in long radiating hairs.

2. H. fulvinota, n. sp.

♀. Closely allied to *H. americana*, but larger, with a conical fulvous spot at end of cell in primaries; the collar only fulvous at the sides; the abdomen greenish, with the basal segments margined laterally with fulvous: expanse of wings 31 millims.

Espiritu Santo (*Higgins*). Type, B.M.

The following genus appears to me to belong to the Ægeriidæ, or at any rate Walker's species. Felder's may be a *Urodus*, but is, I think, congeneric with Walker's.

Genus Polyphlebia, *Felder*.

1. Polyphlebia atychioides, *Felder, Reise de Nov. Lep.* iv. pl. 102. fig. 38.

—— ?

2. Polyphlebia? buprestoides = Aclytia buprestoides, *Walker, Lep. Het. Suppl.* i. p. 101.

Pará (*Bates*). Type B.M.

Subfamily EUCHROMIINÆ.

Antennæ of males pectinated, secondaries with the cell terminating at each extremity in a simple fork, that is to say, the subcostal and median nervures each terminate in two branches diverging from one point*.

Section *a*. *Wings opaque.*

Group *a. a. First median branch in secondaries forked at its outer extremity, anal valves of males expanded and prominent.*

Genus Empyreuma, *Hübner*. Pl. XXVIII. fig. 19.

1. Empyreuma lichas, *Fabric.*

Haiti, Cuba, Honduras. B.M.

2. E. pugione, *Linn.*

Jamaica. B.M.

Group *a. b. First median branch in secondaries simple, anal valves of male normal.*

Genus Histioea, *Walker*. Pl. XXVIII. fig. 21.

* *Abdomen with basal cream-coloured band.*

1. Histioea cepheus, *Cramer.*

Venezuela. B.M.

* *Pseudosphenoptera* is an exception; for here the branches of the median nervure are emitted normally, although the first branch is absent, leaving only two.

2. H. Meldolæ, n. sp.

H. bellatrix, var., *Walker, Lep. Het.* i. p. 218 (1854).

Differs from *H. bellatrix* (the type of which is an abnormality) in the presence of three (instead of one) red streaks parallel to the inner margin of primaries, the postmedian testaceous band converted into three or four spots forming a tapering series towards costa, the red costal streak continued nearly to apex, the red markings of secondaries more contracted, the lateral metallic green spots on the abdomen larger: expanse of wings 52 to 67 millims.

Trinidad, coll. Meldola; Venezuela (*Dyson & Becker*). B.M.

3. H. bellatrix, *Walker*.

Venezuela. Type, B.M.

4. H. Colombiæ, n. sp.

Primaries as in *H. bellatrix*, excepting that the postmedian band is yellower and twice as broad; secondaries with the red spot smaller and separated from the interno-median red patch, almost as in *H. cepheus*, the creamy abdominal patch smaller: expanse of wings 68 millims.

New Granada (*Stevens*). Type, B.M.

** *Abdomen without a basal cream-coloured band.*

5. H. amazonica, n. sp.

Allied to the preceding, but the postmedian band more oblique and slightly narrower, the spot at end of cell smaller, the red streaks on costal and internal areoles more slender and less distinct, the red spot of secondaries narrower and distinctly trifid; no red streak on interno-median area, and no internal creamy streak; the pterygodes entirely black; the abdomen without a cream-coloured band: expanse of wings 59 to 72 millims.

Ega and Villa Nova (*Bates*), Eastern Peru (*Degand*). Type, B.M.

Allied to *H. proserpina*, but the primaries of the *H. bellatrix* type.

6. H. inferioris, n. sp.

Primaries as in *H. amazonica*, excepting that the creamy spot in the cell is larger; secondaries with the scarlet streak reduced to two or three little spots, as in *H. proserpina*: expanse of wings 62 to 66 millims.

Lower Amazons (*Wallace*). Type, B.M.

Perhaps a variety of the preceding, but certainly intermediate in character between it and *H. proserpina*.

7. H. proserpina, *Hübner*.

Brazil. B.M.

8. H. PAULINA, *Walker.*
St. Paul. Type, B.M.

In this last species the secondaries are entirely black.

Genus EUCHROMIA*, *Hübner.* Pl. XXVIII. fig. 20.

Synonyms. Phalanna, Hira, Glaucopis (*part.*), Fregella, Hippola (*part.*).

1. EUCHROMIA LETHE, *Fabric.*=Euchromia (Hira) lethe, *Walker, L. H.* p. 221.
Natal, Cape, Madagascar. B.M.

The *Sphinx eumolphos* of Cramer and *Glaucopis Folletii* and *formosa* of Boisduval are synonymous with the above species.

2. E. SPERCHIUS, *Cramer*=Euchromia (Hira) sperchius, *Walker, L. H.* p. 220.
Congo, Angola, and Sierra Leone. B.M.

This is doubtless the western and south-western representtative of *E. lethe.*

3. E. INTERSTANS=Euchromia (Hira) interstans, *Walker, L. H.* p. 221.
Ashanti. Type, B.M.

This species appears to be restricted to Ashanti, the form from Sierra Leone being distinct.

4. E. LEONIS, n. sp.
Smaller and more brightly coloured than *E. interstans,* the metallic spots being all brilliant green, and the yellow spots on the wings more golden in tint; primaries with the large, basal, bifid, yellow patch larger and more oblique, postmedian quadrifid band slightly narrower; basal yellow spot of secondaries more distinct: expanse of wings 45 millims.
Sierra Leone (*Foxcroft & Morgan*). Type, B.M.

Mr. Walker, as in many other instances, enumerated the examples of this species first, under *E. interstans*; they, however. represent his var. β.

5. E. HORSFIELDII=Phalanna Horsfieldii, *Moore, P. Z. S.* 1859, p. 200.
Java (*Horsfield*). Type, B.M.

6. E. MADAGASCARIENSIS = Glaucopis madagascariensis, *Boisd. Madag.*
Madagascar.

* *E. sperchius,* Cr.

7. E. africana, n. sp.

Euchromia (Hira) madagascariensis, *Walker* (nec *Boisduval*), *Lep. Het.* i. p. 222, n. 29 (1854).

Allied to *E. Horsfieldii*, from which it chiefly differs as follows:—Second pale band of abdomen scarlet above instead of buff; primaries with basal half of wing golden yellow, red at base, not impinged upon by black projections from the subcostal or submedian nervures; post-median quadrifid band or spot narrower and golden yellow; secondaries golden yellow, with a broader apical black border; abdominal margin not throwing out a black projection to end of cell, as in *E. Horsfieldii*, base reddish instead of whitish: expanse of wings 44 to 52 millims.

Natal (*Gueinzius & Becker*), Zoolu (*Angas*). Type, B.M.

This species is entirely distinct from *E. madagascariensis*.

8. E. celebensis, n. sp.

Allied to *E. polymena*, but differing as follows:—reddish instead of white spots on the shoulder*; basal band of abdomen cream-coloured above instead of scarlet, blue bands of abdomen becoming snow-white at the sides, the double scarlet band broadly margined with white on both sides below; primaries with the subbasal ochreous spot widely separated from the central band, and the large subapical ochreous patch narrower and divided in the centre by a black line: expanse of wings 49 millims.

Celebes (*Wallace*). Three specimens, B.M.

A very distinct and beautiful species.

9. E. polymena = Sphinx polymena, *Linn. S. N.* ii. p. 806.

North India, Canara, South India, Ceylon. B.M.

10. E. fraterna, n. sp.

Closely allied to the preceding, but the blue bands on abdomen obsolescent; the sixth segment (succeeding the two scarlet bands) edged with scarlet instead of blue: expanse of wings 47 millims.

Moulmein (*Clerck*). Type, B.M.

11. E. orientalis, n. sp.

Allied to *E. polymena*, but the spots on the shoulders reddish, the blue bands obsolescent, the fourth, fifth, and sixth segments of the abdomen entirely scarlet, and the seventh segment edged behind with scarlet: expanse of wings 47 millims.

North India (*James*). Type, B.M.

12. E. laura, n. sp.

Allied to *E. polymena*, but the spots on the shoulders blue, the blue bands dull, the fourth, fifth, and sixth segments of the abdomen en-

* This is, however, occasionally the case in *E. polymena*.

tirely scarlet, the seventh segment black; ochreous spots on basal area of wings obsolescent: expanse of wings 48 millims.
East India (*Argent*). Type, B.M.

13. E. SIAMENSIS, n. sp.
Allied to *E. polymena*, but the fourth, fifth, sixth, and seventh segments scarlet; anus blue-black: expanse of wings 46 millims.
Siam (*Bowring*). Type, B.M.

14. E. SEMILUNA = Euchromia (Fregella) semiluna, *Walker, L. H.* p. 272.
—— ? Type, B.M.

15. E. THELEBAS = Sphinx thelebas, *Cramer, Pap. Exot.* pl. 150.
N.E. coast of Australia. B.M.

Perhaps a variety of *E. ganimede*; Cramer's locality is (almost certainly) incorrect.

16. E. ISIS = Glaucopis isis, *Boisduval, Astrolabe*, p. 193.
Oceania.

17. E. GANYMEDE = Glaucopis ganymede, *Doubl. Lort's Disc. App.* pl. 3.
Australia (*Dring &c.*), Lizard Island (*Macgillivray*). B.M.

18. E. IRUS = Sphinx irus, *Cramer, Pap. Exot.* pl. 368.
Ceram, Dorey, Gilolo, and Celebes (*Wallace*). B.M.

The *G. irius* (*sic*) of Boisduval is identical with this species.

19. E. CŒLIPENNIS = Hira cœlipennis, *Walker, L. H. Suppl.* p. 99.
Amboina (*Type*). B.M.

This may, I think, be the *G. bourica* of Boisduval.

20. E. ŒNONE, n. sp.
Allied to *E. aruica*, but the collar scarlet instead of metallic green, the shoulders yellow instead of green, the basal segment of the abdomen yellow instead of creamy white, the second segment with a yellow lateral spot, the third with a scarlet lateral spot, the fourth and fifth above (and the third to fifth below) broadly banded with scarlet, the sixth, seventh, and anus green behind; wings black with hyaline white spots, as in *E. aruica*, but broader: expanse of wings 44 millims.
Solomon Islands (*Denham*). Type, B.M.

We have two examples of this beautiful species in bad condition.

21. E. ARUICA = Hira aruica, *Walker, Lep. Het. Suppl.* i. p. 98.
Aru (*Wallace*). Type, B.M.

22. E. RUBRICOLLIS = Hira rubricollis, *Walker, Lep. Het. Suppl.* p. 99.
Aneiteum, New Hebrides. Type, B.M.

Genus EUROTA, *Walker*.

1. EUROTA PICTA = Eurata pictula, *Walker, L. H.* i. p. 181 = picta, *H.-Sch.*
Venezuela. B.M.

2. E. HERRICHII = Glaucopis sericaria, *H.-Sch. Auss. Schm.* fig. 229.
This is certainly distinct from the *G. sericaria* of Perty.

Genus SYNTOMEIDA, *Harris*. Pl. XXVIII. fig. 16.

Hippola, *Walker*.

1. SYNTOMEIDA SERICARIA = Glaucopis sericaria, *Perty, Delect.* pl. 31. fig. 14.
Minas.

2. S. HISTRIO = Glaucopis histrio, *Guérin, Ic. Règ. An.* p. 502.
Bolivia.

3. S. ALBIFASCIATA, n. sp.
Nearly allied to *S. melanthus*, but smaller, and with all the spots on the thorax and bands on the abdomen creamy-white instead of scarlet: expanse of wings 39 millims.
Honduras (*Dyson*). Type, B.M.

4. S. MELANTHUS = Sphinx melanthus, *Cr.* pl. 248. fig. C.
Nicaragua, Guatemala, Venezuela. B.M.

5. S. IPOMŒÆ = Glaucopis (Syntomeida) ipomœæ, *Harris, Descr. Sph.*
Georgia.
This appears to be quite distinct from *S. ferox*.

6. S. FEROX = Euchromia (Hippola) ferox, *Walker, L. H.* p. 223.
Glaucopis euterpe, *H.-Sch. Aussereur Schm.* fig. 430.
United States. Type, B.M.

7. S. CAPISTRATA = Zygæna capistrata, *Fabric. Sp. Ins.* p. 165.
Læmocharis selecta, *H.-Sch. Aussereur Schm.* fig. 256.
Brazil. B.M.

8. S.? EPILAIS = Euchromia (Hira) epilais, *Walker, L. H.* p. 227.
Honduras (*Dyson*). Type, B.M.

9. S.? TINA = Euchromia (Tipulodes) tina, *Walker, Lep. Het.* i. p. 233.

Sphenoptera Batesii, *Felder, Reise der Nov. Lep.* tab. cii. fig. 35.
Rio Grande (*Becker*). Type, B.M.

Genus Endera, *Walker*.

1. Endera vulcanus = Euchromia (Endera) vulcanus, *Walker, L. H.* p. 228.
Glaucopis vulcanus, *H.-Sch. Ausl. Schm.* fig. 295
Mexico. Type, B.M.

2. E. saulcyi = Glaucopis saulcyi, *Guérin, Ic. Règ. Anim.* p. 502.
Calonota? niveifascia, *Walker, L. H.* vii. p. 1628.
Martinico (*Guérin*), ——? B.M.

Genus Eupyra, *Herrich-Schäffer*.

1. Eupyra principalis, *Walker. Lep. Het. Suppl.* i. p. 97.
Mexico. Type, B.M.

2. E. regalis, *H.-Sch. Aussereur. Schmett.* i. pl. 13. fig. 57.
Quito.

Allied to the preceding species.

3. E. ignita, *H.-Sch. Aussereur. Schmett.* i. pl. 13. fig. 55.
Euchromia (Chrysocale) ignita, *Walker, Lep. Het.* i. p. 209.
"Venezuela" (*Herrich-Schæffer*), Bogota (*Isaacson*). B.M.

4. E. imperialis, *H. Sch. Aussereur. Schmett.* i. pl. 13. fig. 54.
Venezuela.

5. E. florella = Chrysocale florella, *Butler, Ann. & Mag.* 4th S. xii. p. 227.
Huasampilla, Peru (*Whitely*). Type, B.M.

Nearly allied to the preceding species, but much more brilliant in colour.

6. E. plebeia, *Herrich-Schäffer, Aussereur. Schmett.* i. pl. 13. fig. 56.
Euchromia (Chrysocale) opulenta, *Walker, Lep. Het.* i. p. 210.
"Caracas" (*Herrich-Schäffer*), Venezuela (*Dyson*). B.M.

Genus Trichela, *H.-Sch.*

Enope, *Walker*.

1. Trichela tolumensis, *Herrich-Schäffer, Aussereur. Schmett.* i. pl. 13. fig. 53.
Euchromia (Enope) hirsuta, *Walker, Lep. Het.* i. p. 208.
Bogota. B.M.

2. T. FENESTRATA = Sphinx fenestrata, *Drury, Ill.* i. pl. 25. fig. 3.
Jamaica.

I doubt the *S. fenestrata* of Stoll being conspecific; it seems to have rather the character of *Procallypta*, n. gen.

The following genus was restricted by Walker before Grote suggested *S. thetis* of Cramer as its type.

Genus CALONOTOS, *Hübner*.

Section AUTOCHLORIS, *Hübn.*

Mystrocneme, *H.-Sch.*

1. CALONOTOS ALMON = Sphinx almon, *Cramer, Pap. Exot.* iii. pl. 224. fig. F.
Surinam.

This is the type of Hübner's *Autochloris*; but *C. phlegmon* is the type of *Calonotos*.

2. C. GEMINATA = Mystrocneme geminata, *Herrich-Schäffer, Ausser-eur. Schmett.* i. fig. 419.
Euchromia (Calonotos) varipes, *Walker, L. H.* i. p. 235.
Pará. B.M.

I think the *Calonota perspicua* of Walker must be this species.

Section CALONOTOS, *Hübn.*

Læmocharis (*part.*), *H.-Sch.*

3. C. PHLEGMON = Zygæna phlegmon, *Fabricius, Sp. Ins.* ii. p. 160.
Pará (*Bates*). B.M.

I believe the *C. interrupta* of Walker to be this species.

4. C. NEXA = Læmocharis nexa, *Herr.-Sch. Auss. Schm.* fig. 254.
Santarem and Villa Nova (*Bates*), Santa Marta (*Bouchard*). B.M.

Section SPHENOPTERA, *Felder*.

Læmocharis (*part.*), *H.-Sch.*

5. C. HELYMUS = Zygæna helymus, *Fabricius, Sp. Ins.* ii. p. 162.
Glaucopis aterrima, *Sepp, Ins. Surin.* pl. 97.
Demerara. B.M.

6. C. SERICEA = Læmocharis sericea, *H.-Sch. Auss. Schm.* fig. 253.
—— ? B.M.

7. C. TRIANGULIFERA = Sphenoptera triangulifera, *Felder, Nov. Reise*, pl. cii. fig. 34.
—— ?

8. C. AURATA=Euchromia (Macrocneme) aurata, *Walker, L. H.* p. 250.
Venezuela. Type, B.M.

9. C. EACUS=Sphinx eacus, *Cramer, Pap. Exot.* iv. p. 357.
Pseudomya errans, *Hübner, Verz.* p. 124.
Surinam?

10. C. NYCTEUS=Sphinx nycteus, *Cramer, Pap. Exot.* iv. pl. 325. fig. F.
Euchromia (Hippola) apricans, *Walker, L. H.* i. p. 224.
Venezuela (*Becker*). B.M.

11. C.? VESPA=Pseudophea vespa, *H.-Sch. Auss. Schmett.* fig. 426.
Pará.

Excepting in the form of the abdomen, this species has quite the aspect of a *Sphenoptera*.

Genus AMYCLES, *Herrich-Schäffer*. Pl. XXVIII. fig. 18.

1. AMYCLES TENEBROSA=Euchromia (Pampa) tenebrosa, *Walker, L. H.* i. p. 240.
Pará (*Bates*). Type, B.M.

2. A. POSTICA=Pampa postica, *Walker, L. H.* vii. p. 1630.
Santarem (*Bates*). Type, B.M.

3. A. FLAVIFASCIA, *Herrich-Schäffer, Auss. Schmett.* fig. 231.
Euchromia (Pampa) aliena, *Walker, Lep. Het.* i. p. 241, n. 68.
Pará and Ega (*Bates*). B.M.

Genus PSOLOPTERA, n. gen.

Allied to *Calonotos* and *Amycles*; differs from the former in its more strongly plumose antennæ, and from the latter in the branches of the subcostal and median nervures of secondaries not being emitted from a footstalk. Type, *P. thoracica*, Walker.

1. PSOLOPTERA THORACICA=Euchromia (Autochloris) thoracica, *Walker, L. H.* i. p. 243.
Ega (*Bates*). Type, B.M.

2. P. LEUCOSTICTA=Glaucopis leucosticta, *Hübner, Samml.* i. pl. 69 (1806).
Pará (*Bates & Smith*), Santarem (*Bates*). B.M.

Genus Saurita, *Boisduval.*

1. Saurita cryptoleuca = Euchromia (Pampa) cryptoleuca, *Walker, L. H.* i. p. 239.
Pará (*Bates*). Type, B.M.

2. S. cassandra = Sphinx cassandra, *Linnæus,* S. N. ii. p. 806.
Venezuela (*Becker & Dyson*). B.M.

This species was placed by Mr. Walker under *Calonotos*: it is, however, clearly distinct from that grop, and Dr. Boisduval has done well in making a genus for its reception: in the general form and coloration of the body it resembles Felder's genus *Homœocera.*

Genus Pseudosphenoptera, n. gen. Pl. XXVIII. fig. 4.

Closely resembling *Calonotos* (Section *Sphenoptera*), but easily separated by the neuration of secondaries, the two median branches not being emitted in the usual way from one point, inasmuch as the first branch leaves the nervure before the end of the cell, also in the subcostals being placed upon a footstalk. Type *Pseudosphenoptera basalis,* Walker.

1. Pseudosphenoptera basalis = Euchromia (Macrocneme) basalis, *Walker, Lep. Het.* i. p. 251.
Ega (*Bates*). Type, B.M.
Very like *C. nycteus* of Cramer.

Genus Ichoria, n. gen. Pl. XXVIII. fig. 9.

Wings long and narrow; nearly allied to *Calonotos*; but the branches of the median nervure in secondaries placed upon a long footstalk, and the lower discocellular receding.

Type *I. quadrigutta.*

1. Ichoria quadrigutta = Euchromia (Aclytia) quadrigutta, *Walker, L. H.* i. p. 245.
Mexico (*Hartweg*). Type, B.M.

2. I. tricincta = Glaucopis tricincta, *Herrich-Sch. Auss. Schmett.* fig. 300.
Brazil.

3. I.? concisa = Euchromia (Autochloris) concisa, *Walker, Lep. Het.* i. p. 243.
Pará (*Bates*). Type, B.M.

Genus Macrocneme, *Hübner*.

1. Macrocneme maja = Zygæna maja, *Fabricius, Mant. Ins.* ii. p. 106.
Pará (*Smith & Bates*). B.M.

2. M. leucostigma = Glaucopis leucostigma, *Perty, Delect.* pl. 31. fig. 11.
Pará (*Bates*), Honduras and Venezuela (*Dyson*). B.M.

3. M. ferrea, n. sp.
Nearly allied to the preceding species; but the secondaries, instead of being black above, are shining greenish steel-colour, with a black border widest at apex; the black spot towards base of primaries is less strongly defined: expanse of wings 42 millims.
New Granada (*Children*), Espiritu Santo (*Stevens*). Type, B.M.

4. M. cupreipennis, *Walker, Lep. Het.* vii. p. 1632.
——? (*Children*). Type, B.M.

5. M. esmeralda, n. sp.
Body blackish-brown, frons metallic blue, white on each side; crest and hind margins of eyes blue-spotted, three metallic green spots on the thorax, abdomen with a dorsal streak and a lateral macular line of metallic green, also a lateral ventral streak of white, basal segment below green: primaries above metallic green, base, inner margin, and outer margin dark brown, a black streak in the cell; secondaries blue-black: wings below dark brown, primaries with discoidal area metallic green; secondaries with costal area to second third of wing metallic green: expanse of wings 31 millims.
Ega (*Bates*). Type, B.M.

6. M. indistincta, n. sp.
Allied to the preceding species, but with distinct white spots on the shoulders, abdomen bronzy greenish, the metallic green streaks ill-defined; lateral stripes of white spots below well defined, three basal segments below metallic green; primaries with the brown border of outer margin broader: expanse of wings 37 millims.
Pará (*Bates*). Type, B.M.

7. M. splendida, n. sp.
Head and thorax black, frons white, bluish in the centre, collar spotted laterally with blue and white; shoulders with a white spot; thorax with three silvery bluish spots in a triangle, two on meso- and one on metathorax; abdomen metallic green, with brighter green dorsal and lateral stripes, basal segment black, with green dorsal stripe; glandular drums greyish in front, metallic green behind: palpi below fringed with white scales; coxæ and sides of femora white; metathorax metallic green; base of venter metallic green margined

behind by a semicircular white zone, followed on the posterior segments by a series of diamond-shaped white dots; wings below black; primaries with median and discoidal area metallic green, secondaries with basicostal area metallic green: expanse of wings 34 millims.

Santa Marta (*Bouchard*). Two examples, B.M.

This beautiful little species is allied to *M. vittata*, but is very distinct.

8. M. VITTATA = Euchromia (Macrocneme) vittata, *Walker, L. H.* i. p. 249.

Pará (*Bates*). Type, B.M.

9. M. OBSCURA = Tipulodes obscura, *Wallengren, Wien. Monatsschr.* iv. p. 40.

Guayaquil.

Genus CALLICARUS, *Grote*.

This genus has been well defined by Grote, and contains the following species:—1. *C. plumipes*, Drury; 2. *C. punctata*, Guérin; 3. *C. pennipes*, Grote; 4. *C. texanus*, Grote.

Genus MASTIGOCERA (part.), *Boisduval*.

1. MASTIGOCERA CYANEA, n. sp.

Thorax black, with the inner and anterior margins of the tegulæ and two parallel longitudinal streaks on the prothorax speckled with bluish green scales; collar blue-green behind; head with two white spots in front of the eyes; antennæ black, tipped with white; anterior margin of the collar with two central white dots; basal segment of abdomen black with four transverse white dots, other segments bronzy green, white lateral dots on the second and third segments; wings above bright steel-blue; primaries with a black oblique spot near base of internal area, apex and outer margin diffusely blackish; secondaries with costa brown, abdominal area, apex, and outer margin black: body below black-brown, coxæ white-spotted, legs steel-blue, the tufts of hind legs black, tipped with white; primaries below with basal half steel-blue, apical half and inner margin black; secondaries steel-blue, the outer margin black: expanse of wings 42 millims.

Brazil. Type, B.M.

Although this species has the aspect of a *Macrocneme*, the tufting of the hind legs is that of *Mastigocera*.

2. M. FUSILLA, n. sp. = Euchromia (Macrocneme) Æacus, *Walker* (*nec Cramer*), *Lep. Het.* i. p. 250. n. 86.

Pará (*Bates*). Type, B.M.

M. pusilla is of a smoky-black colour, the primaries with a central diffused bluish patch extending from near the base to beyond the cell; the head and thorax are spotted with white; and the abdomen is metallic blue-green at the sides and on the basal segments below; the last three or four segments are laterally margined below with white; the pectus is spotted with green: expanse of wings 28 millims.

3. M. TARSALIS = Horamia tarsalis, *Walker, Lep. Het.* vii. p. 1633.
——? (*Stevens*). Type, B.M.

4. M. ŒDIPUS, *Boisduval, Consid. Lép. Guat.* p. 81.
Guatemala.

5. M. CLAVIPES, *Boisduval, Consid. Lép. Guat.* p. 81.
Mexico (*Boisd.*), Venezuela. B.M.

6. M. TIBIALIS, n. sp.
Head black, frons, palpi, and crest orange; antennæ black with orange tips; pterygodes black-brown, margined in front and internally with orange; collar black-brown, with a pale yellow dot at each side, and a third (divided) in the centre; thorax dark purplish brown, with a paler line on each side, two orange lituræ forming an imperfect semicircle in front, and two orange dots behind; basal segment and drums of abdomen greyish brown internally, bright ochreous externally, a central oblong brown-edged white spot at base; other segments shining slate-colour margined with orange, second segment white laterally and below; anus orange: wings dull rusty brown, secondaries with basal half dull orange; wings below paler, more orange in tint, especially towards the base; pectus dark brown with lateral white spots, legs orange, with the knees and proximal ends of the tibiæ black; abdomen orange, third to fifth segments slate-coloured internally: expanse of wings 34 millims.
Haiti (*Tweedie*). Type, B.M.

Allied to *M. clavipes*.

Genus Horama, *Hübner*.

1. HORAMA INCERTA, *Walker, Lep. Het.* vii. p. 1627.
——? (*Milne*). Type, B.M.

This is such a bad example as to be almost unrecognizable.

2. H. DIFFUSA, *Grote, P. E. S. Phil.* 1866, p. 181.
Horamia (*sic*) pretellus, *Herrich.-Sch. Corr.-Blatt Regensb.* p. 113 (1866).
Cuba.

3. H. PRETUS = Sphinx pretus, *Cramer, Pap. Exot.* ii. pl. 175. figs. E, F.

St. Thomas. B.M.

4. H. GROTEI, n. sp.

Very like *H. pretus*, but longer in the wing and much deeper in colour; the head yellow, with a transverse black line on the crest; collar yellow, margined with black; pterygodes plum-colour, margined with orange; thorax clay-coloured, smoky brown in front and behind; basal segment of abdomen purple in front, lemon-yellow behind; other segments dark clay-colour; second segment purplish opaline in front and at the sides, with a very slender yellowish hind margin; third segment pale yellow at the sides behind; fourth to seventh very narrowly rosy at the sides; antennæ deep clay-coloured, with a black band just beyond the middle; outer half of primaries and secondaries dark clay-colour, basal area of primaries bright clay-colour; wings below with basal area ochraceous; pectus blackish; coxæ purplish, with a white margin; trochanters bright yellow; femora purplish slate-colour; tibiæ and tarsi ochreous, last pair of tibiæ black at the proximal extremity: expanse of wings 44 millims.

Jamaica (*Gosse*). Two specimens, B.M.

I have named this pretty species after my friend Augustus R. Grote, the well-known American Lepidopterist.

Genus ORCYNIA, *Walker*.

1. ORCYNIA CALCARATA = Euchromia (Orcynia) calcarata, *Walker, Lep. Het.* i. p. 274.

Santarem (*Bates*). Type, B.M.

This magnificent hornet-like species is evidently nearly allied to the genus *Horama*; it also has many characters in common with *Isanthrene*: the wings are semi-opaque, so that it forms a good transition from the opaque-winged to the clear-winged group.

Section *b. Wings translucent.*

Genus ISANTHRENE. Pl. XXVII. fig. 4.

1. ISANTHRENE POMPILOIDES = Glaucopis (Isanthrene) pompiloides, *Walker, Lep. Het.* i. p. 156.

Guatemala (*Stevens*). Type, B.M.

Before proceeding further with the species referred to *Glaucopis*, I may as well remark that not only is the Fabrician type of the genus doubtful, but the name *Glaucopis* had already been used as a genus of Aves twenty years before it was characterized as a group of Lepidopterous insects.

2. I. FLAVICORNIS = Sphinx flavicornis, *Fabricius, Mant. Ins.* ii. p. 104.
Glaucopis (Isanthrene) vespoides, *Walker, Lep. Het.* i. p. 155.
Villa Nova and Parâ (*Bates*). B.M.

3. I. USTRINA, *Hübner, Samml. Exot. Schmett.* figs. 493, 494.
Brazil (*Mornay & Becker*). B.M.

4. I. INCENDIARIA = Glaucopis incendiaria, *Hübner, Samml.* pl. 166.
Glaucopis (Isanthrene) flavicornis, *Walker* (*nec Fabr.*), *L. H.* p. 155.
S. America. B.M.

5. I. MAXIMA, n. sp.
Nearly allied to *I. incendiaria*, but larger, with smaller yellow spots on the shoulders, only the first three segments of abdomen laterally spotted with yellow, dorsal bluish spots larger, ventral white spots rather smaller; apical black area of primaries decidedly larger: expanse of wings 57 millims.
Rio (*J. P. G. Smith*). Type, B.M.

6. I. PERBOSCII = Glaucopis perboscii, *Guérin, Ic. Règ. Anim.* p. 501.
Campeachy Bay.

7. I. BASIFERA, *Walker, Lep. Het. Suppl.* i. p. 86.
Bogota.
Seems allied to *I incendiaria.*

Genus HOMŒOCERA, *Felder*. Pl. XXVII. fig. 6.

1. HOMŒOCERA CRASSA, *Felder, Reise der Nov. Lep.* iv. tab. cii. fig. 26.
—— ?

2. H. JANSONIS = Gymnelia jansonis, *Butler, Lep. Exot.* pl. lxi. fig. 17.
Cartago, Costa Rica (*Van Patten*). Type, B.M.

3. H. STRETCHII, n. sp.
Body golden yellow, back of head black, enclosing two large metallic blue-green spots; antennæ black (♀ with a central yellow streak); collar with a black spot on each side; pterygodes with a black margin all round; prothorax with two parallel clavate central black stripes enclosing metallic green spots in the clavus; metathorax with two black-encircled metallic-green spots; hind margin of thorax black; basal segment of abdomen narrowly edged behind with black, other segments broadly margined behind with black, two metallic blue-

green spots on each segmental band; coxæ below with large elliptical metallic blue-green spots: segments of abdomen edged with brown in the male: wings pale yellowish hyaline, veins and outer margin black; apex of primaries and a triangular spot at anal angle of secondaries black: expanse of wings 34 to 36 millims.

Santa Martha (*Bouchard*). Type, B.M.

I have named this very beautiful species after my friend and brother lepidopterist R. H. Stretch, Esq., of San Francisco.

4. H. BEATA, n. sp.

Allied to *H. scintillans*, but differing as follows:—all the yellow bands, spots, and other markings on the body replaced by rusty-red ones, the basal segments of the abdomen below sordid white; apical black patch on primaries narrower, and border of outer margin rather wider: expanse of wings 36 millims.

Santa Martha (*Bouchard*). Type, B.M.

5. H. SCINTILLANS = Læmocharis scintillans, *Herr.-Sch. Auss. Schm.* fig. 244.

Glaucopis (Pœcilosoma) flavitarsis, *Walker, L. H.* i. p. 158.

Venezuela (*Dyson*). B.M.

6. H. GEMMIFERA = Glaucopis (Gymnelia) gemmifera, *Walker, Lep. Het.* i. p. 152.

Venezuela (*Dyson*). Type, B.M.

7. H. MELAS = Sphinx melas, *Cramer, Pap. Exot.* i. pl. 45. f. G.

Surinam.

Walker's var.? does not belong to the genus.

8. H. SALVINI, n. sp.

Frons red-brown behind palpi, metallic green above; crest black; back of head black, with two large metallic-green spots; antennæ black, encircled with whitish at their origin, collar metallic green; pterygodes black, with a broad internal metallic-green border; thorax black, a large bifid green spot in front, and two similarly coloured spots behind; abdomen black, with a lateral decreasing series of metallic green interrupted bands, front margins of first two or three segments very narrowly edged with testaceous, anal segments deep orange: wings testaceous hyaline, veins black, primaries with base, a broad apical patch, the apical half of costa, outer and inner margins black, a bifid metallic green spot at base; secondaries with the margins and a spot at anal angle black; body below black; coxæ and trochanters and the inner margin of femora of front legs snow-white, front margins of tibiæ and hind margins of femora of second and third pairs metallic green; tarsi brown; abdomen with a broad semicircular basal white band; lateral metallic green spots; anus orange: expanse of wings 38 millims.

Obispo, Panamá (*Salvin*). Type, B.M.

A beautiful and very distinct species, somewhat resembling *Pheia intensa*.

Genus SAROSA, *Walker*. Pl. XXVII. fig. 11.

1. SAROSA SESIIFORMIS=Glaucopis (Sarosa) sesiiformis, *Walker, Lep. Het.* i. p. 151.

Venezuela (*Dyson*). Type, B.M.

Closely resembles *Homœocera scintillans* in coloration.

2. S. ACUTIOR=Isanthrene acutior, *Felder, Reise der Nov. Lep.* iv. tab. cii. f. 27.

——?

Somewhat resembles *Erruca machilis*.

3. S. POMPILINA, n. sp.

Head and thorax black-brown, frons with four white dots; collar grey prothorax with a furcate grey marking in the middle; abdomen blackish slate-colour, with a grey stripe down each side; a few testaceous hairs at the base; palpi black; antennæ deep ferruginous, becoming black towards base and apex; body below brown; tarsi of front pair of legs red; coxæ of hind pair of legs white; a large white spot on each side of the third abdominal segment; wings pale testaceous hyaline, costal vein, first two branches of the subcostal above, all the veins below, and basi-internal margin of primaries red; costa, inner margin, and other veins black; secondaries with veins, margins above, and a biundulated anal border black; costa below red, especially at base: expanse of wings 31 millims.

Espiritu Santo (*Higgins*). Type, B.M.

Not unlike *Erruca Pertyi*.

Genus ERRUCA, *Walker*. Pl. XXVII. fig. 7.

Læmocharis (part), *Herrich-Schäffer*.

1. ERRUCA PERTYI=Læmocharis Pertyi, *H.-Sch. Auss. Schmett.* i. fig. 249.

Espiritu Santo (*Higgins*). B.M.

2. E. ATERRIMA=Gymnelia aterrima, *Walker, Lep. Het. Suppl.* i. p. 85.

Ega (*Bates*). Type, B.M.

3. E. VARIA=Glaucopis (Isanthrene) varia, *Walker*, *Lep. Het.* i. p. 157.
Pará (*Bates*). Type, B.M.

4. E. GRENADENSIS, n. sp.
Head black, a metallic-blue spot on the crest; antennæ brown, tawny at the base; collar black, with a blue spot on each side; thorax black, an orange spot on the shoulders; metathorax with a large bilobed yellow spot in the centre; abdomen shining, blackish piceous; basal segment with two anterior central yellow spots, and a yellow spot on each side: wings testaceous hyaline; apex of primaries broadly black, outer margin narrowly black, projecting inwards along submedian nervure; inner margin narrowly black, costal margin very narrowly black; costal and internal areoles orange, also the median nervure and its second and third branches; secondaries with the apical third of costal margin and the outer and abdominal margins narrowly black; costal areole ochreous: body below black; thorax spotted with blue; first two segments of abdomen laterally spotted with white, next two segments with blue; legs black, with deep yellow tarsi: expanse of wings 40 millims.
Pacho, Province of Cundinamarcha, New Granada (*Janson*).
Type, B.M.

Somewhat allied to *E. varia.*

5. E. NOTIPENNIS, n. sp.
Allied to *E. machilis*, wings the same, excepting that the narrow black margin and the black spot near anal angle of secondaries are better defined; body quite different: head lilac above; face white, with a central lilac spot; antennæ tawny; collar and pterygodes black with a yellow margin; thorax black-brown with a central pale yellow line terminating behind in a spot of the same colour, two blue spots on either side of the central line; prothorax with two additional slender diverging yellow lines; metathorax black, with a yellowish spot in the middle and one on each side; two basal segments of abdomen yellow internally, tawny across the middle, and black externally; remaining segments black, second to fifth segment with lateral lilac streak; palpi, pectus, outer margin of first ventral segment, second segment and front of third segment cream-coloured; a lateral line on palpi, the legs, basal segment, and sides of second segment orange ochreous; a line on upper surface of femora, on the last pair of tibiæ, on all the tarsi, a spot at proximal end of tibiæ, the outer half of the third and the whole of the remaining segments of venter black; a spot on upper surface of distal end of front tibiæ, a spot on each side of the metathorax, and a series of lituræ on each side of last segments of venter lilac: expanse of wings 40 millims.
Villa Nova (*Bates*). Type, B.M.

6. E. VESPIFORMIS, n. sp.

Allied to the preceding species and to *E. machilis*; differs from the latter as follows: all the wing-veins black, the margins also more distinctly black, the costal area of primaries much less tawny; subanal black spot of secondaries shorter and broader; antennæ bright tawny, all the tawny markings upon the body replaced by black, the femora and tibiæ above with a black streak; the metathorax and first three basal segments of abdomen yellow in front and at the sides, and black behind; the lateral lilac streak narrower: expanse of wings 42 millims.

Villa Nova (*Bates*). Three examples, B.M.

This is certainly the best imitation of a wasp in the genus; it is a beautiful species and well marked.

7. E. MACHILIS = Læmocharis machilis, *Herrich-Schäffer, Auss. Schmett.* fig. 245.

Villa Nova, St. Paulo, and Ega (*Bates*). B.M.

8. E. PORPHYRIA = Glaucopis (Isanthrene) porphyria, *Walker, Lep Het.* i. p. 157.

Ega and Pará (*Bates*). Type, B.M.

The *Sphinx porphyria* of Cramer does not even belong to this family; Walker cannot have looked at the figure.

9. E. VESPARIA = Glaucopis vesparia, *Perty, Delect. Anim.* pl. 31. fig. 9.

Villa Nova (*Bates*). Type, B.M.

Perty's figure represents this species as stouter than it actually is.

10. E. HILARIS = Pœcilosoma hilaris, *Walker, Lep. Het. Suppl.* i. p. 88.

Ega (*Bates*). Type, B.M.

Somewhat like *Homœocera Stretchii*, but allied to *E. vesparia*.

11. E. NIGERRIMA = Gymnelia nigerrima, *Walker, Lep. Het. Suppl.* i. p. 86.

Ega (*Bates*). Type, B.M.

12. E. CONTRACTA = Læmocharis contracta, *Walker, Lep. Het.* vii. p. 1609.

St. Paulo (*Bates*). B.M.

13. E. DEYROLLII = Læmocharis Deyrollii, *Herrich-Schäffer, Auss. Schmett.* figs. 247, 251 *a*.

Rio Grande (*Becker*). B.M.

This species is the type of the genus *Erruca*; *Læmocharis* can scarcely be said to have a type; I therefore prefer to consider *L. stulta* and allies as representing that genus.

Genus SPHECOPSIS, *Felder*.

1. SPHECOPSIS HYALOZONA, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 29.
——?

Although I do not intend to incorporate in the present paper all the new Zygænidæ described by Felder, but only those genera of which we possess representatives in the collection of the British Museum, I have been tempted to quote the above as being a transition from *Erruca* to *Myrmecopsis*.

Genus MYRMECOPSIS, *Newman*. Pl. XXVII. figs. 8, 9.

1. MYRMECOPSIS TARSALIS=Glaucopis (Pseudosphex) tarsalis, *Walker, Lep. Het.* i. p. 196.
Pará (*Bates*). Type, B.M.

2. M. SEMIHYALINA=Glaucopis semihyalina, *Walker, Lep. Het.* i. p. 197.
Pseudosphex vespiformis, *H.-Sch. Auss. Schmett.* fig. 425.
Pará (*Bates*). Type, B.M.

3. M. OPACA, *Walker, Lep. Het.* vii. p. 1620.
Pará (*Bates*).

4. M. ICHNEUMONEA=nov. gen. Ichneumonea, *H. Sch.-Auss. Schmett.* fig. 225.
Brazil.

5. M. POLISTES=Pseudosphex polistes, *Hübner, Exot. Schm. Zutr.* figs. 39, 40.
M. eumenides, *Newman, Zool.* viii. Append. cxxii.
Ega (*Bates*). B.M.

The genus *Myrmecopsis* has been confounded by Dr. Herrich-Schäffer with *Pseudosphex*; it was not, however, founded upon Hübner's type (which was *P. zethus*); it differs entirely in neuration from that insect and its allies, and must therefore be retained as distinct with Newman's designation. Herrich-Schäffer had the acumen to see how entirely different the two types were; but he took the type of *Pseudosphex* out of its genus and constituted for it his genus *Abrochia*; he appears to me, however, to have discovered his error, and to have shifted the name *Abrochia* to my new genus *Sphecosoma*.

Genus SPHECOSOMA, n. gen.

Abrochia (part), *Herrich-Schäffer*.

This is, I believe, the *Abrochia* of the 'Correspondenz-Blatt,' but not of the 'Aussereuropäische Schmetterlinge;' it closely resembles *Pseudosphex*, but differs from it in the simple *Euchromioid* neuration of the secondaries. Type, *S. fasciolata*, n. sp.

1. SPHECOSOMA FASCIOLATUM, n. sp.

Body sulphur-yellow; frons white, with a central grey spot; a transverse line or crest and another at back of head black; antennæ with basal half blackish, apical half orange, apex blackish; palpi golden yellow; collar with a black band behind; pterygodes margined with black; thorax with a black central longitudinal line and a streak on each side of it close to the pterygodes, a transverse line at back of thorax and the inner edges of the glandular drums black; all the segments banded with black, first segment with three longitudinal black lines; wings whitish hyaline, veins and outer margin slenderly black; costal and interno-basal areoles of primaries orange; body below pale sulphur-yellow; legs orange, femora and tibiæ with a black streak above; abdomen with an apparently pale cream-coloured wax-like sheath over basal segments, edged behind with black: expanse of wings 25 millims.

Santa Martha (*Bouchard*). Type, B.M.

2. S. ARCTATUM = Pseudosphex arctata, *Walker, Lep. Het. Suppl.* i. p. 95.

Ega (*Bates*). Type, B.M.

3. S. TESTACEUM = Glaucopis (Pseudosphex) testacea, *Walker, Lep. Het.* i. p. 196.

Demerara. Type, B.M.

Genus LOXOPHLEBIA, n. gen. Pl. XXVII. fig. 14.

Allied to the preceding genus, but larger, the outer margin of the primaries much longer, the discocellulars forming an oblique line; the secondaries less than half the length of the primaries, the abdomen very slightly contracted at the base.

Type, *L. vesparis*, Butler.

1. LOXOPHLEBIA VESPARIS = Pœcilosoma vesparis, *Butler, Ann. & Mag.* S. 4. vol. xii. p. 327.

Huasampilla, Peru (*Whitely*). Type, B.M.

Genus ANDRENIMORPHA, n. gen. Pl. XXVII. fig. 10.

Allied to *Gymnelia*, but the primaries broader, the upper radial invisible (as also the recurrent nervure *), consequently only one discocellular nervure strongly angulated in the centre, the third median and the lower radial emitted together from a short footstalk; abdomen more distinctly separated from the thorax than in *Gymnelia*. Type, *G. xanthogastra*, Perty.

1. ANDRENIMORPHA XANTHOGASTRA = Glaucopis xanthogastra, *Perty, Delect.* pl. 31. f. 5.
Brazil (*Stevens*). B.M.

Genus GYMNELIA, *Walker*. Pl. XXVII. fig. 13.

1. GYMNELIA LÆNNUS = Glaucopis (Gymnelia) lænnus, *Walker, Lep. Het.* i. p. 154.
Rio and Brazil (*Stevens*), Brazil (*Becker*). Type, B.M.

2. G. CONSOCIATA, *Walker, Lep. Het. Suppl.* i. p. 85.
Ega (*Bates*). Type, B.M.

3. G. CAUNUS = Sphinx caunus, *Cramer, Pap. Exot.* pl. 224. fig. E.
Surinam.

Nearly allied to the preceding species, and quite distinct from *Sphinx leucaspis* of Gmelin, with which Walker has associated it.

4. G. COLLOCATA, *Walker, Lep. Het. Suppl.* i. p. 84.
Ega (*Bates*). Type, B.M.

5. G. COMPLETA = Glaucopis (Gymnelia) completa, *Walker, Lep. Het.* i. p. 153.
Pará (*J. P. G. Smith*). Type, B.M.

6. G. ENAGRUS = Sphinx enagrus, *Cramer, Pap. Exot.* iii. pl. 248. f. D.
Surinam (*Cramer*), Ega (*Bates*). B.M.

The genus *Gymnelia*, as above restricted, forms a very natural little group of bee-like species, all of them characterized (as to markings) by a broad black border to the wings and a broad black fascia or elongated spot upon the discocellulars of primaries; they all have black bodies with metallic bluish lateral spots upon the abdomen; and five out of the six species have the anal segments more or less tawny; they have the discocellulars of primaries nearly in a straight line and transverse.

* The recurrent nervure is represented in Perty's figure; so that this is apparently a variable character.

Genus Læmocharis, *Herrich-Schaffer* (part).

1. Læmocharis stulta, *Herrich-Schäffer, Auss. Schmett.* fig. 258.
Glaucopis (Pheia) dolens, *Walker, Lep. Het.* i. p. 148. n. 13.
Parâ (*Bates*). B.M.

2. L. trigutta = Glaucopis (Pseudomya) trigutta, *Walker, Lep. Het.* i. p. 145.
Bogota (*Parzudaki*). Type, B.M.

3. L. hæmatica = Glaucopis hæmatica, *Perty, Delect.* pl. 31. fig. 6.
L. zantes, *Herr.-Sch. Auss. Schmett.* fig. 240.
Brazil. B.M.

4. L. fenestrina, n. sp.
Nearly allied to the preceding species, but the basal area of primaries less opaque, and a much broader hyaline patch (covering the greater part of the disk) beyond the cell of primaries; body below (excepting anal segments), bases of wings, inner margin of primaries, and costa of secondaries white: expanse of wings 27 millims.
Brazil. B.M.

5. L. decisa = Pseudomya decisa, *Walker, Lep. Het. Suppl.* i. p. 81.
Ega (*Bates*). Type, B.M.

The genus *Læmocharis*, as thus restricted, may have to be united to the *Pheia* of Walker; it, however, contains only small species at present, most of them with a well-marked but diffused streak from the costa, across the discocellulars of primaries, and the median fork of secondaries proceeding from a very short, instead of a long footstalk; in *L. decisa*, in fact (the species most like *Pheia* in appearance), the footstalk is scarcely apparent, being reduced to little more than a point.

Genus Echoneura, n. gen.

Allied to *Læmocharis* and *Pheia*; but easily distinguished from the former by the form of the discocellulars of primaries, which are equally divided in the centre by the upper radial and recurrent nervure, are equal in length and consequently produce parallel projecting terminations to the discoidal cell; from the latter it differs in the same character, as also in the more limited hyaline areas of the wings. Type, *E. intricata*, Walker.

1. Echoneura intricata = Euchromia (Calonotos) intricata, *Walker Lep. Het.* i. p. 237.
Rio Janeiro (*Stevens*). Type, B.M.

2. E. angusta, n. sp.

Body black, a minute dot behind each eye, and a dot on each side of the collar steel-blue; a longitudinal blue spot at back of thorax, third to fifth segments of abdomen with small lateral marginal metallic green dots: wings brown, with an elongated and gradually widening central hyaline-white patch from near base to just beyond end of cell; nervures black; pectus spotted with metallic green: expanse of wings 33 millims.

Espiritu Santo (*Higgins*). Type, B.M.

Allied to *E. intricata*, but darker, with smaller hyaline area in primaries.

3. E. catastibina, n. sp.

Very like *E. intricata* above, excepting that the hyaline area on the wings is considerably smaller; below, however, the wings are white with the veins brown and the hyaline patches as above: expanse of wings 32 millims.

Brazil (*Bates*). Type, B.M.

Mr. Walker placed this very distinct species with his type of *E. intricata*.

4. E. tenuis, n. sp.

Very similar in shape to *E. angusta*. Body black, two dots at back of collar, the thorax, pterygodes, and a dot at base of primaries red; metallic blue and green dots above, as in *E. angusta*: wings as in *E. intricata*, hyaline, with a broad brown border and black veins: body below black, tibiæ of anterior pair of legs spotted in front with metallic green: expanse of wings 35 millims.

Espiritu Santo (*Higgins*). Type, B.M.

Genus Thrinacia, n. gen.

Allied to the preceding genus, but smaller; neuration of primaries nearly the same, but the second median branch emitted further from the end of the cell; secondaries with the first median branch forked at its extremity, as in *Empyreuma* of section *a*.

Type, *T. afflicta*, Walker.

1. Thrinacia afflicta = Glaucopis (Pseudomya) afflicta, *Walker, Lep. Het.* i. p. 144.

Pará (*Bates*). Type, B.M.

We have a species allied to this undescribed, but in bad condition, and without a locality.

2. T. CONSOLATA = Pseudomya consolata, *Walker, Lep. Het.* vii. p. 1601.
Brazil.

Genus PSEUDOMYA, *Hübner*.

Mr. Walker restricted this genus in his 'Lepidoptera Heterocera,' pt. i. pp. 142–145, to two old species, of which one was Hübner's *Pseudomya tipulina*; this will therefore be the type. I suspect that the *melanthis* of Cramer is more nearly allied to *Eucerea* (*Charideinæ*).

1. PSEUDOMYA TIPULINA = Glaucopis tipulina, *Hübner, Samml. Exot. Schmett.* i.
G. (Pseudomya) bibia, *Walker, Lep. Het.* i. p. 143.
Pará (*Bates*). B.M.

We have a species, possibly distinct from this, from Espiritu Santo and Santa Catharina; it is, however, very closely allied, if different; so that I hesitate to describe it.

2. P. TRISTISSIMA = Glaucopis tristissima, *Perty, Delect.* pl. 31. f. 7.
Pará (*Bates*). B.M.

3. P. DESPERATA, *Walker, Lep. Het.* vii. p. 1602.
Sp. ead.? Pará (*Bates*). B.M.

I do not know whether I have rightly identified this species; but our example is peculiar on account of its small secondaries.

Genus PHEIA, *Walker*.

1. PHEIA ALBISIGNA = Glaucopis (Pheia) albisigna, *Walker, Lep. Het.* i. p. 146.
Honduras (*Miller*); Ega (*Bates*). Type, B.M.

2. P. GEMMATA, n. sp.
Body black; frons conical, blue-green, crest blue-green, a blue-green spot at base of primaries; a greenish blue spot at the back of thorax, first to third and fifth to seventh segments of abdomen with lateral blue-green spots: primaries hyaline-white; veins, a broad patch at apex, and a broad border to outer margin black-brown; a subcostal orange line and a bifid orange basi-internal patch; secondaries hyaline-white, veins, apex, and outer margin black; costal area creamy ochraceous: body below dull black; trochanters and femora of legs, metathorax and basal segments of abdomen below, spotted with blue-green, two small lateral spots of the same colour at anal extremity of

abdomen; costæ of wings golden yellow, otherwise as above: expanse of wings 37 millims.

Santa Martha (*Bouchard*). Type, B.M.

3. P. INTENSA=Glaucopis (Pœcilosoma) intensa, *Walker, Lep. Het.* i. p. 159.

Honduras (*Dyson*). Type, B.M.

This species, in the character of its body, recalls the genus *Saurita*. The genus, as a group, nearly approaches *Gymnelia*.

Genus MOCHLOPTERA, n. gen. Pl. XXVII. fig. 15.

Glaucopis (part), *Herrich-Schäffer*.

Allied to *Gymnelia*, but distinguished at a glance from all the allied genera by the breadth of the primaries, the longer legs, and the position of the first branch of the median nervure, which is emitted almost from the same point as the second branch, so that the three median branches and the lower radial are all crowded together at the lower extremity of the cell.

Type, *M. acroxantha*, Perty.

1. MOCHLOPTERA ACROXANTHA = Glaucopis acroxantha, *Perty, Delect.* pl. 31. fig. 4.

Brazil (*Stevens*). B.M.

Perty's figure represents the primaries as much narrower than they really are, the outer margin in the insect being nearly equal to the inner.

2. M.? XANTHOCERA=Gymnelia xanthocera, *Walker, Lep. Het.* vii. p. 1603.

Brazil.

Genus COSMOSOMA, *Hübner*. Pl. XXVII. fig. 3.

1. COSMOSOMA PANOPES=Læmocharis panopes, *Herrich-Schæffer, Auss. Schm.* fig. 243.

Glaucopis (Pœcilosoma) subflamma, *Walker, Lep. Het.* i. p. 159.

Brazil (*Stevens*). B.M.

2. C. ELEGANS, n. sp.

Head black, frons with two white dots, back of head with two metallic-blue dots; antennæ black; collar black, with a small blue dot on each side; a blue-green dot on each shoulder; pterygodes with a large blue-green spot; thorax black brown with two blue-green dots in front; abdomen dark brown; wings hyaline-white, veins black, discocellulars marked by a black line, margins rather narrowly black, apex of primaries very broadly black: body below dark brown; coxæ marked with large metallic-green spots; tarsi of second pair of legs tipped with white, of third pair almost wholly white: expanse of wings 39 millims.

Espiritu Santo (*Higgins*). Type, B.M.

Somewhat like a small form of the preceding in general appearance.

3. C. PHERES = Sphinx pheres, *Cramer, Pap. Exot.* iv. pl. 382. f. C.
? Læmocharis metallescens, *Ménétriés, Cat.* ii. tab. xiv. fig. 1.
Rio Janeiro (*Stevens*). B.M.

4. C. CHALCOSTICTA, n. sp.
Glaucopis (Pœcilosoma) pheres, var., *Walker, Lep. Het.* i. p. 162. n. 38.
Pará (*Bates*). Type, B.M.

Easily distinguished from the preceding species by the bright brassy- instead of blue-green spots on the body, and the broader black apical patch in primaries.

5. C. CONFINE = Læmocharis confinis, *Herrich-Schäffer, Auss. Schm.* fig. 255.
Glaucopis remota, *Walker, Lep. Het.* i. p. 170.
Venezuela (*Dyson*). Type, B.M.

6. C. ADMOTUM = Læmocharis admota, *Herrich-Schäffer, Auss. Schm.* fig. 241.
Pernambuco (*J. P. G. Smith*), Espiritu Santo (*Higgins*). B.M.

7. C. GAUDENS = Pœcilosoma gaudens, *Walker, Lep. Het.* vii. p. 1607.
"Pará" (*Walker*). Sp. ead.? Brazil. B.M.

8. C. FESTIVUM = Glaucopis (Cosmosoma) festiva, *Walker, Lep. Het.* i. p. 171.
Honduras (*Dyson*). Type, B.M.

I think this may be Cramer's *Sphinx echemus.*

9. C. CENTRALE = Glaucopis (Cosmosoma) centralis, *Walker, Lep. Het.* i. p. 171.
Rio Janeiro (*Johnson*). Type, B.M.

Apparently *C. ada* of Herrich-Schäffer.

10 C. TYRRHENE = Euchromia tyrrhene, *Hübner, Samml. ex. Schm. Zutr.* f. 483, 484.
Jamaica (*Gosse*), Haiti (*Tweedie*), Santarem (*Bates*). B.M.

11. C. AUGE = Sphinx auge, *Linnæus, Syst. Nat.* ii. p. 807. n. 46.
C. omphale, *Hübner, Samml. ex. Schmett.* ii. Hyalinæ, f. 1–4.
Florida (*Doubleday*), St. Thomas (*Hornbeck*), Jamaica (*Gosse*). B.M.

This species has no connexion whatever with *Sphinx eagrus* of Cramer, with which Walker has made it synonymous: the Linnæan description will only agree with one insect; and that is the *C. omphale* of Hübner.

12. C. COCCINEUM, n. sp.

Head black, frons metallic green; antennæ black; collar, pterygodes, and thorax scarlet, margin of metathorax and glandular drums black with a broad metallic blue-green external border; abdomen rose-red; wings hyaline-white, veins black, outer and inner margins rather broadly dark brown; primaries with apex broadly dark brown; a subcostal line, the base and basi-internal area scarlet; secondaries with base and basi-costal area rose-red; pectus black-brown; coxæ and trochanters metallic blue-green, legs otherwise brown; venter white; wings below nearly as above; primaries with reddish ochraceous instead of scarlet, secondaries with scarlet instead of rose-red; expanse of wings 47 millims.

Espiritu Santo (*Higgins*). Type, B.M.

More nearly allied to *C. auge* than to any other species, but very distinct.

13. C. HANGA = Læmocharis hanga, *Herr.-Sch. Auss. Schm.* fig. 246.
Espiritu Santo (*Stevens*). B.M.

14. C. PYRRHOSTETHUS, n. sp.

Head black, frons metallic blue-green; antennæ black; collar, pterygodes, and thorax red; mesothorax with a large posterior, central, rounded, blue spot, metathorax with a smaller central elongated spot; abdomen black spotted with blue-green at the sides: wings nearly as in *C. coccineum*, but with a decided blackish oblique spot on the discocellulars of primaries, and the red coloration paler: body below dark brown; coxæ and trochanters spotted with blue-green, remainder of legs clay-coloured: expanse of wings 42 millims.

New Granada. Type, B.M.

15. C. TELEPHUS = Glaucopis (Cosmosoma) telephus, *Walker, Lep. Het.* i. p. 170.

Closely allied to the preceding species, but without the blackish spot on the discocellulars of primaries, and altogether brighter in colouring, also without the blue spot on mesothorax.

Venezuela (*Dyson & Becker*). Type, B.M.

16. C. RESTRICTUM, n. sp.

Closely allied to *C. teuthras*, but duller in colouring; the red streak on the inner margin of primaries confined to the basal third of the wing, and the metallic-green spots on the abdomen smaller: expanse of wings 39 millims.

Santarem (*Bates*). Type, B.M.

Perhaps a variety, but more likely a local form, of the next species.

17. C. TEUTHRAS = Glaucopis (Cosmosoma) teuthras, *Walker, Lep. Het.* i. p. 168.

Pernambuco (*J. P. G. Smith*), Venezuela (*Dyson*). Type, B.M.

18. C. CINGULATUM, n. sp.

Closely allied to *C. teuthras*, but duller in colouring; the costal and internal red streaks more extended, the latter almost to external angle; red spot at end of cell widely encircled with black; black border of primaries rather broader at apex, of secondaries at apex and anal angle; metallic-green spots on the body rather smaller: differences below as above: expanse of wings 43 millims.

Veragua (*Salvin*). Type, B.M.

This is a well-marked local form of *C. teuthras*.

19. C. ERUBESCENS, n. sp.

Closely allied to *C. teuthras*, but smaller, the discocellular scarlet spot of primaries smaller, the red costal streak paler at base, but extending in front nearer to apex, the internal red streak continued to external angle, the black-brown outer marginal border narrower; secondaries with the red abdominal streak reaching almost to the anal angle; green spots on abdomen smaller: expanse of wings 36 millims.

Brazil (*Mornay*). Type, B.M.

Certainly a local representative of *C. teuthras*.

20. C. IMPAR = Glaucopis (Cosmosoma) impar, *Walker, Lep. Het.* i. p. 169.

Mexico (*Argent*). Type, B.M.

Genus PŒCILOSOMA, *Hübner*. Pl. XXVII. fig. 5.

1. PŒCILOSOMA CHRYSIS, *Hübner, Samml. exot. Schmett. Zutr.* figs. 211, 212.

Ega (*Bates*). B.M.

This is the type of the genus, which is nearly allied to the preceding.

2. P. MEGASPILUM=Cosmosoma megaspila, *Walker, Lep. Het. Suppl.* i. p. 90.

Ega (*Bates*). Type, B.M.

Nearly allied to *P. chrysis*, but more slender, with longer and rather narrower wings, and with a black spot or fasciole on the discocellulars of primaries.

Genus ILIPA, *Walker*.

Chrostosoma (part), *Hübner*.

1. ILIPA BRACONOIDES=Glaucopis (Ilipa) braconoides, *Walker, Lep. Het.* i. p. 166.

Honduras (*Dyson*). Type, B.M.

2. I. FULVIVENTRIS = Læmocharis fulviventris, *Ménétriés, Cat.* ii. t. xiv. f. 5.

Pará (*Bates*). B.M.

3. I. TENGYRA = Glaucopis (Ilipa) tengyra, *Walker, Lep. Het.* i. p. 167.

Brazil (*Becker*). Type, B.M.

4. I.? EVADNES = Sphinx evadnes, *Cramer, Pap. Exot.* iv. pl. 357. f. A.

Surinam.

This may be a *Dycladia*; but it is impossible to decide without examining the insect. The species referred to *S. evadnes* by Walker is quite distinct.

5. I. NOTATA, n. sp.

Head black, frons with a metallic-green dot in the centre and a creamy white spot on each side; antennæ dark brown; collar black with a green spot on each side; pterygodes golden yellow, with a brown external margin; thorax golden yellow, with a central brownish spot; first four segments of abdomen golden yellow, with lateral and central series of black spots; fifth segment black, with squamose yellow posterior margin; sixth and seventh segments black, with metallic-green spots behind: wings hyaline-white with black veins; primaries with base, costal and inner margins, discocellulars, apex, and a rather broad external border black-brown; secondaries with apex, outer, and abdominal margins black-brown; costa pale brown: pectus golden yellow; legs brown, with the coxæ, trochanters, and lower margin of femora golden yellow; abdomen dark brown, with a large white spot on each side of basal segments: expanse of wings 45 millims.

Pacho, Province of Curdinamarca, New Granada (*Janson*). Type, B.M.

Easily distinguished from all its allies by the colouring of the body.

6. I. DETERMINATA, n. sp.

Head black, frons and back of head metallic green; antennæ black; pterygodes black; thorax black-brown, with a central metallic-green spot on metathorax; first four segments of abdomen golden yellow, a central black spot on first segment, remaining segments black, last two segments with lateral green spots; wings hyaline-white, with veins black; primaries with costal, outer and inner margins, apex, and a spot on the discocellulars rather broadly black; a spot at base of costa and a small diffused basi-subcostal litura metallic green; secondaries with apex, outer and abdominal margins black, costal area grey-brown; pectus black; trochanters and front of tibiæ metallic green; abdomen nearly as above: expanse of wings 43 millims.

Pacho, New Granada (*Janson*). Type, B.M.

This species has a larger black spot on the discocellulars of the primaries than any other known species.

7. I. STILBOSTICTA, n. sp.

Head black, frons with two white dots; origin of antennæ and a central spot on back of head white; antennæ black; pterygodes black, thorax black, with a large central white spot on prothorax; abdomen golden yellow, with the three terminal segments black; wings hyaline-white, veins black; primaries with apex and margins black, a white spot at base of costa and a white point near base of subcostal nervure; secondaries with apex, outer, and abdominal margin black, costal margin dark grey: pectus black, trochanters of front pair of legs white; abdomen as above: expanse of wings 38 millims.

♂, ♀. Pacho, New Granada (*Janson*). Two specimens, B.M.

Most nearly allied to *I. fulviventris*, but differing in its greater size and the black anal segments of the abdomen.

Genus LEUCOTMEMIS, n. gen. Pl. XXVII. fig. 12.

Allied to the preceding genus and to *Mochloptera*, agreeing with the latter in neuration, but differing from both in the great size of the head and the very strongly pectinated antennæ.

Type *L. latilinea*, Walker.

1. LEUCOTMEMIS LATILINEA = Glaucopis (Ilipa) latilinea, *Walker*, *Lep. Het.* i. p. 167.

Brazil (*Bates*). Type B.M.

This species is coloured much like an *Ilipa*; but its structural distinctions are seen at a glance.

Genus Dycladia, *Felder*.

1. Dycladia mexicana = Gymnelia mexicana, *Walker, Lep. Het. Suppl.* i. p. 84.
Mexico (*Bottori*). Type, B.M.

2. D. selva = Glaucopis selva, *Herrich-Schäffer, Auss. Schmett.* fig. 227.
Monte Video.

Allied to the preceding species.

3. D. ornatula = Glaucopis (Pœcilosoma) ornatula, *Walker, Lep. Het.* i. p. 163.
Pará (*Bates*). Type, B.M.

4. D. helena = Glaucopis helena, *Herrich-Schäffer, Auss. Schmett.* fig. 230.
Brazil.

Allied to the preceding species, but the abdomen with yellow bands.

5. D. teda = Glaucopis (Phacusa) teda, *Walker, Lep. Het.* i. p. 177.
Santa Catharina, Brazil (*Becker*). Type, B.M.

6. D.? eximia = Glaucopis eximia, *Herr.-Sch. Corr.-Blatt Regensb.* p. 113 (1866).
Cuba.

7. D. vittata = Pheia vittata, *Walker, Lep. Het. Suppl.* i. p. 83.
Vera Cruz (*Sallé*). Type, B.M.

8. D. dorsalis = Glaucopis (Phacusa) dorsalis, *Walker, Lep. Het.* i. p. 177.
Santarem (*Bates*). Type, B.M.

9. D. bura = Læmocharis bura, *Herrich-Schäffer, Auss. Schmett.* fig. 239.
Glaucopis (Phacusa) discifera, *Walker, Lep. Het.* i. p. 178.
Pará (*Bates*). B.M.

10. D. picta = Glaucopis (Phacusa) picta, *Walker, Lep. Het.* i. p. 176.
Pará and Santarem (*Bates*). Type, B.M.

11. D. emergens = Eurata emergens, *Walker, Lep. Het. Suppl.* i. p. 92.
Ega (*Bates*). Type, B.M.

Nearly allied to the preceding species.

12. D. LUCETIUS = Sphinx lucetius, *Cramer, Pap. Exot.* iv. pl. 357. f. D.

Surinam.

13. D. HEMILEUCA, n. sp.

Nearly allied to *D. tenthredoides*, but smaller, without the orange spot on the centre of the thorax, the metallic spots on the posterior abdominal segments less vivid; primaries with a broader and more regular transverse black band; legs and pectus paler; abdomen cream-coloured, the terminal segments brown in the female: expanse of wings ♂ 22 millims.

Eastern Peru (*Degand*). Type, B.M.

14. D. TENTHREDOIDES = Ilipa tenthredoides, *Walker, Lep. Het.* vii. p. 1610.

Ega (*Bates*).

15. D. INTERSECTA = Eurata intersecta, *Walker, Lep. Het. Suppl.* i. p. 91.

Ega (*Bates*). Type, B.M.

16. D. ALBIVENTRIS = Glaucopis (Phacusa) albiventris, *Walker, Lep. Het.* i. p. 176.

Pará (*Bates*). Type, B.M.

17. D. VARIPES = Glaucopis (Phacusa) varipes, *Walker, Lep. Het.* i. p. 175.

Pará (*Bates*). Type, B.M.

18. D. MARGARIPHERA, n. sp.

Head, collar, and antennæ black, two dark blue metallic spots on the back of the head and two on the collar; pterygodes black, with a longitudinal yellow streak; thorax black, a dark blue spot on centre of hinder part of thorax; basal segment of abdomen black, with its hind margin orange, and on each side a blue spot; glandular drums orange; the second to fourth segments scarlet, the fifth to seventh black, all of them with a pearly opaline spot on each side: wings yellowish testaceous, veins (excepting on the borders of dark spots) and all the margins (excepting where interrupted by dark patches) yellow; primaries with a large subquadrate jet-black spot at end of cell enclosing two metallic dark blue spots, apex broadly, and external angle less broadly dark brown; secondaries with the apex, outer margin, and anal angle dark brown: palpi yellow, tipped with black; pectus brown; legs yellow, the tibiæ brown above and irrorated with metallic-blue scales; venter yellow, scarlet at the sides, with the last two segments dark brown: expanse of wings 34 millims.

Pará (*Bates*). Type, B.M.

A beautiful species, intermediate in pattern between *D. varipes* and *D. correbioides*, but differing from all the species in the pearly spots on the body.

19. D. CORREBIOIDES, *Felder, Reise der Nov. Lep.* iv. tab. cii. fig. 20.
Pacho, New Granada (*Janson*). B.M.

20. D. CLIMACINA, n. sp.

Head orange; antennæ black, tipped with white; collar orange, with a slender black edge; pterygodes orange, edged with black; thorax black-brown, with a broad, central, longitudinal, orange streak, two dots in front, and two spots behind of the same colour; first four segments of abdomen golden yellow, the last three dark metallic blue; a well-defined, central, longitudinal, stripe, a narrower, irregular, lateral line, and transverse bars on the anterior margins of the segments all black, the first two or three shining (when the head faces the light) with a bronzy-opaline lustre; wings testaceous hyaline; primaries with the base of costa black, with a white spot, interno-basal area orange, veins of basal area black, apical two fifths black enclosing a large subquadrate quinquefid hyaline spot; secondaries with abdominal and basicostal areas golden yellow, a triangular spot at end of cell and the apical half of costa black, outer margin black, broadest at apex and anal angle; body below dark brown; palpi orange, black above and at the tips; tibiæ, proximal ends of femora, and distal extremities of tarsi yellowish orange; venter with a central transverse yellow belt: wings below as above: expanse 33 millims.

Espiritu Santo (*Higgins*). Type, B.M.

Somewhat intermediate between *L. tenthredoides* and *D. torrida*.

21. D. TORRIDA = Glaucopis (Pœcilosoma) torrida, *Walker, Lep. Het.* i. p. 161.
Tapajos (*Bates*). Type, B.M.

22. D. BATESII, n. sp.

Allied to *D. bromus*; but the primaries with the apical fourth black: expanse of wings 30 millims.

St. Paulo and Pará (*Bates*). Type, B.M.

23. D. BROMUS = Sphinx bromus, *Cramer, Pap. Exot.* iii. pl. 35. f. G.
Surinam.

Cramer's figure of this species is rather rough, and represents the wings as very long and narrow, more so even than in *Sphecosoma*.

24. D. MINOR, n. sp.
Glaucopis (Phacusa) bromus, var.?, *Walker, Lep. Het.* i. p. 179. n. 70.
Brazil (*Stevens*). Type, B.M.

This is altogether smaller than *D. bromus*, and has the apex of primaries too broadly black to be that species.

Genus MARISSA, *Walker*.

Agerocha (*Hübner*, part.), *Walker*.

1. MARISSA MULTICINCTA = Glaucopis (Pœcilosoma) multicincta, *Walker, Lep. Het.* i. p. 163.
Haiti (*Cuming*). Type, B.M.

This species has the abdomen longer than its congeners, but is evidently closely allied to *M. columbina*.

2. M. COLUMBINA = Zygæna columbina, *Fabricius, Ent. Syst.* iii. p. 403.
Læmocharis fasciatella, *Ménétriés, Cat.* ii. pl. 14. f. 4.
Haiti (*Tweedie*). B.M.

I feel certain that the species figured by Hübner and Ménétriés are the same, and represent the insect which we possess from Haiti.

3. M. RUBRIPUNCTATA, n. sp.
Glaucopis (Marissa) columbina, *Walker, Lep. Het.* i. p. 174. n. 59.
Jamaica (*Gosse*). Type, B.M.
This species has the sides of the abdomen, top of the head, a line behind the eyes, the front of the collar, the base of the palpi, coxæ, trochanters, femora, body below, a spot at end of discoidal cell of primaries on both surfaces, and two or three spots at apex of secondaries on the under surface scarlet.

4. M. LATENIGRA, n. sp.
Allied to the preceding species, but differing in the head being black above, with the crest and a dot at base of antennæ scarlet; the longitudinal central black streak on abdomen broader; no scarlet spot at end of cell in primaries, or at apex of secondaries below: the black borders of the wings (broader than in any other species, covering the apical half of secondaries), and the posterior segments of the venter black: expanse of wings 29 millims.
Honduras (*Miller*). Type, B.M.

Placed by Walker with the preceding species.

5. M. EONE = Agerocha eone, *Hübner, Exot. Schm. Zutr.* figs. 417, 418.
Santarem and Ega (*Bates*). B.M.

6. M. CRUENTA = Glaucopis cruenta, *Perty, Delect.* pl. 31. f. 8.
Amazons.

7. M. INSULARIS = Eunomia insularis, *Grote, P. E. S. Phil.* 1866, p. 188.
Glaucopis elegantula, *H.-Sch. Corr.-Blatt Regensb.* 1866, p. 114.
Cuba.

8. M. NITIDULA = Glaucopis nitidula, *Herr.-Sch. Corr.-Blatt Regensb.* 1866, p. 114.
Cuba.

9. M.? DIAPHANA = Glaucopis diaphana, *Sepp, Ins. Surin.* pl. 81.
Surinam.

Group with small secondaries.

Genus HYSIA, *Walker*.

1. HYSIA MELALEUCA = Glaucopis (Hysia) melaleuca, *Walker, Lep. Het.* i. p. 173.
Pará (*Bates*). Type, B.M.

2. H. TEMENUS = Sphinx temenus, *Cramer, Pap. Exot.* iv. pl. 367. f. D.
Surinam.

3. H. ASTYOCHE = Euchromia astyoche, *Hübner, Samml. exot. Schmett Zutr.* figs. 793, 794.
Surinam.

Not the *Glaucopis astyoche* of Walker.

4. H. DELECTA, n. sp.
Glaucopis (Hysia) astyoche, *Walker, Lep. Het.* i. p. 173. n. 56.
Pará (*Bates*). Type, B.M.

Genus DIPTILON, *Prittwitz*.

1. DIPTILON TELAMONOPHORUM, *Prittwitz, Stett. ent. Zeit.* p. 349 (1870).
Rio.

2. D. BIVITTATUM = Cosmosoma bivittata, *Walker, Lep. Het. Suppl.* i. p. 90.
Brazil (*Gardner*). Type, B.M.

3. D. DEIEIDES, *Prittwitz, Stett. ent. Zeit.* p. 349 (1870).
Rio.

Genus Desmidocnemis, *Moeschler*.

1. Desmidocnemis Prittwitzi, *Moeschler, Stett. ent. Zeit.* p. 346 (1872).
Cayenne.

2. D.? platyleuca = Glaucopis (Herea) platyleuca, *Walker, Lep. Het.* i. p. 198.
Venezuela (*Dyson*). Type, B.M.

I believe that this is a *Desmidocnemis*, but cannot feel certain without seeing the type of that genus.

Genus Hyda, *Walker* (part.).

1. Hyda xanthorhina = Eurata xanthorhina, *Herr.-Sch. Auss. Schmett.* f. 226.
Glaucopis (Hyda) basilutea, *Walker, Lep. Het.* i. p. 182.
Santarem (*Bates*), Pernambuco (*J. P. G. Smith*), Santa Martha (*Bouchard*), Pacho, New Granada (*Janson*). B.M.

Section *c*.

Abdomen with a terminal and sometimes with lateral tufts of hair-scales.

Genus Methysia, n. gen.

General appearance of *Thrinacia*, neuration of primaries as in *Cosmosoma*; secondaries small, elongated, and parchment-like, capable of being entirely concealed behind the inner marginal border of primaries, cell reaching to middle of wing, discocellular slightly receding from the subcostal to the median nervure, upper branch of subcostal fork running to the costal margin; head rather small; antennæ well pectinated; abdomen with a terminal tuft. Type *M. notabilis, Walker*.

1. Methysia notabilis = Glaucopis (Pseudomya) notabilis, *Walker, Lep. Het.* i. p. 144.
Pará (*Bates*). Type, B.M.

Genus Dixophlebia, n. gen. Pl. XXVIII. fig. 8.

Evidently allied to the preceding genus, but shorter and broader in the wing; the wings with smaller transparent areas; seconaries with discoidal cell very short, discocellulars forming together a strongly angulated line, upper rather longer than lower; a well-defined radial nervure continued as a recurrent nervure through the cell to base, median branches emitted from the end of a very long footstalk.

Type *D. quadristrigata*, Walker.

1. Dixophlebia quadristrigata = Pseudomya quadristrigata, *Walker, Lep. Het. Suppl.* i. p. 82.
Ega (*Bates*). Type B.M.

Genus Mallodeta, n. gen.

Lycorea, *Walker* (nec *Doubleday*, 1847).

1. Mallodeta æcyra=Læmocharis æcyra, *Herr.-Sch. Auss. Schmett.* fig. 250.
Glaucopis (Hyda) sortita, *Walker, Lep. Het.* i. p. 184.
Brazil (*Bates*). Type, B.M.

2. M. clavata=Glaucopis (Lycorea) clavata, *Walker, Lep. Het.* i. p. 192.
Brazil (*Bates*). Type, B. M

3. M. consors=Glaucopis (Hyela) consors, *Walker, Lep. Het.* p. 183.
Brazil (*Bates*). Type, B.M.

The above species are probably all from Pará.

Genus Lagaria, *Walker*.

1. Lagaria vulnerata=Læmocharis vulnerata, *Herr.-Sch. Auss. Schmett.* fig. 238.
Glaucopis (Lagaria) erythrarchos, *Walker, Lep. Het.* i. 164.
Brazil (*Low*). B.M.

2. L. ignicolor=Læmocharis ignicolor, *Ménétriés, Cat.* ii. t. xiv. fig. 3.
Minas Geraes.

Genus Hyela, *Walker*.

1. Hyela sanguinea = Glaucopis (Hyela) sanguinea, *Walker, Lep. Het.* i. p. 172.
—— ? Type, B.M.

2. H. stipata=Glaucopis (Hyela) stipata, *Walker, Lep. Het.* i. p. 184.
Pará (*Bates*). Type, B.M.

3. H. frontalis=Glaucopis (Eunomia) frontalis, *Walker, Lep. Het.* i. p. 188.
Brazil (*Bates*). Type, B.M.

4. H. vacillans=Eunomia vacillans, *Walker, Lep. Het.* vii. p. 1617.
St. Paulo (*Bates*). B.M.

Subfamily EUNOMIINÆ.

This subfamily closely resembles the preceding, of which it might almost be considered an aberrant group; it differs in the following character:—

Median nervure of secondaries with more than two branches, one of which is always emitted before the end of the discoidal cell.

Dr. Herrich-Schäffer has united this subfamily with the preceding, with the Charideinæ, and with the Syntominæ, including them all in a synoptic Table; but his characters are to me perfectly incomprehensible; the new genera are barely indicated and consequently cannot be recognized. He describes his genus *Abrochia* thus:—"Hind wing without median cell;" he means probably that the discocellulars are wanting, and consequently that the cell is open. One of his genera is simply diagnosed by the word "*farbig*;" and considering that there is no moth destitute of colour, this seems to me very insufficient. The new species described in the same paper (Correspondenz-Blatt zool.-min. Ver. Regensb. 1866) are very difficult to identify, the following being a sample of the descriptions:—

TRICHÆA SETICORNIS.

"Cæruleo mixta, abdomine a sgm. 2, antennis apice albis, dorso medio nigro-squamatis, tarsis p. apice albis. 506–623."

If the above diagnosis had been written without abbreviations, it would have been insufficient for the determination of the species. What is meant by "cæruleo mixta" is to me a mystery. Another error in the above paper is the adoption of well-known generic names in a wrong sense. I will take *Eunomia* as an example, inasmuch as even my friend Grote appears to have misapplied it. It has been used recently for a genus of Euchromiinæ (*Marissa* of Walker); now the correct application of the name will be seen from the following considerations:—

Hübner first characterized the genus at p. 125 of his 'Verzeichniss,' and included the following species:—

1st, *Eunomia columbina*, Fabricius; 2nd, *E. auge*, Linn., and *E. eagrus* of Cramer; 3rd, *E. andromacha*, Fabr., and *E. caunus* of Cramer.

Hübner, in his 'Sammlung exotischer Schmetterlinge,' figured *E. auge* (n. 2) as *Cosmosoma omphale*. Walker described this genus and adopted *C. omphale* as its type; this at once restricted the genus to four species.

Walker, at p. 174 of his 'Lepidoptera Heterocera,' characterized his genus *Marissa*, taking as its type *M. columbina*, thus again restricting *Eunomia*.

At p. 152 he also described *Gymnelia* (type, *G. lænnus*), with which *G. caunus* is congeneric.

At p. 189 he described *Dinia* (type, *D. eagrus* of Cramer).

The genus *Eunomia* is thus naturally restricted to *E. andromacha* of Fabricius, which is the only sense in which it can fairly be adopted.

As may well be supposed, Dr. Herrich-Schäffer has united in generic groups most incongruous species: his *Glaucopis* (a name which cannot stand) is a collection of very distinct genera; so is his *Læmocharis*. The genera which I have recognized through his excellent figures in the 'Sammlung aussereuropäischer Schmetterlinge' are as follows:—

Copæna, H.-Sch.=*Macrocneme*.
Hæmaterion, H.-Sch.=probably *Eunomia*, *Dinia*, *Æthria*, &c.
Hyalopis, H.-Sch.=*Erruca*.
Mystrocneme, H.-Sch.=*Herea*= ? *Cercophora*, H.-Sch.
Chrysostola, H.-Sch.=*Pseudosphex*.
Correbia=*Pionia*.
Euclera=*Androcharta*.

I cannot identify *Echeta* or *Trichæa*; but the former appears to have no type, so that this is of little consequence.

Genus Eunomia, *Hübner* (restricted).

1. Eunomia andromacha=Sphinx andromacha, *Fabric. Sp. Ins.* ii. p. 161.
Glaucopis (Dinia) finalis, *Walker, Lep. Het.* i. p. 190.
Pará (*Bates*), Venezuela (*Dyson*). B.M.

2. E. sanguiflua, *Hübner, Samml. exot. Schmett. Zutr.* figs. 697, 698.
Bahia.

3. E. carnicauda, n. sp.
Glaucopis (Eunomia) sanguiflua, *Walker* (*nec Hübner*), *Lep. Het.* i. p. 187.
Rio Janeiro (*Stevens*). Type, B.M.

It will be seen that Walker adopted the above (which is congeneric with *E. andromacha*) as the type of his *Eunomia*; he was therefore nearer to the truth than any of his successors.

4. E. FULVICAUDA, n. sp.

Allied to *E. leucaspis*, much smaller, and different in the colour of the body: body above black; palpi white in front; head dark brown, a green dot behind each eye; antennæ black; pterygodes black, broadly bordered internally with metallic blue-green; thorax with a large posterior metallic-green spot; abdomen with all the segments bordered behind with dark metallic green; anal tuft black internally, golden yellow externally: wings exactly as in *E. andromacha*, hyaline-white, with the veins, margins, and bases black; primaries with a black litura at end of cell: body below dark brown; coxæ metallic blue-green; trochanters, basal segments of abdomen, and anus white; anal tuft golden yellow: expanse of wings 26 millims.

St. Paulo (*Bates*). Type, B.M.

This is a pretty little species, but duller in colouring than any other in the genus.

5. EUNOMIA SARCOSOMA, n. sp.

Palpi white in front, black behind; frons white; top of head and antennæ black; collar white-edged in front, golden greenish at the sides, dark grey in the centre; pterygodes black, edged internally with golden greenish; a white spot on the shoulders; thorax black, with a bronzy dot in front and an elongated bronzy whitish spot behind; glandular drums bluish black: abdomen scarlet; a central longitudinal brown band running through the first four segments, on the lateral margins of which are bronzy dots; terminal, lateral, and anal tufts scarlet: wings as in the other species, excepting that the black border of secondaries is narrower, that there is less black at base, and that the primaries have a greenish-white dot close to the base: pectus below black, coxæ golden greenish; trochanters white; abdomen scarlet, with whitish patches in the centre of each segment, anus yellow: expanse of wings 31 millims.

Pacho, New Granada (*Janson*). Type, B.M.

6. E.? MERRA = Lasioprocta merra, *Wallengren, Wien. ent. Mon.* iv. p. 41.

Callao.

Character of *E. andromacha*, but smaller, Dr. Wallengren describes it as having dorsal abdominal reddish-fulvous spots, the anus with black hairs: in this respect it agrees with no species known to me; possibly, however, it may be the male of the following, which has no anal tuft.

7. E. PLATYZONA = Scytale platyzona, *Felder, Reise der Nov. Lep.* iv. tab. cii. fig. 24.
Pacho, New Granada (*Janson*). B.M.

The following appears also to belong to *Eunomia.*

8. E.? EBURNEIFERA = Glaucopis eburneifera, *Felder, Reise der Nov. Lep.* iv. tab. cii. fig. 21.

Genus DINIA, *Walker.*

1. DINIA SAUCIA = Glaucopis (Dinia) saucia, *Walker, Lep. Het.* i. p. 190.
Colombia (*Becker*), Venezuela (*Dyson*). Type, B.M.

Described by Walker as variety δ of *D. eagrus* (*D. auge*, Walker).

2. D. MENA = Eunomia mena, *Hübner, Samml. ex. Schm.* ii. pl. 155.
Glaucopis auge, var. β, *Walker, Lep. Het.* i. p. 190.
New Granada (*Stevens*), Venezuela (*Dyson*), Brazil (*Bates*). B.M.

3. D. EAGRUS = Sphinx eagrus, *Cramer, Pap. Exot.* iii. pl. 108. f. C.
Rio (*M'Gillivray*), Honduras (*Miller*), Veragua (*Salvin*), Mexico (*Argent*). B.M.

The three forms enumerated above may be only varieties of one species.

4. D. SUBAPICALIS = Glaucopis (Dimia) subapicalis, *Walker, Lep. Het.* i. p. 190.
Lima (*Kayler*) and "—— ?" Type, B.M.

Genus ÆTHRIA, *Hübner.*

1. ÆTHRIA HÆMORRHOIDALIS = Sphinx hæmorrhoidalis, *Stoll, Pap. Exot.* pl. 12. f. 1.
Rio (*Bates*), Brazil (*Bates, Milne, Low, Doubleday*). B.M.

2. Æ. SMARAGDINA = Eunomia smaragdina, *Walker, Lep. Het. Suppl.* i. p. 92.
Æthria saturatissima, *Walker, l. c.* p. 93.
Ega (*Bates*). Type, B.M.

There is only one example to represent the two descriptions united above, which were (I have no doubt) taken from the same individual. The explanation is self-evident. Mr. Walker comes one day and describes a new species; but, owing to the lateness of the hour, or some other cause, omits to label it as a type; the next time he comes to the collection he continues his MS., and, finding this species without a label, forthwith redescribes it. This will, I think, account for several instances which I have noticed of evidently the same species described twice over in consecutive pages of Walker's Catalogues.

Genus Corematura, n. gen.

Primaries with two subcostal and four apparent median branches visible to the naked eye, the lower radial forming the fourth median, the upper radial not visible; discocellular strongly angulated in the middle. Secondaries with two subcostal branches, the upper one lying close to the costa, and four median branches, the fourth being really the lower radial; discocellular strongly angulated. Antennæ slender. Head rather small. Abdomen very long, with large bushy anal tuft.

Type *C. chrysogastra*, Perty.

1. Corematura chrysogastra = Glaucopis chrysogastra, *Perty, Delect.* pl. 31. f. 10.

Eunomia abdominalis, *Walker, Lep. Het.* vii. p. 1617.

St. Paulo (*Bates*), Archidona (*Stevens*). B.M.

Described again by Walker (in his 'Supplement,' i. p. 89) as *Lagaria abdominalis*.

Genus Argyroeides, n. gen.*

Primaries with one evident subcostal branch (forking from below near apex); two radials placed at the upper and lower extremities of the cell, so that the lower discocellular is reduced to about a quarter the length of the upper; discocellulars nearly straight; three median branches, emitted regularly beyond the middle of the nervure. Secondaries with two subcostals; one radial; straight discocellulars, the upper rather longer than the lower; three median branches emitted regularly beyond the middle of the nervure. Antennæ plumose to near the tip. Head moderately large; palpi about level with top of head. Abdomen constricted at the base, with terminal straight anal tuft.

Type *A. ophion*, Walker.

1. Argyroeides ophion = Glaucopis (Dinia) ophion, *Walker, Lep. Het.* i. p. 191.

Carthagena and Venezuela (*Becker*). Type, B.M.

* I am aware of the fact that *Argyrodes* (*sic*) has been used for a genus of Arachnida; but I think *Argyroeides* distinct enough for so dissimilar a group of animals.

Genus PEZAPTERA, n. gen.

Costal and subcostals of primaries well defined; subcostal with a fork near apex, and a third branch (generally representing the upper radial) emitted just beyond end of cell; lower radial emitted with second and third median branches from lower extremity of cell; an interradial and recurrent nervure, lying close to the lower radial until near to the cell, which it passes through to the base, thus making two discocellulars with the usual angle. Secondaries small; subcostal branches forming a simple long fork; upper radial and continuous recurrent nervure running through the centre of cell and along the margin of lower radial to outer margin; discocellulars rather long, nearly equal in length, the upper one slightly concave, running obliquely inwards, the lower convex, running obliquely outwards, emitting the lower radial from its centre; three median branches, the second and third emitted near together at end of cell. Body much as in *Argyroeides*, but the abdomen rather less constricted. Type *P. sordida*.

1. PEZAPTERA SORDIDA = Eunomia sordida, *Walker, Lep. Het.* vii. p. 1617.

Pheia divisa, *Walker, Lep. Het. Suppl.* i. p. 83.

Santarem, Villa Nova, and Ega (*Bates*). Type B.M.

The type of *P. sordida* is faded; but *P. divisa* has its black colouring; in other respects the two types are identical.

Genus EUMENOGASTER, *Herrich-Schäffer*.

1. EUMENOGASTER EUMENES, *Herrich-Schäffer, Auss. Schmett.* pl. 73. fig. 423.

Brazil.

2. E. NOTABILIS = Pseudosphex notabilis, *Walker, Lep. Het. Suppl.* i. p. 94.

Tapajos (*Bates*). Type B.M.

3. E.? TRICOLOR = Glaucopis tricolor, *Packard, 1st Ann. Rep. Peab. Acad.* p. 62 (1869).

Napo and Maranon rivers.

I believe this to be a *Eumenogaster*; it seems nearly allied to *E. notabilis*, so far as I can judge from the description.

Genus Trichura, *Hübner.*

1. Trichura latifascia = Glaucopis (Trichura) latifascia, *Walker, Lep. Het.* i. p. 193.
Pará (*Bates*). Type, B.M.

2. T. caudata = Zygæna caudata, *Fabricius, Sp. Ins.* ii. p. 165.
Rio (*Stevens*), Brazil (*Argent*), St. Paulo (*Bates*). B.M.

3. T. coarctata = Sphinx coarctata, *Cramer, Pap. Exot.* i. pl. 4. figs. F, G.
Pernambuco (*J. P. G. Smith*), Pará (*Bates*). B.M.

4. Trichura druryi, *Hübner, Verz. bek. Schmett.* p. 126. n. 1365.
Sphinx coarctata, *Drury* (*nec Cramer*), *Ill.* ii. pl. 27. fig. 2.
Honduras (*Dyson*). B.M.

5. T. esmeralda = Glaucopis (Trichura) esmeralda, *Walker, Lep. Het.* i. p. 194.
Honduras (*Dyson*). Type, B.M.

6. T. aurifera, n. sp.
Glaucopis (Trichura) melas, var.? *Walker* (*nec Cramer*), *Lep. Het.* i. p. 194. n. 94.
Pará (*Bates*). Type B.M.
The *Sphinx melas* of Cramer is a *Homœocera.*

Genus Syntrichura, n. gen.

Subcostal of primaries with very short terminal fork, only visible with a lens; upper radial emitted from the upper end of cell, lower only present as a fine line proceeding from the end of the third median branch; discocellulars nearly in a straight line; second and third median branches nearer together than first and second. Secondaries as in *Trichura.*

Type *S. virens*, n. sp.

1. Syntrichura virens, n. sp.
Body dark shining green; antennæ black, with whitish tips; pterygodes with whitish margins; whitish dorsal and lateral streaks at base of abdomen: wings as in *Trichura,* hyaline-white with black veins, margins, and discocellular litura in primaries: body below black; base of abdomen white: expanse of wings 23 millims.
St. Paulo (*Bates*). Type, B.M.

Genus Herea, *Walker.*

1. Herea metaxantha = Glaucopis (Herea) metaxanthus, *Walker, Lep. Het.* i. p. 198.
Pará (*Bates*). Type, B.M.

2. H. RUFICEPS=Glaucopis (Herea) ruficeps, *Walker, Lep. Het.* i. p. 198.
Pará (*Bates*). Type, B.M.

Genus PSEUDOSPHEX, *Hübner*.

1. PSEUDOSPHEX ZETHUS, *Hübner, Samml. exot. Schmett. Zutr.* figs. 49, 50.
Pará and Santarem (*Bates*). B.M.

2. P. ÆQUALIS=Isanthene æqualis, *Walker, Lep. Het. Suppl.* i. p. 87.
Ega (*Bates*). Type, B.M.

3. P. SINGULARIS=Glaucopis (Hyela) singularis, *Walker, Lep. Het.* i. p. 182.
Pará (*Bates*). Type, B.M.

4. P. MUNDA=Isanthrene munda, *Walker, Lep. Het.* vii. p. 1605.
Santarem (*Bates*). Type, B.M.

5. P. CONSOBRINA, *Walker, Lep. Het.* vii. p. 1619.
Tapajos (*Bates*). B.M.

6. P. POSTICA=Glaucopis (Phacusa) postica, *Walker, Lep. Het.* i. p. 178.
Santarem (*Bates*). Type, B.M.

7. P. BROMUS=Chrysostola bromus, *Herr.-Sch. Auss. Schmett.* fig. 427.
Brazil.

This must not be confounded with *Sphinx bromus* of Cramer, which is a *Dycladia*.

There is a little group of genera, including *Illipula*, *Antichloris*, and *Eriphia*, which seem to make a passage between the present subfamily and the Charideinæ; I believe them to be Zygænidæ, yet hardly know how to distinguish them structurally from the Charideinæ. I shall refer them to the Zygænoid Arctiidæ under the subfamily name of Antichlorinæ.

EXPLANATION OF THE PLATES.

PLATE XXVII.

Fig. 1. Venation of secondaries of *Callitomis*.
2. Venation of primaries of *Pheia*.
3. Ditto of *Cosmosoma*.
4. Ditto of *Isanthrene*.

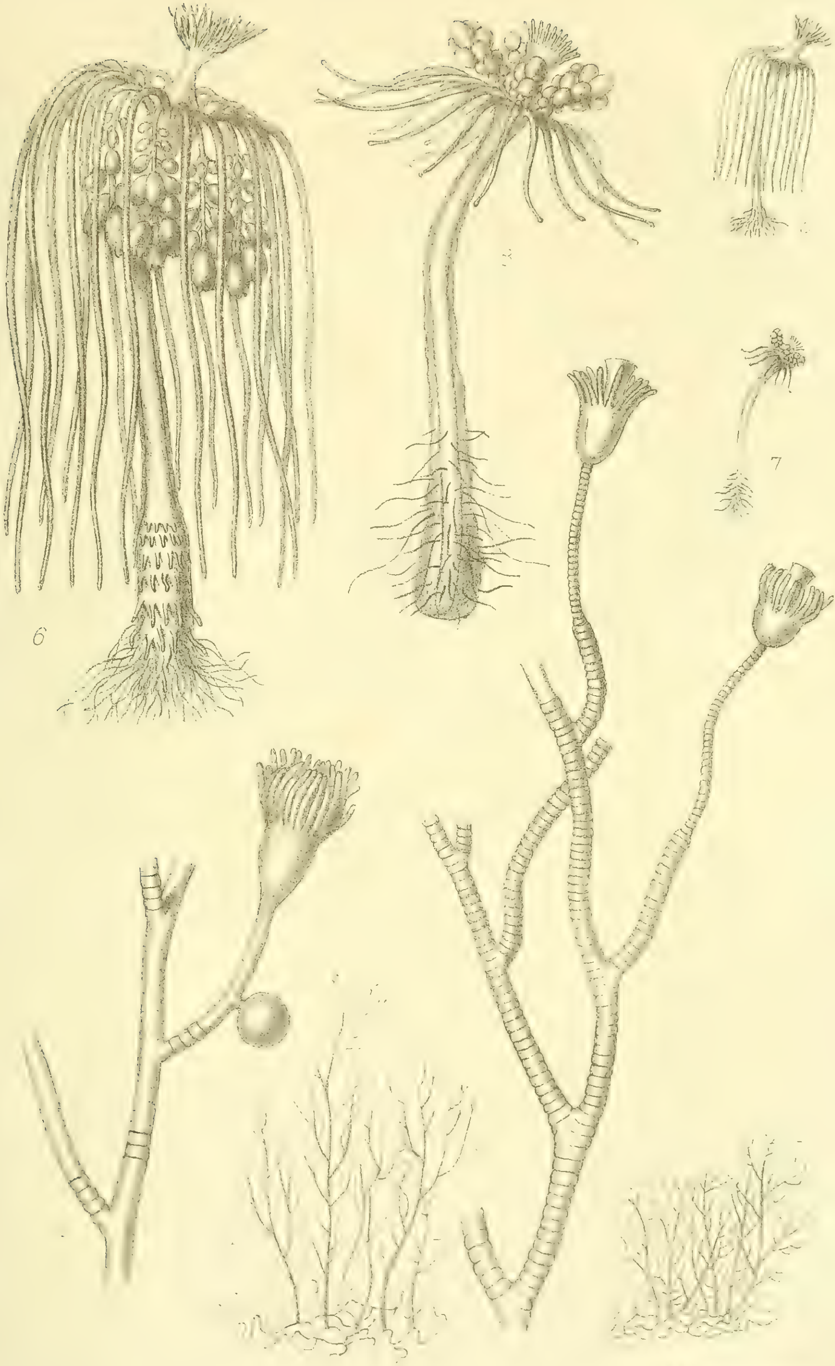
PLATE XXVII. (*continued*).

Fig. 5. Venation of primaries of *Pœcilosoma.*
6. Ditto of *Homœocera.*
7. Ditto of *Erruca.*
8. Metathorax and abdomen of *Myrmecopsis.*
9. Ditto, profile view.
10. Venation of primaries of *Andrenimorpha.*
11. Ditto of *Sarosa.*
12. Ditto of *Leucotmemis.*
13. Ditto of *Gymnelia.*
14. Ditto of *Loxophlebia.*
15. Ditto of *Mochloptera.*

PLATE XXVIII.

Fig. 1. Venation of secondaries in *Procotes.*
2. Ditto of *Notioptera.*
3. Ditto of *Trianeura.*
4. Ditto of *Pseudosphenoptera.*
5. Ditto of *Harrisina.*
6. Ditto of *Thyrassia.*
7. Ditto of *Psichotoë.*
8. Ditto of *Dixophlebia.*
9. Ditto of *Ichoria.*
10. Ditto of *Epitoxis.*
11. Ditto of *Thyretes.*
12. Ditto of *Eutomis.*
13. Ditto of *Pampa.*
14. Ditto of *Artona.*
15. Ditto of *Phacusa.*
16. Ditto of *Syntomeida.*
17. Ditto of *Saliunca.*
18. Ditto of *Amycles.*
19. Ditto of *Empyreuma.*
20. Ditto of *Euchromia.*
21. Ditto of *Histiœa.*

The group of genera constituting Walker's Family *Dioptidæ* contains the types of species referable to the *Euchromiinæ*, the *Charideinæ*, the *Pericopiinæ*, the *Nyctemeridæ*, and the *Pseudo-Deltoids!* I shall consider them in a special paper.



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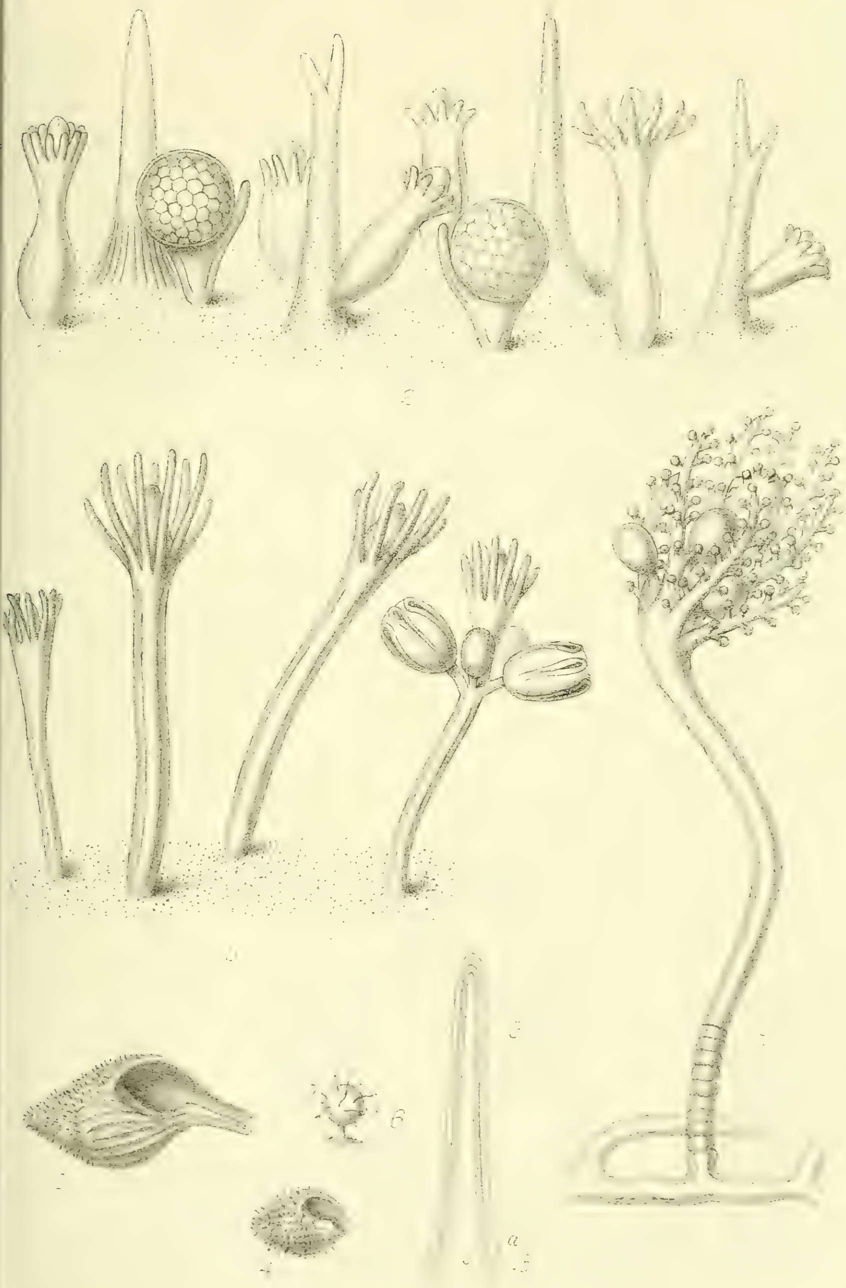

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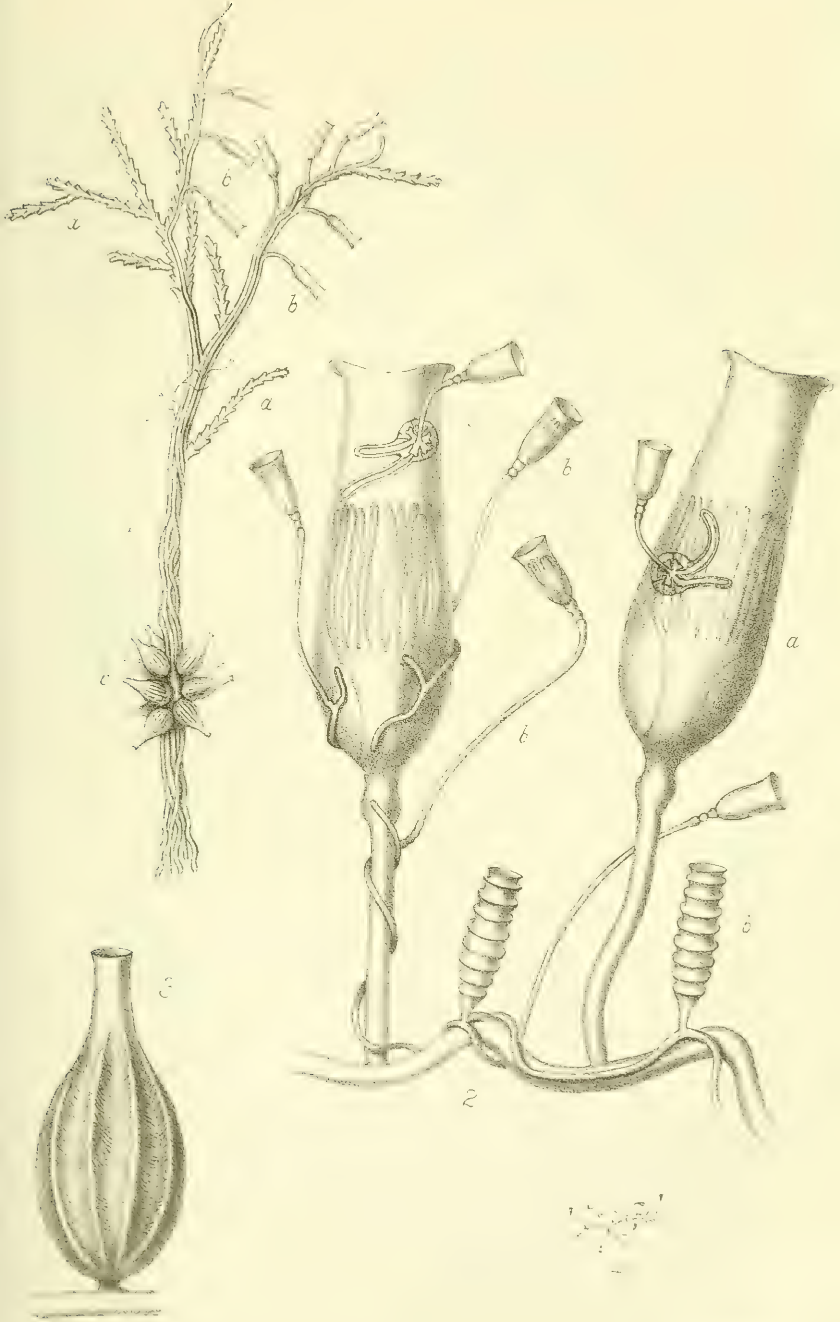

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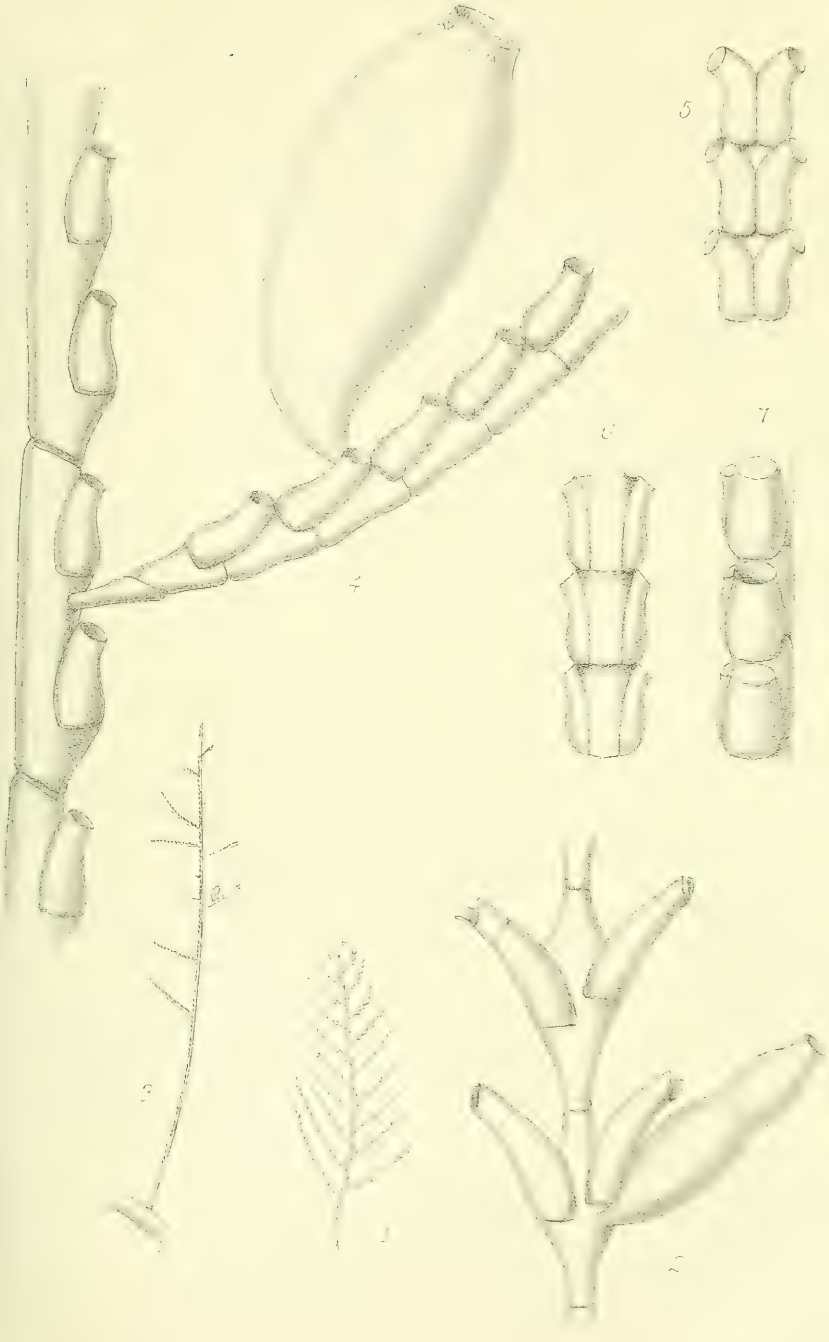

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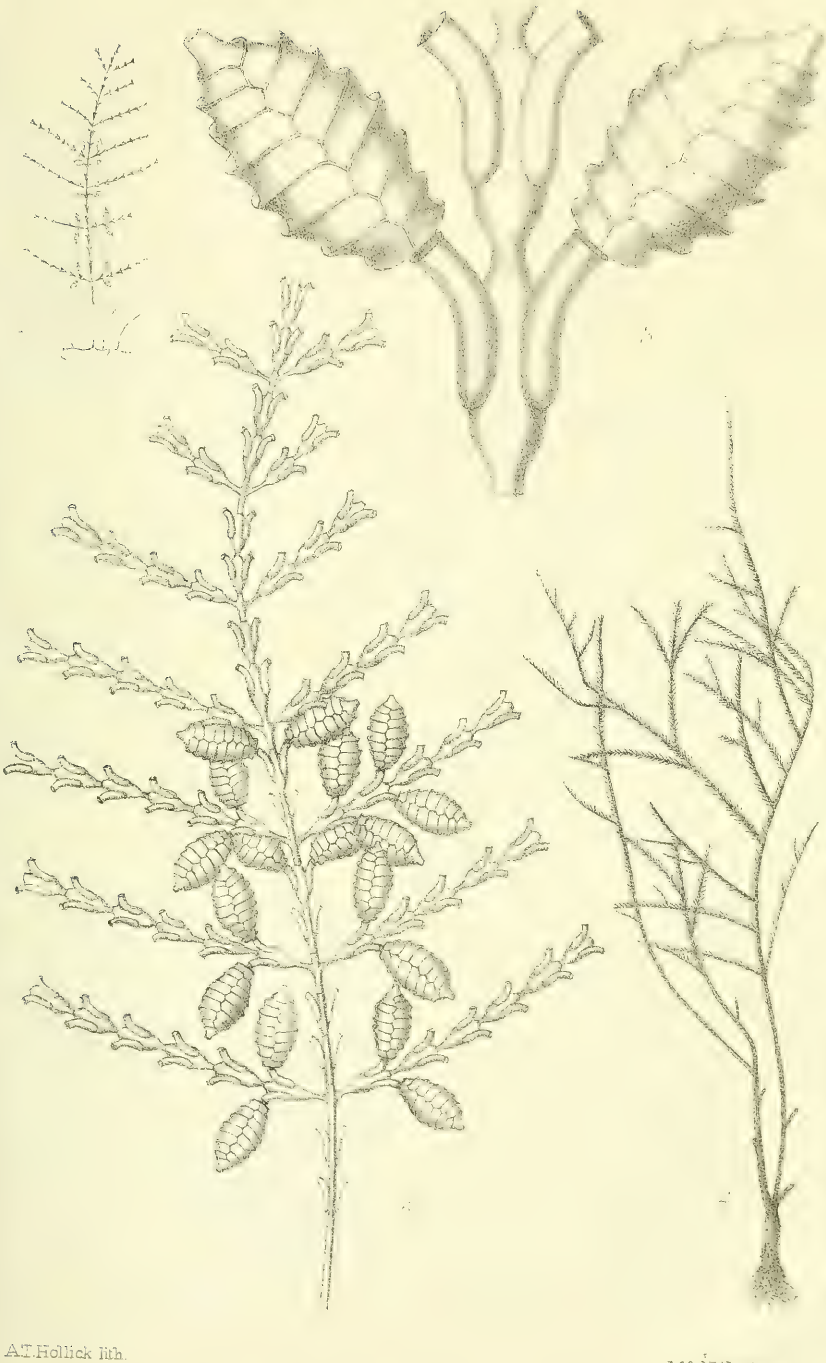

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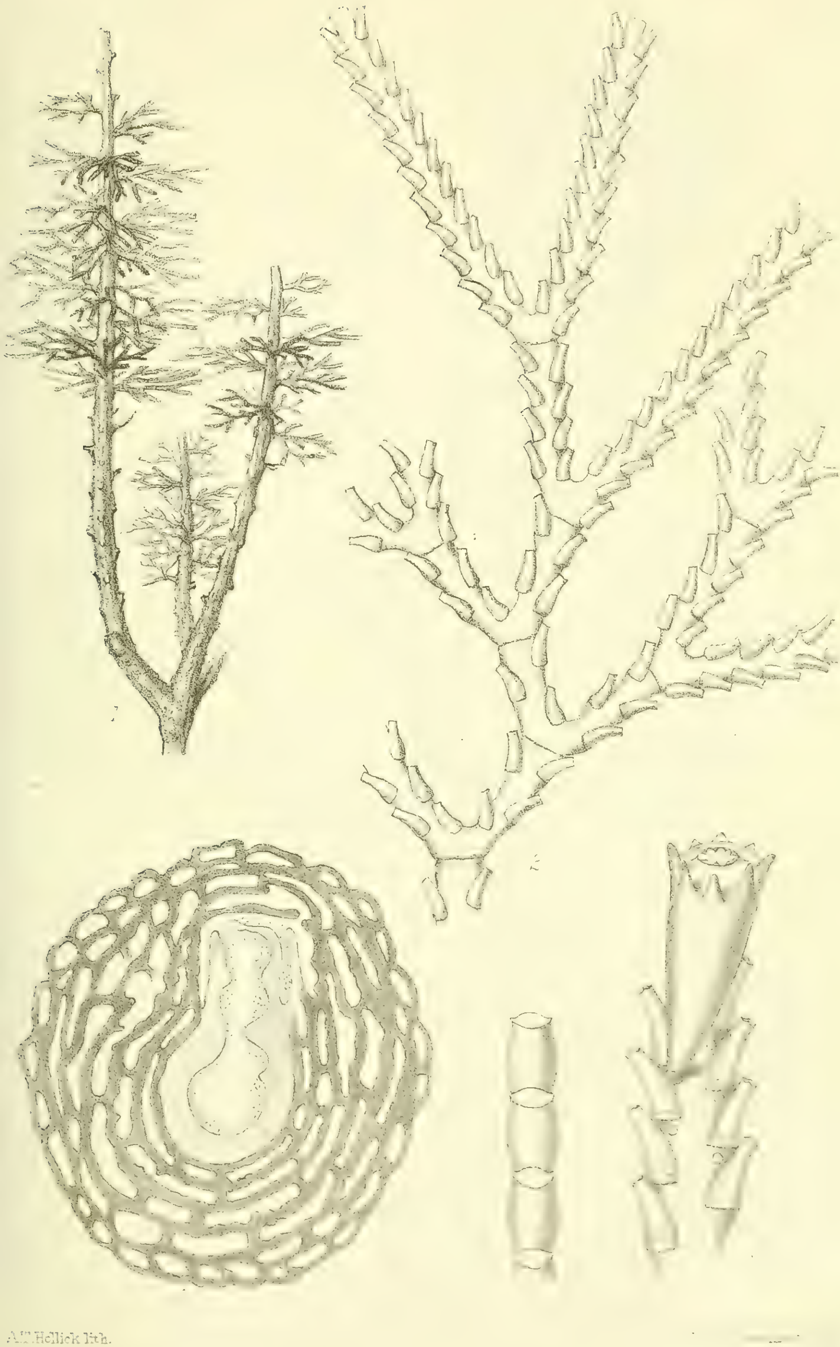

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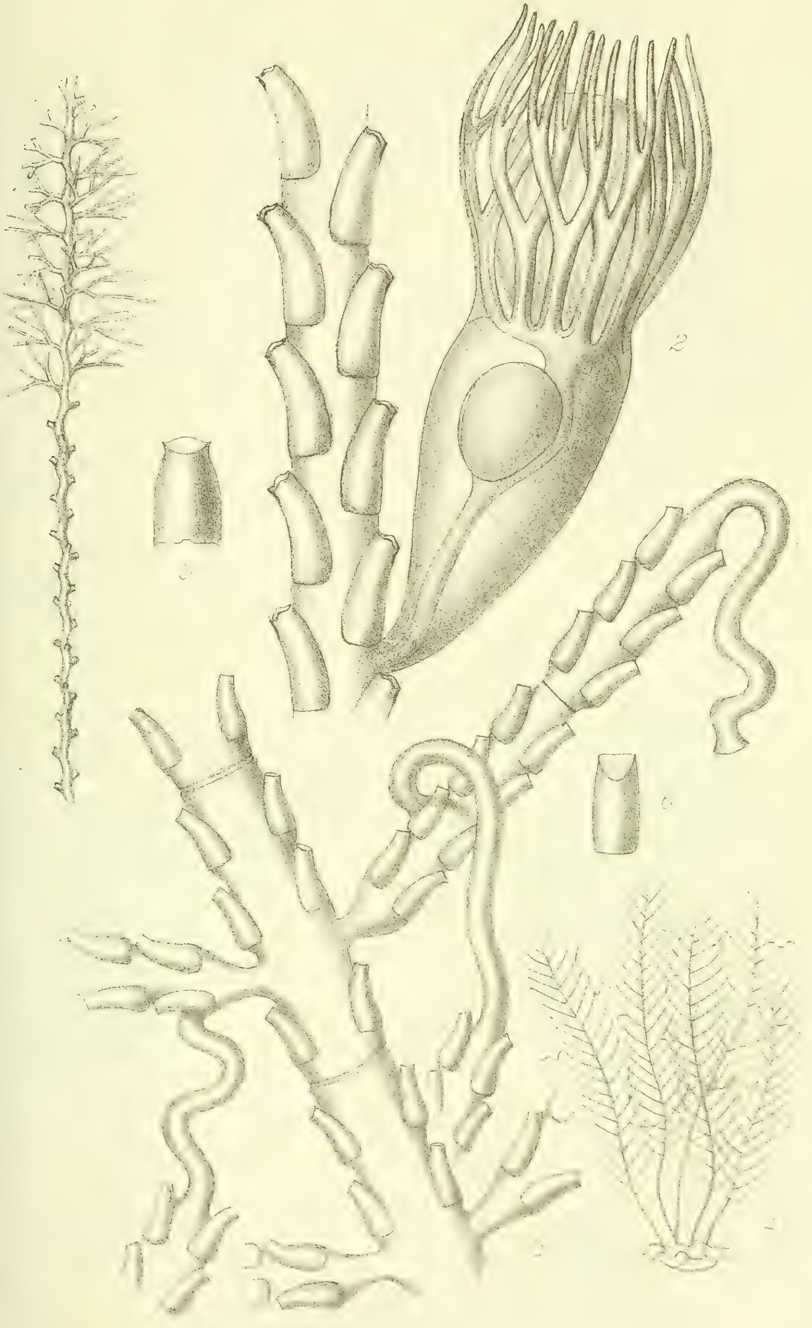

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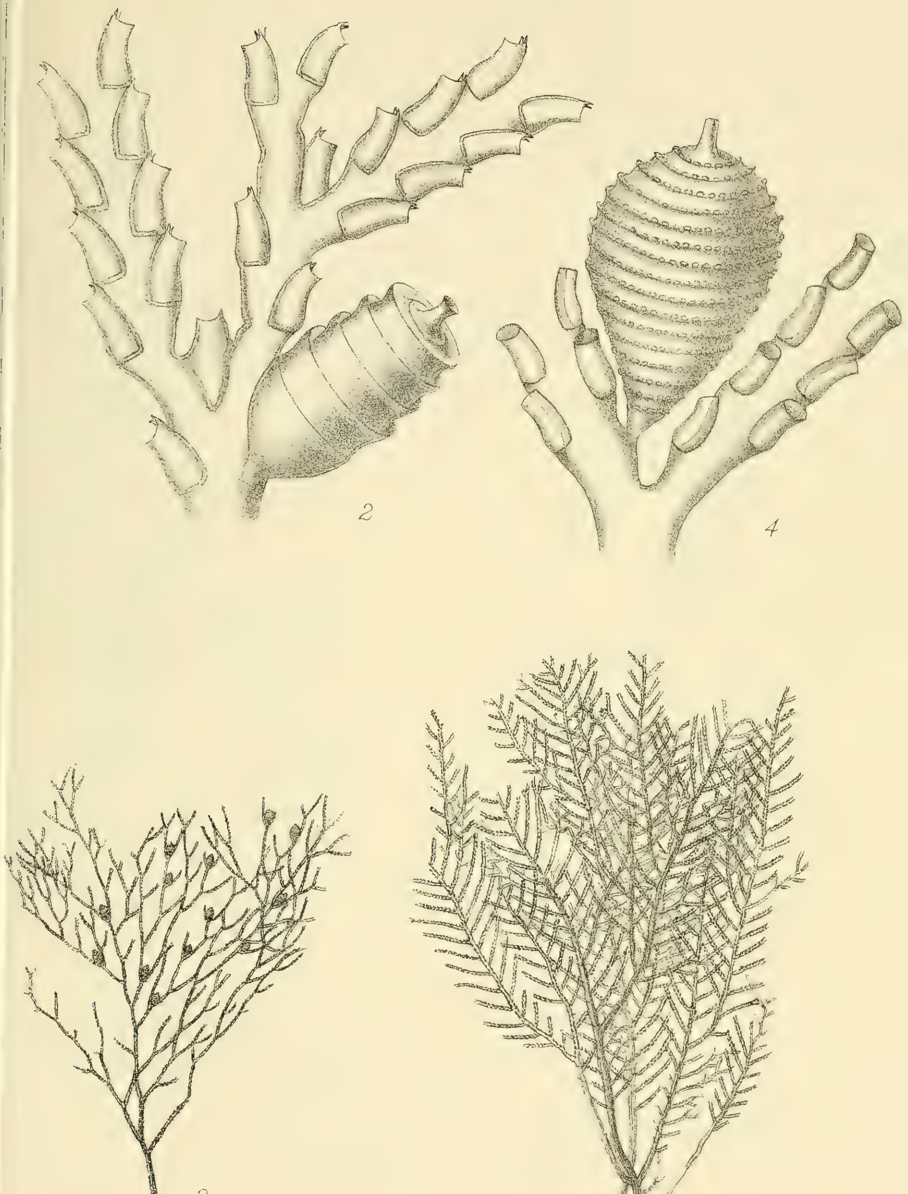

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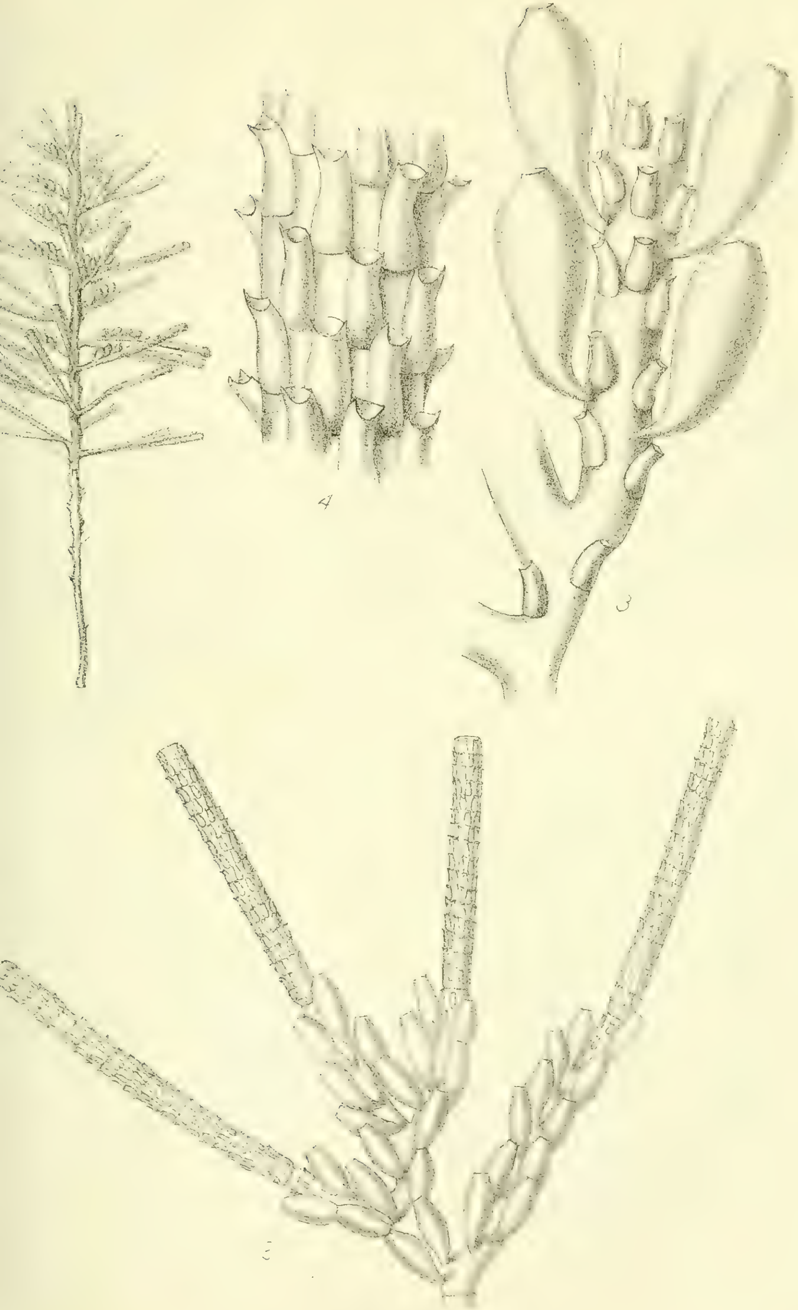

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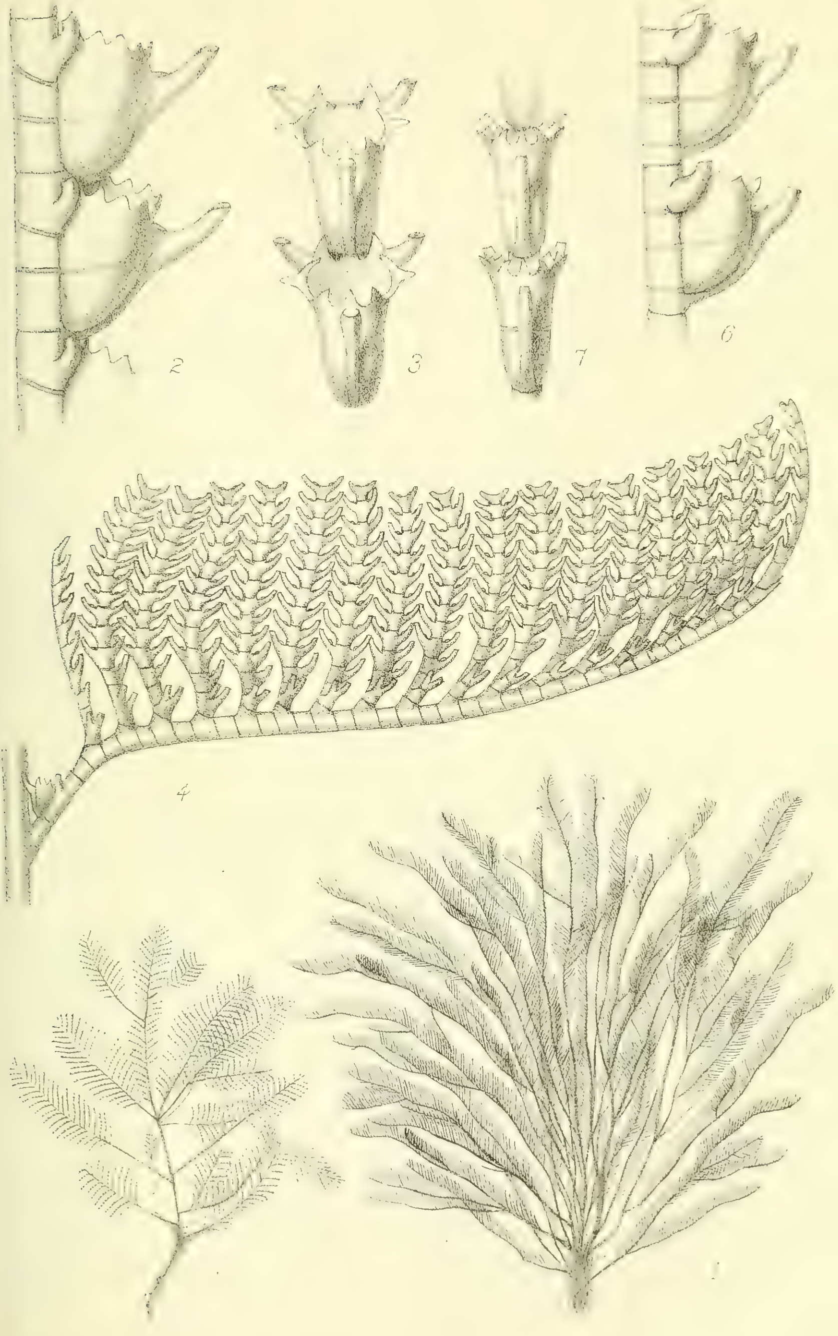

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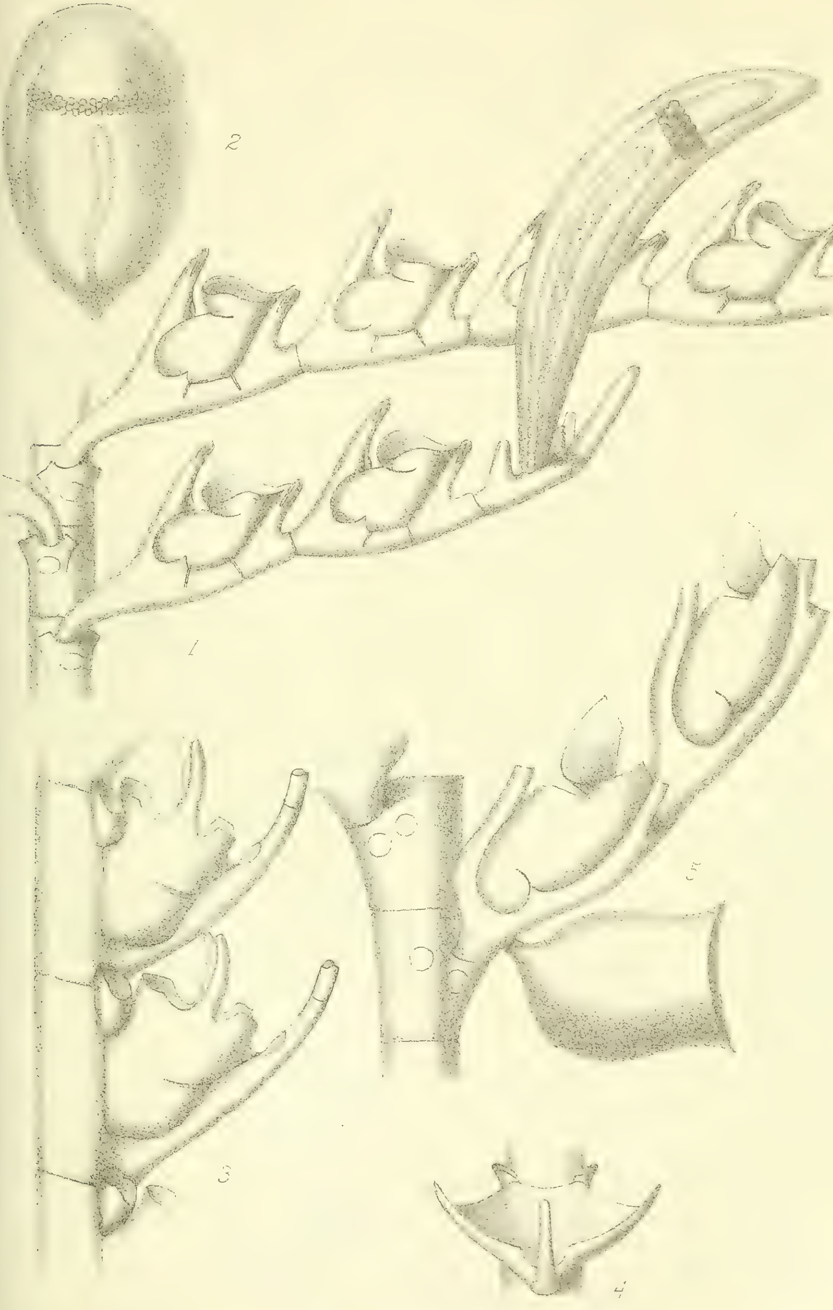

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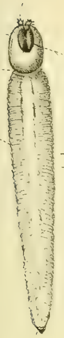
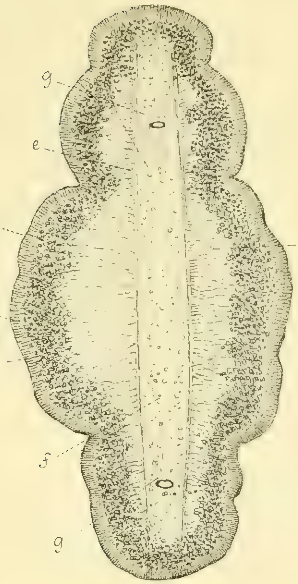


Fig. 2

Fig. 3



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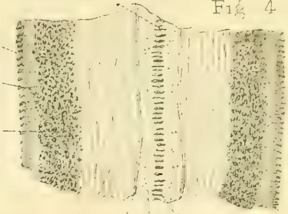

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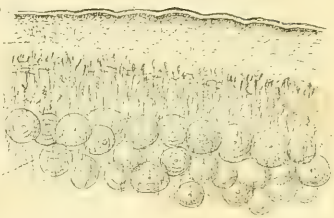

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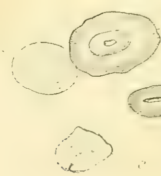
Fig. 7.



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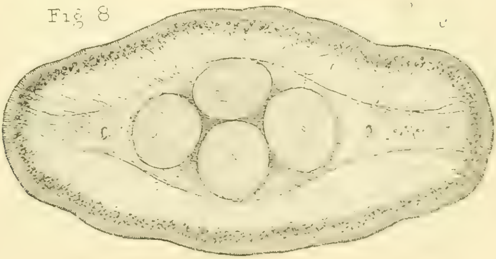

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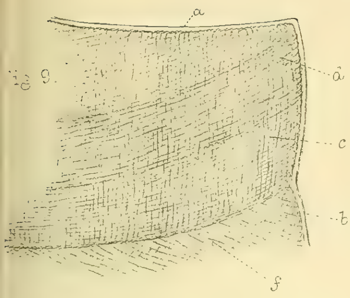

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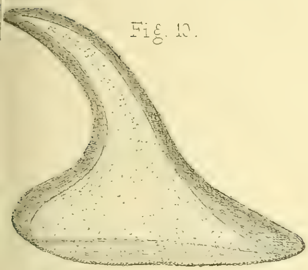

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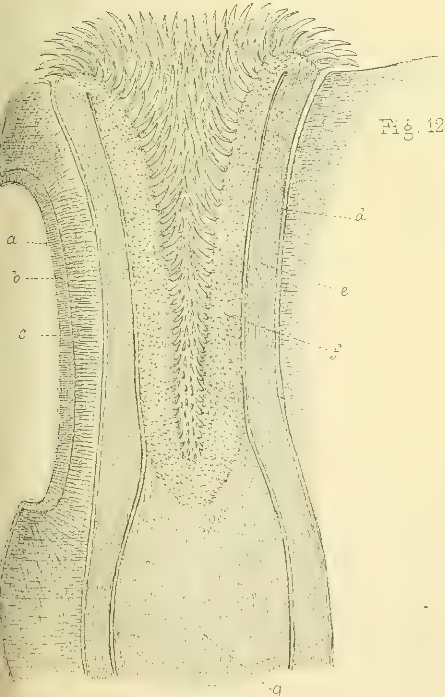
Fig. 12.



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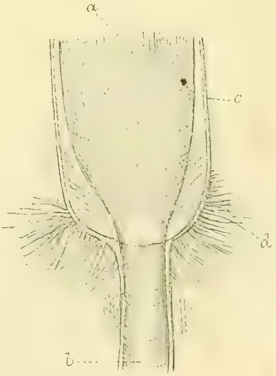

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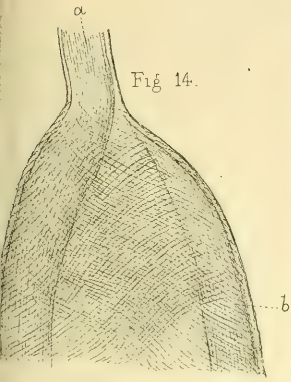

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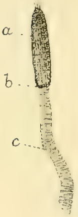

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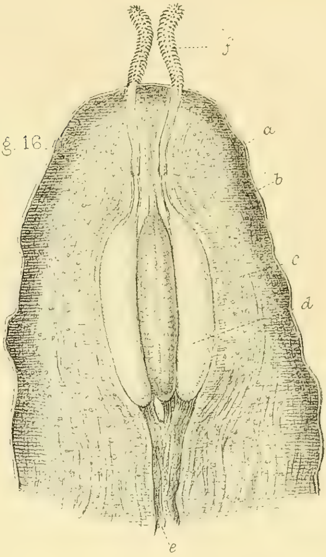

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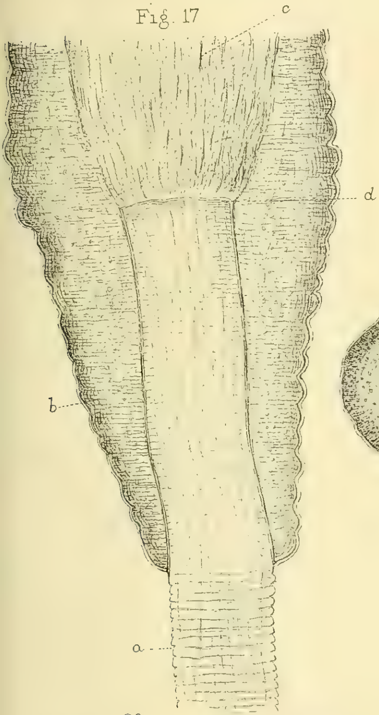

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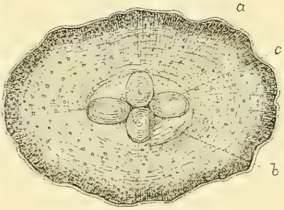

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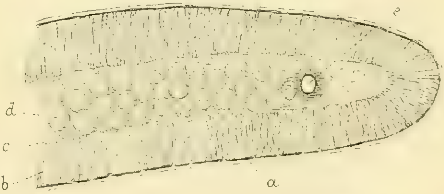

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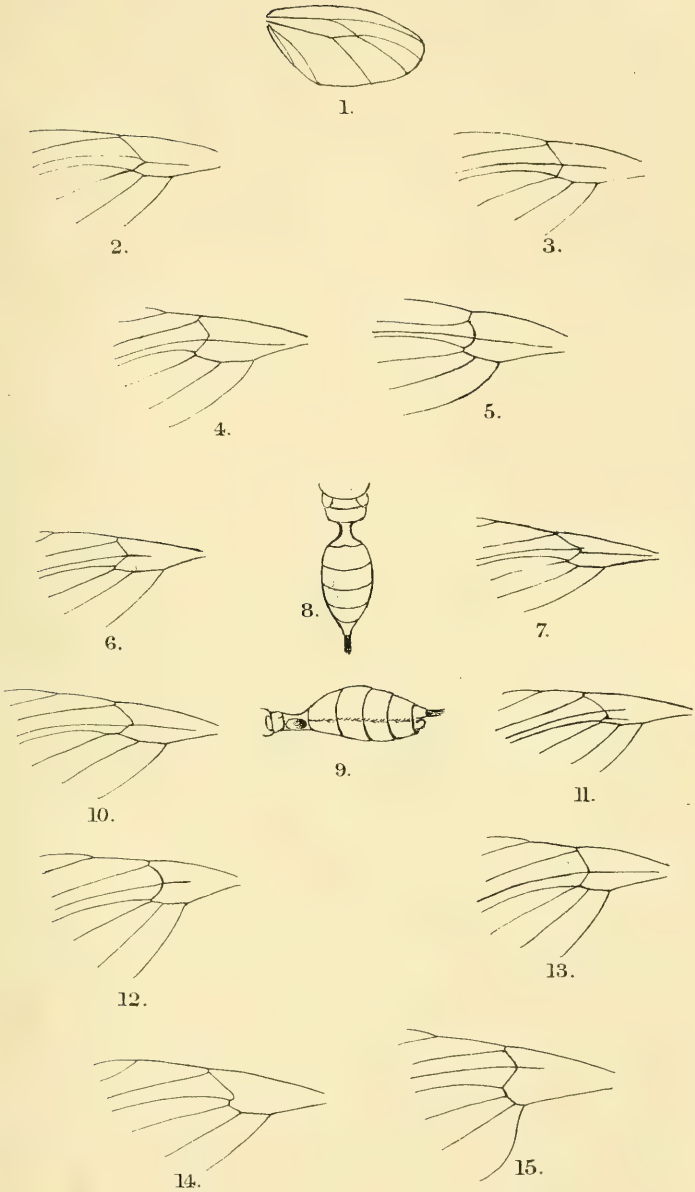

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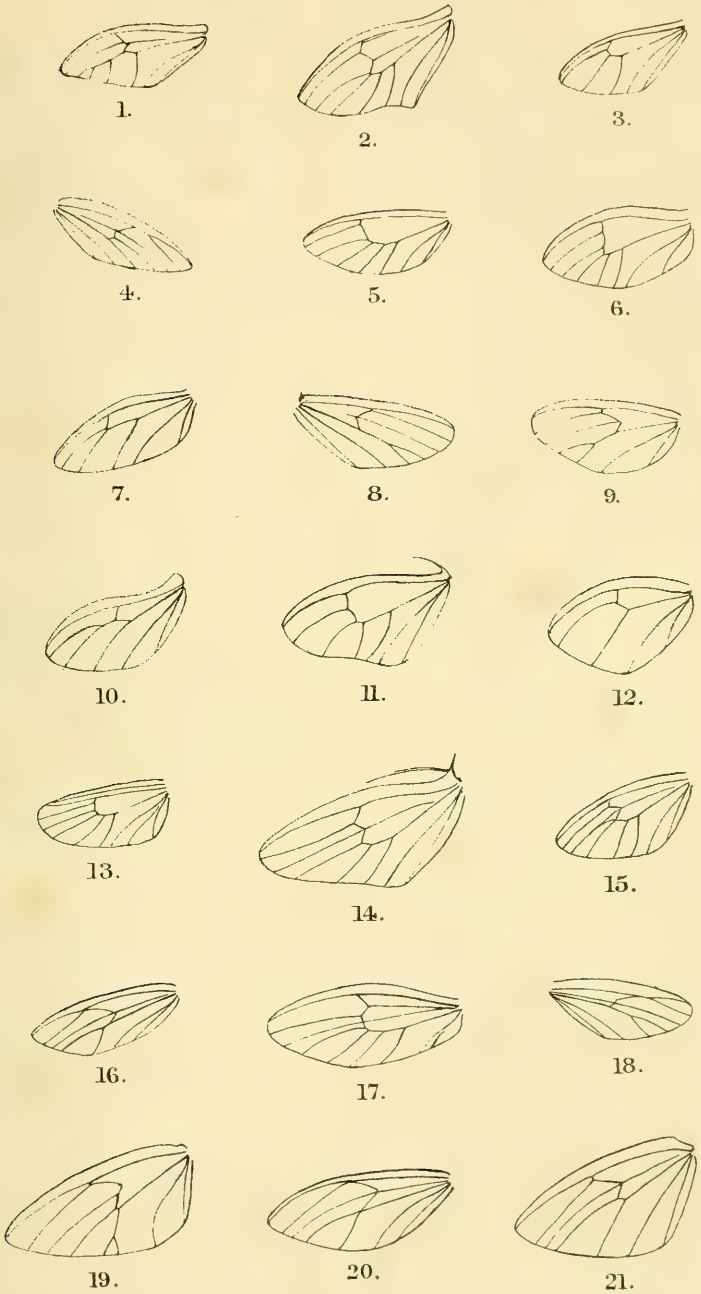

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VOL. XII. ZOOLOGY No 63.

CONTENTS.

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PLATE XXVII. (*continued*).

Fig. 5. Venation of primaries of *Pœcilosoma*.
6. Ditto of *Homœocera*.
7. Ditto of *Erruca*.
8. Metathorax and abdomen of *Myrmecopsis*.
9. Ditto, profile view.
10. Venation of primaries of *Andrenimorpha*.
11. Ditto of *Sarosa*.
12. Ditto of *Leucotmemis*.
13. Ditto of *Gymnelia*.
14. Ditto of *Loxophlebia*.
15. Ditto of *Mochloptera*.

PLATE XXVIII.

Fig. 1. Venation of secondaries of *Procotes*.
2. Ditto of *Notioptera*.
3. Ditto of *Trianeura*.
4. Ditto of *Pseudosphenoptera*.
5. Ditto of *Harrisina*.
6. Ditto of *Thyrassia*.
7. Ditto of *Psichotoë*.
8. Ditto of *Dixophlebia*.
9. Ditto of *Ichoria*.
10. Ditto of *Epitoxis*.
11. Ditto of *Thyretes*.
12. Ditto of *Eutomis*.
13. Ditto of *Pampa*.
14. Ditto of *Artona*.
15. Ditto of *Phacusa*.
16. Ditto of *Syntomeida*.
17. Ditto of *Saliunca*.
18. Ditto of *Amycles*.
19. Ditto of *Empyreuma*.
20. Ditto of *Euchromia*.
21. Ditto of *Histiæa*.

The group of genera constituting Walker's Family *Dioptidæ* contains the types of species referable to the *Euchromiinæ*, the *Charideinæ*, the *Pericopiinæ*, the *Nyctemeridæ*, and the *Pseudo-Deltoids!* I shall consider them in a special paper.

On the Subfamilies Antichlorinæ and Charideinæ of the Lepidopterous Families Zygænidæ and Arctiidæ. By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Read June 17, 1875.]

(Plate XXIX.)

In a former communication to the Society I considered the arrangement and structure of the subfamilies of typical Zygænidæ; I shall now proceed to investigate the aberrant subfamily Antichlorinæ and the Arctiidæ of the group Charideinæ, hitherto referred by entomological authors to the Zygænidæ. Both of these subfamilies are characterized by having the usual number of branches to the median nervure of secondaries; but the Charideinæ are of a more robust, and consequently less typically Zygænoid form; the arrangement and branching of the wing-veins are altogether more like the Arctiidæ; and, as a rule, the wings are more densely clothed with scales. The larvæ, so far as we know them, are also very hairy, and ornamented with long diverging tufts. Owing to loss of last page of MS., the Antichlorinæ are referred erroneously to the Arctiidæ.

Family ZYGÆNIDÆ. (Aberrant group.)

Subfamily Antichlorinæ, *Butler*.

Genus Mallostethus, n. gen.

Palpi rather long; thorax broad, and fluffy in appearance; abdomen gradually narrowing backwards to the anus, which has a terminal tuft of short hairs: wings semiopaque; lower radial of primaries branching from the third median branch; subcostals of secondaries forming a simple fork from upper extremity of discoidal cell; median branches three in number, the first emitted before the end of cell, the second and third forming a fork from the lower extremity of the cell. the false radial and its recurrent nervure running from the base of the median nervure through the cell, along the edge of the third median branch to outer margin. Type *M. metamelas*, Walker.

1. Mallostethus metamelas=Glaucopis (Pseudomya) metamelas, *Walker, Lep. Het.* i. p. 145. n. 8.

Pará (*Grahame & Bates*). Type, B.M.

Genus Pseudaclytia, n. gen.

Allied to the preceding genus, but the thorax less robust; the primaries opaque; the subcostal branches of secondaries forking from a footstalk; the third median branch of secondaries with a fork-branch running into the false radial, and doubtless representing the true radial nervure; a false nervure running from the margin, exterior to and parallel to the submedian nervure, but not reaching the base of the wing.

Type *P. opponens*, Walker.

1. Pseudaclytia opponens=Pampa opponens, *Walker, Lep. Het. Suppl.* i. p. 100.
Ega (*Bates*). Type, B.M.

This species has somewhat the aspect of the genus *Aclytia.*

Genus Napata, *Walker.*

1. Napata terminalis=Euchromia (Napata) terminalis, *Walker, Lep. Het.* i. p. 231.
Pernambuco (*J. P. G. Smith*), Brazil (*Stevens*). Type, B.M.

? 2. N. leucotelus, *Walker, MS.*=Euchromia (Napata) terminalis, var., *Walker, Lep. Het.* i. p. 232.
Honduras and Venezuela (*Dyson*). Type, B.M.

This form has the transparent area of the primaries much more distinct than in the typical *N. terminalis*, as also the dorsal white line on the abdomen.

Genus Chloropsinus, n. gen. Pl. XXIX. fig. 1.

In all respects (excepting neuration) closely resembling *Pseudosphenoptera*; but the secondaries with the subcostals branching from a very short footstalk; the discocellulars forming a sharp angle, through which the false nervure runs from base of median nervure to outer margin; the median nervure with three branches, the first emitted before the end of cell, the second and third forking from the end of cell.

Type *Chloropsinus lanceolatus*, n. sp.

1. Chloropsinus lanceolatus, n. sp.
Exactly like *Pseudosphenoptera basalis* in pattern and colouring, but of a narrower and more slender build: primaries above steel-blue, with the base and outer margin brown; two basal hyaline white spots separated by the median nervure; secondaries dark brown, base hya-

line; body brown, face spotted with white; back of head, pterygodes, and back of thorax spotted with metallic green; abdomen with two basal white spots, two or three dorsal green spots on the hinder segments and a green lateral interrupted streak along each side; antennæ black-brown, white at base; wings below dark brown, with diffused metallic green streaks along the costal and median nervures; body brown below, sides of palpi, front coxæ, and a row of spots along each side of venter metallic green: basal segment of abdomen and hind coxæ white; tarsi ochreous: expanse of wings 43 millims.

St. Paulo (*Bates*). Type, B.M.

This species may eventually turn out to be the male of *Pseudosphenoptera*; if so, that genus (which I have considered as an aberrant group of the Euchromiinæ) will have to be referred to the present subfamily, in which it will still form an aberrant genus on account of the absence of the third median branch in secondaries.

Genus Illipula, *Walker*. Pl. XXIX. fig. 2.

1. Illipula alecton = Sphinx alecton, *Cramer, Pap. Exot.* iv. pl. 382. f. D.

Sesia melanochlorus, *Sepp, Surin.* p. 145, pl. 69.

Brazil (*Mornay*). B.M.

The larva of this species is figured by Sepp; it is white, and clothed with long, slender, white hairs, but has no tufts of bristles at either extremity. Sepp remarks respecting it:—

"Nous trouvions cette Chenille velue couverte de poils longs et blancs, dont nous donnons la figure sur la feuille inférieure, au mois de Février sur la feuille d'un végétal, qu'on nomme *Tayer indien* au Surinam, et nous la découvrîmes six mois après sur les feuilles des *Jurea-bessies*, mais nous ignorons la dénomination Latine de ces deux végétaux."

2. I. dolosa = Euchromia (Pampa) dolosa, *Walker, Lep. Het.* i. p. 238.

Pernambuco (*J. P. G. Smith.*) Type, B.M.

It is a curious fact that although the two species above quoted are placed consecutively in Mr. Walker's Catalogue, he failed to see that they were congeneric.

Genus Ixylasia, n. gen. Pl. XXIX. fig. 8.

Chiefly differs from *Illipula* in its much greater size, more robust body and antennæ, a brush of hairs on each side of the basal segment of the abdomen; and the third median branch of secondaries being emitted from the middle of the second.

Type *I. trogonoides*, Walker.

1. Ixylasia trogonoides = Aclytia trogonoides, *Walker, Lep. Het. Suppl.* i. p. 101.
Brazil (*Gardner*). Type, B.M.

Genus Procalypta, n. gen.

Primaries very elongate, with hyaline spots, costal margin undulated; the second and third median branches and the lower radial emitted close together at end of cell, and far distant from the first median branch; secondaries subtriangular, apical half of costal margin excavated; subcostal vein with two branches, forking off from anterior extremity of discoidal cell; discocellulars strongly angulated, separated by the false nervure, which runs through the cell to near the base of the median nervure; median nervure with three branches, the first emitted before the end of cell, the second and third emitted together at lower extremity of cell. Type *P. subcyanea*, Walker.

1. Procalypta subcyanea = Euchromia (Endera) subcyanea, *Walker, Lep. Het.* i. p. 230. n. 48.
Mexico (*Hartweg*). Type, B.M.

Genus Pterygopterus, n. gen. Pl. XXIX. fig. 10.

Allied to the preceding genus, and to *Antichloris*; wings opaque; secondaries with the anal angle distinctly caudate, and both inner and outer margins slightly excavated, the veins nearly as in the preceding genus, but the front of the cell projecting forward, so shortening the subcostal branches and lengthening the upper discocellular; the false radial also forking from the centre to the apex of second subcostal branch (this may, however, be a natural wing-fold). Type *P. clavipennis*, n. sp.

1. Pterygopterus clavipennis, n. sp.

Body dark brown; frons, the palpi in some lights, crest, a few scales at back of head and at anterior margin of prothorax, a spot on the shoulders, a longitudinal litura on metathorax, the lateral drum-like expansions and an interrupted line along each side of the abdomen metallic green; antennæ black, tipped with orange; primaries with the costal half dark sericeous olive-green, purplish at its borders, with the veins at base, and the median vein between its branches bright bronzy metallic green; inferior and external area chocolate-brown; secondaries with the costal half bright metallic green; anal half brown, with the veins, outer margin, and tail blue-green; wings dark shining blue-green; the apex of primaries (excepting the nervures) broadly dark brown: body black; coxæ of first four legs bright metallic green, hind pair shining yellowish cream-colour, remainder of legs in certain lights dark blue-green; venter in some lights dark green: expanse of wings 47 millims.

Espiritu Santo (*Higgins*). Type, B.M.

This remarkable species forms a natural transition from the *Illipula* to the *Antichloris* group of genera; it is, however, easily distinguished from all Zygænidæ by the peculiar shape of the secondaries.

In the succeeding genera the first branch of the subcostal nervure springs freely from the discoidal cell.

Genus Ceramidia, n. gen. Pl. XXIX. fig. 3.

Wings opaque; secondaries with subcostal branches emitted independently of each other; the discocellulars oblique, angulated; the median branches emitted near together close to the lower extremity of the cell; recurrent false nervure not reaching to the base of the cell: body rather slender; abdomen cylindrical, smooth, with a short terminal tuft of hair in the males. Type *C. fumipennis*, Walker.

1. Ceramidia fumipennis = Euchromia (Pampa) fumipennis, *Walker, Lep. Het.* i. p. 241. n. 66.

Ega (*Bates*). Type, B.M.

2. C. cataleuca, n. sp.

Like *C. fumipennis* above; basal area of primaries below paler; secondaries below with a broad central creamy-white band from costa to abdominal margin: expanse of wings 35 millims.

E. Peru (*Degand*). Type, B.M.

Genus Passineura, n. gen. Pl. XXIX. fig. 4.

Nearly allied to the preceding genus, but the cell of secondaries projecting prominently forwards at its anterior extremity, thus shortening the subcostal branches and increasing the angle of the discocellulars; antennæ rather thicker.

Type *P. fusiformis*, Walker.

1. PASSINEURA FUSIFORMIS = Pampa fusiformis, *Walker, Lep. Het.* vii. p. 1629.
Tapajos (*Bates*). B.M.

Genus ANTICHLORIS, *Hübner*. Pl. XXIX. fig. 5.

1. ANTICHLORIS ERIPHIA = Zygæna eriphia, *Fabricius, Sp. Ins.* ii. p. 163. n. 31.
Parâ (*Bates*). B.M.

Antichloris phemonoë, Hübner, Zutr. figs. 15, 16, is synonymous with the above; but *A. caca* is distinct.

2. A. SCUDDERII, n. sp.
Closely allied to *A. eriphia*, but the wings and antennæ purplish chocolate-brown instead of dark shining green; the collar with larger lateral crimson spots; the abdomen duller in colour; the secondaries are also more acuminate at apex: below the differences are similar, excepting that the costal area of secondaries is dark shining green: expanse of wing 40 millims.
Santarem (*Bates*). Type, B.M.

I have named this species after Mr. Samuel Scudder, the well-known American entomologist.

3. A. CACA, *Hübner, Samml. exot. Schmett. Zutr.* figs. 133, 134.
Brazil (*Bates*). Type, B.M.

This is larger and darker than *A. eriphia*; the secondaries are less constricted at apex; and the costal area is sordid whitish instead of silvery white; the abdomen is also bronzy, with the lateral and dorsal streaks scarcely perceptible; the wings, however, are similar on the under surface.

4. A. ANTHRACINA = Euchromia (Amycles) anthracina, *Walker, Lep. Het.* i. p. 253.
Venezuela (*Walker*). Type, B.M.

Walker confounded this species with examples of another genus, being doubtless misled by a certain amount of similarity in coloration.

5. A. QUADRICOLOR = Charidea quadricolor, *Walker, Lep. Het. Suppl.* p. 1867.
Brazil (*Walker*). Type, B.M.

Here, again, Mr. Walker was misled by the colouring of the insect, the secondaries having a crimson streak from apex to middle of disk, and a crimson outer margin.

Genus Eriphia, *Felder*. Pl. XXIX. fig. 6.

1. Eriphia ustulata, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 17.
Pacho, New Granada (*Janson*); Bogota (*Stevens*). B.M.

2. E. tractipennis, n. sp.
Allied to the preceding; wings darker, narrower, and more elongated; back of head crimson; pterygodes without metallic bronzy streaks; metallic spots on abdomen of a greener tint; a large metallic-green (instead of pale tawny) patch covering the end of cell and the area immediately beyond it; basicostal metallic-green patch on secondaries larger; coxæ of front pair of legs scarlet, the remaining coxæ and a central spot on third segment of venter silvery white: expanse of wings 40 millims.
Chontales, Nicaragua (*Janson*). Type, B.M.

A well-marked and very handsome species.

Family ARCTIIDÆ.

Subfamily Charideinæ.

Genus Aclytia, *Hübner*. Pl. XXIX. fig. 7.

1. Aclytia simulatrix = Pelochyta simulatrix, *Walker, Lep. Het. Suppl.* i. p. 106,
Bogota.

Evidently allied to *A. halys*.

2. A. halys = Sphinx halys, *Cramer, Pap. Exot.* iv. pl. 357. fig. C.
Santarem (*Bates*). B.M.

3. A. flavigutta = Euchromia (Aclytia) flavigutta, *Walker, Lep. Het.* i. p. 246.
Brazil (*Stevens*). Type, B.M.

This species is perfectly distinct from *A. halys* in the pattern of the primaries, and from *A. heber* in the restricted hyaline area of the secondaries.

4. A. heber = Sphinx heber, *Cramer, Pap. Exot.* iii. pl. 287. f. A.
Santarem (*Bates*). B.M.

5. A. punctata, n. sp.
Euchromia (Aclytia) heber, *Walker* (*nec Cramer*), *Lep. Het.* i. p. 244. n. 75.
This species differs from the preceding in its greater size, broader wings, the paler colour of the thorax and primaries; the darker metallic-

green bands on the abdomen; the yellow spot on the primaries reduced to a point and placed about halfway between the base and apex; the narrower black apical border of secondaries; and on the underside in the paler apical half of primaries, the greyish tint of the internal area, and the elongate triangular form of the yellow spot: expanse of wings 32 millims.

Honduras (*Dyson*). Type, B.M.

Genus Charidea, *Dalman* (*Herrich-Schäffer*). Pl. XXIX. fig. 11.

1. Charidea submacula = Euchromia (Automolis) submacula, *Walker, Lep. Het.* i. p. 214. n. 13.

Venezuela (*Dyson*). Type, B.M.

I believe this to be a mimic of the genus *Histiæa*; the two constantly come together in collections.

2. C. arrogans = Euchromia (Automolis) arrogans, *Walker, Lep. Het.* i. p. 214. n. 14.

Venezuela (*Becker*), Veragua (*Salvin*). Type, B.M.

3. C. splendida, *Herrich-Schäffer, Auss. Schmett.* fig. 232.

Venezuela.

4. C. Alonzo, n. sp.

Closely allied to *C. fulgida*, but with a pale quadrifid crimson streak crossing the disk obliquely from subcostal nervure to second median branch; the scarlet border of secondaries terminating more abruptly towards apex; primaries below with the metallic-green streak restricted to the base of the wing; the discoidal scarlet spot larger, but paler; the postmedian band of upper surface broad and well defined: expanse of wings 42 millims.

Venezuela (*Dyson*). Type, B.M.

This is the supposed variety of *C. fastuosa* indicated in Walker's list.

5. C. Imogena, n. sp.

Allied to *C. fulgida*, but with a trifid rosy streak crossing the disk very obliquely from base of upper radial to just below second median branch; the scarlet border of secondaries much wider, and terminating abruptly towards apex; all the metallic-green colouring more golden in hue; the basal area of secondaries more decidedly blue: primaries below with the metallic areas golden green; the scarlet discoidal spot replaced by a larger rose-coloured spot; no green spot beyond the cell, but a broad oblique rosy band as in *C. Alonzo*;

border of secondaries as above, but rosy: expanse of wings 45 millims.

Peru. Type, B.M.

Nearly allied to the preceding species.

6. C. FULGIDA, *Herrich-Schäffer, Auss. Schmett.* i. 235.
Euchromia (Automolis) fastuosa, *Walker, Lep. Het.* i. p. 215. n. 13.
Jamaica (*Children*), Brazil (*Mornay*). B.M.

7. C. CINCTIPENNIS, *Walker, Lep. Het. Suppl.* i. p. 97.
Bogota (*Stevens*). Type, B.M.

8. C. SCINTILLANS=Euchromia scintillans, *Butler, Lep. Exot.* pl. lxi. fig. 16.
Cartago, Costa Rica (*Van Patten*). Type, B.M.

9. C. FULGENS, *Herrich-Schäffer, Auss. Schmett.* i. fig. 234.
Bogota (*Stevens*). Three specimens, B.M.

10. C. MICANS, *Herrich-Schäffer, Auss. Schmett.* i. fig. 233.
Bogota (*Stevens*). Four specimens, B.M.

Two of our examples have the spots on primaries very pale, and, towards the base, suffused with yellowish.

11. C. HURAMA, n. sp.
Body above purplish black; head and thorax spotted and streaked, and the abdomen broadly banded with metallic blue-green: primaries blackish brown, base metallic green; a large oval interno-median spot, bounded above by the median nervure, an elongated subcuneiform patch, placed obliquely to the above-mentioned spot and almost filling the discoidal cell, and a broad, oblique, trifid fasciole, cut by the third median and lower radial veins, all pale rose-colour; secondaries shining purple, with the costa brown; fringe rosy whitish; body below nearly as above; primaries with the interno-median and discoidal patches enlarged and fused, deep rose-colour; postmedian fasciole widened and deeper in colour; interno-basal area of wings shot with steel-blue; secondaries purple, metallic green at the base, with a broad costal and external blackish border; fringe rosy whitish: expanse of wings 44 millims.
Ecuador (*Buckley*). Type, B.M.

A very beautiful and distinct species.

12. C. BELLA=Glaucopis bella, *Guérin, Icon. Regn. Anim.* p. 502.
Charidea hæmatodes, *Boisduval, Lép. Guat.* p. 82.
Orizaba, Mexico (*Botteri*). B.M.

13. C. BIVULNERA, *Grote.*
Orizaba, Mexico (*Botteri*). B.M.
Is not this lovely little insect the male of *C. bella*?

14. C. GLORIOSA = Euchromia (Automolis) gloriosa, *Walker, Lep. Het.* i. p. 215.
Guatemala (*Sallé*). Type, B.M.
Nearly allied to *C. bivulnera*.

15. C. JUCUNDA = Euchromia (Automolis) jucunda, *Walker, Lep. Het.* p. 16.
Charidea fastuosa, *Ménétriés, Cat.* ii. t. xiv. fig. 8.
Brazil (*Becker*), Rio (*J. P. G. Smith*), Espiritu Santo (*Stevens*). Type, B.M.

I have little doubt that *Cyanopepla* and *Entomis* of Felder are identical with *Charidea*. *Cyanopepla eucyane*, which is in Mr. Druce's collection, does not differ in structure.

Genus HELIURA, n. gen. Pl. XXIX. figs. 13, 17.

Allied to *Charidea*; males generally with a broad caudate termination to the anal angle of posterior wing, emitting from the back a radiating compressed brush of stiff hairs; the subcostal nervure with three branches, the first ill-defined in the female, emitted before the end of the cell, the second and third forming a fork from the anterior extremity; discocellulars forming a sickle-shaped line, the upper one being considerably longer than the lower and distinctly inarched; second and third median branches emitted together from a footstalk at posterior extremity of cell. Type *H. solicauda*, n. sp.

1. HELIURA APICALIS, *Herrich-Schäffer, Auss. Schmett*, i. f. 236.
Euchromia albiplaga, *Walker, Lep. Het.* i. p. 218.
Brazil (*Mornay*), Venezuela (*Dyson*). B.M.

This species (Pl. XXIX. fig. 9) is somewhat abnormal, the sexes being apparently alike and somewhat resembling *Charidea* in their eminently metallic coloration; it is, however, so nearly allied to *H. thetis* and *tenens* in other respects that I have not thought it worth while to place it in a separate genus. Mr. Walker erroneously referred it to his genus *Histiæa*.

2. H. CAPYS = Zygæna capys, *Fabricius, Sp. Ins.* ii. p. 166. n. 48.
Surinam.

3. H. LACTEINOTA, n. sp.
Euchromia (Dipænæ) capys, var.? *Walker, Lep. Het.* i. p. 262.
Tapajos and Ega (*Bates*). Type, B.M.

Readily distinguishable from *H. capys* by the transparent area in secondaries.

4. H. THETIS = Sphinx thetis, *Linnæus, Mant.* i. p. 539.
Zygæna thoas, *Fabricius, Sp. Ins.* ii. p. 166, n. 53.
♀. Venezuela (*Dyson*). B.M.

This is *E. thetis*, var. ? of Walker.

5. H. LENEUS = Sphinx leneus, *Cramer, Pap. Exot.* iii. pl. 248, f. G.
♂. Demerara (*Bowerbank*). B.M.

This is *E. thoas*, var. ? of Walker; it differs from the preceding species in the less brilliant metallic colouring of the abdomen, the smaller transparent area of secondaries, and the smaller white spot at apex of primaries.

6. H. TETRAGRAMMA = Euchromia (Eucereeon) tetragramma, *Walker, Lep. Het.* i. 268.
♂. Santarem (*Bates*). Type, B.M.

7. H. PYRRHOSOMA, n. sp.

Larger than the preceding species, the wings longer, the hyaline spots towards apex of primaries united, the secondaries with a narrower blackish border: back of head dull ochraceous, the pterygodes margined and the thorax longitudinally streaked with the same colour; coxæ, trochanters, and distal half of femora red, the remainder of the legs brown: expanse of wings 32 millims.

Pará (*Graham*). Type, B.M.

Easily distinguished from *H. tetragramma* by its superior size and the colouring of the legs, the tibiæ of that species being alternately spotted with reddish and black.

8. H. SOLICAUDA, n. sp.

Euchromia (Eucereon) tetragamma, var. β, and fem.? *Walker, Lep. Het.* i. p. 268.
♂, ♀. Honduras (*Dyson*). Types, B.M.

This is altogether a paler species (that is to say, with more white colouring in the wings) than the two preceding it.

Genus ACRIDOPSIS, n. gen. Pl. XXIX. fig. 14.

Allied to the preceding genus; wings alike in both sexes, the first subcostal branch of secondaries wanting, but the false radial and its recurrent continuation present; lower discocellular reduced almost to a point; lower radial curved; costal margin slightly excavated. Type *A. latifascia*, Walker.

1. Acridopsis latifascia=Eucerea latifascia, *Walker, Lep. Het.* vii. p. 1639.
Pará (*Bates*). B.M.

Excepting in the coloration of the body, this species is much like *Heliura solicauda.*

2. A. marica=Sphinx marica, *Cramer, Pap. Exot.* i. pl. 20. f. F, G.
Pará (*Graham*). Two examples, B.M.

Confounded by Walker with the next species.

3. A. grylloides=Euchromia (Eucereon) grylloides, *Walker, Lep. Het.* i. p. 271.
Pará (*Graham*). Type, B.M.

4. A. thalassica=Eucerea thalassica, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 18.
—— ?

Genus Telioneura, *Felder*. Pl. XXIX. fig. 12.

1. Telioneura subplena=Euchromia (Eucereon) subplena, *Walker, Lep. Het.* i. p. 266.
Rio Janeiro (*Stevens*). Type, B.M.

This appears to be referable to Felder's genus, although different in colour.

2. T. glaucopis, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 31.
—— ?

3. T.? coras=Sphinx coras, *Cramer, Pap. Exot.* iv. pl. 312. f. A.
Surinam.

The *Acharia brunnus* of Hübner's 'Verzeichniss' will be the type of that genus, not because it is the first species (as Scudder seems to think that I imagine to be the rule), but owing to Walker's action at p. 274 of his 'Catalogue:' he moreover refers *A. coras* to *Automolis* with a ?

Genus Creatonotus, *Herrich-Schäffer* (restricted). Pl. XXIX. fig. 23.

1. Creatonotus incertus, *Herrich-Schäffer, Auss. Schmett.* i. fig. 503.
Automolis reducta, *Walker, Lep. Het.* vii. p. 1638.
Fifty miles W. of Rio Janeiro (*Sir W. Smith*). B.M.

This is one of the most remarkable species of the group.

Genus AUTOMOLIS, *Hübner.* Pl. XXIX. fig. 25.

Euplesia, *Felder*; Eucyrta (part), *Felder.*

1. AUTOMOLIS SPHINGIDEA = Glaucopis sphingidea, *Perty, Delect. Anim.* pl. 31. f. 12.
Pará (*Bates*). B.M.

Walker referred this species to his group Dipænæ.

2. A. VITTIGERA=*Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 9.
Ega (*Bates*). B.M.

Closely allied to the preceding species.

3. A. FULGURATA, n. sp.
Frons black, metallic green behind the palpi, crest with a transverse orange line; top of head black with a large, central, metallic-green spot, and an orange stripe on each side; collar black in the middle, orange on each side; pterygodes orange, a black spot on the shoulders; thorax black, clothed with brown hairs; abdomen jet-black, with lateral and dorsal metallic-green spots: wings purplish brown, primaries with the nervures pale brown; a broad central orange streak from base of inner margin to upper radial, the line of which it follows, and tapers to near outer margin; secondaries with the costal area almost to apex occupied by a sharply defined orange patch: body below black, pectus spotted with metallic green, trochanters of front pair of legs with a central orange dot; venter with lateral green dots, the three basal segments with a double parallel series of orange spots: expanse of wings 46 millims.
Espiritu Santo (*Higgins*). Type, B.M.

4. A. SYPILUS=Sphinx sypilus, *Cramer, Pap. Exot.* ii. pl. 99. f. A.
Surinam.

This may be regarded as type of *Automolis*, since it is congeneric with the species proposed as type by Walker, 'Lep. Het.' vii. p. 1634.

5. A. PACKARDII, n. sp.
Euchromia (Dipænæ) Sypilus, *Walker* (*nec Cramer*), *Lep. Het.* i. p. 260. n. 106.
This species has two orange streaks in primaries, the one running from near the base to near the outer margin, the other from near costa (at external third) to outer margin; the shorter streak, therefore, is nearly parallel to, but slightly divergent from, the long one: expanse of wings 38 millims.
Pará and Ega (*Bates*). Type, B.M.

Nearly allied to the preceding species.

6. A. FLAVICINCTUS = Creatonotus flavicinctus, *Herrich-Schäffer, Auss. Schmett.* i. fig. 433.
Automolis angulosa, *Walker, Lep. Het.* vii. p. 1634.
Bogota (*Stevens*). B.M.

7. A. PRÆTEXTA = Eucyrta prætexta, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 6.
—— ?

8. A. CONTRARIA = Euchromia (Dipænæ) contraria, *Walker, Lep. Het.* i. p. 259, n. 104.
Ega (*Bates*). Type, B.M.

9. A. GEOMETRICA = Eucyrta geometrica, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 6.
—— ?

Evidently allied to the preceding species.

10. AUTOMOLIS AMEOIDES, n. sp.
Head black, frons metallic blue-green; collar nearly yellow, with blue-black dorsal and lateral streaks; pterygodes yellow; thorax yellow with a central longitudinal metallic-blue streak; basal segments of abdomen yellow, anal segments black, all the segments with lateral, and the anal segments with dorsal metallic blue-green spots: wings mealy yellow; primaries with a dark-edged dove-coloured border from apex to external angle (whence it throws off a broad oblique band to centre of costa) and along the inner margin nearly to the base; secondaries with a broad (internally sinuated) external chocolate-brown border, tapering along abdominal margin to near the base: pectus black, spotted with metallic green; trochanters of front legs with a large yellow central spot; tibiæ and tarsi of all the legs with a lateral creamy whitish line; venter yellow transversely banded with metallic green; anus black-brown, spotted with green: wings nearly as above; borders and central band of primaries darker: expanse of wings 53 millims.
Ecuador (*Buckley*). Type, B.M.

The genus *Pionia* of Walker would perhaps be best placed here; it differs very little in structure from the following group; Walker, however, placed it between *Hydrusa* and *Phauda*.

Genus POMPOSTOLA, *Hübner*.

P. hyparchus of Cramer is type as determined by Walker.

1. POMPOSTOLA HYPARCHUS = Zygæna hyparchus, *Fabricius, Sp. Ins.* ii. p. 160.
Sierra Leone (*Morgan*), Ashanti. B.M.

2. P. SEMIAURATA = Euchromia (Pompostola) semiaurata, *Walker, Lep. Het.* i. p. 207. n. 3.
Sierra Leone (*Foxcroft*) and "——?" Type, B.M.

3. P. VICARIA = Euchromia (Pompostola) vicaria, *Walker, Lep. Het.* i. p. 207. n. 2.
Ashanti and Sierra Leone (*Foxcroft*).

I think it quite possible that the genus *Diospage* is not structurally distinct from this group; it contains the two species *D. rhebus* and *auratus* of Cramer; but we have representatives of neither in the British Museum.

Genus BELEMNIA, *Walker*. Pl. XXIX. fig. 24.

1. BELEMNIA ERYX, *Fabricius, Sp. Ins.* ii. p. 161. n. 22.
Brazil (*Miller*). B.M.

2. B. CRAMERI, *Butler, Ann. & Mag. Nat. Hist.* ser. 4. vol. xv. p. 339.
Sphinx inaurata, *Cramer* (*nec Sulzer*), *Pap. Exot.* iii. pl. 140. figs. E, F.
Santa Catharina (*Becker*), Pará and Tapajos (*Bates*), Honduras (*Miller*). Type, B.M.

The colouring of the body in Hübner's figures of "*Chrysaor eryx*" is more like the Fabrician species; otherwise I should have supposed them to represent *B. Crameri*.

3. B. INAURATA = Sphinx inaurata, *Sulzer, Hist. Ins.* pl. 20. fig. 4.
"America."

The male of this species has the hinder segments of the abdomen blue, as in *B. Crameri*; otherwise it is more like the succeeding species.

4. B. JOVIS, *Butler, Ann. & Mag. Nat. Hist.* ser. 4. vol. xv. p. 339.
Honduras (*Miller*), Veragua (*Salvin*). Type, B.M.

Genus APICONOMA, n. gen. Pl. XXIX. fig. 22.

Allied to *Automolis*, but the subcostals of secondaries branching from a footstalk. Type *A. opposita*, Walker.

1. APICONOMA APICALIS = Euchromia (Dipænæ) apicalis, *Walker, Lep. Het.* i. p. 261.
Pará (*Bates*). Type, B.M.

2. A. OPPOSITA = Euchromia (Dipænæ) opposita, *Walker, Lep. Het.* i. p. 260.
Automolis saturata, *Walker, Lep. Het.* vii. p. 1635.

Euplesia ochrophila, *Felder, Reise der Nov. Lep.* iv. pl. cii. f. 10.
Brazil (*Argent*). Type, B.M.

3. A.? VENTRALIS = Glaucopis ventralis, *Guérin, Ic. Règne Anim.* p. 503.
Mexico.

4. A. SEMIROSEA = Automolis semirosea, *Walker, Lep. Het. Suppl.* i. p. 103.
Ega (*Bates*). Type, B.M.

This species has somewhat the aspect of a *Noctua*.

Genus RHIPHA, *Walker*. Pl. XXIX. fig. 21.

Apyre *and* Arara, *Walker*; Eucyrta (part), *Felder*.

The species which I have here grouped together agree in venation, but are very dissimilar in coloration. I shall refer them to three sections under Walker's names.

Sect. 1. ARARA, *Walker*.

1. RHIPHA VITTIPES = Arara vittipes, *Walker, Lep. Het.* iii. p. 642.
Brazil (*Stevens*). Type, B.M.

General colouring of *Apiconoma semirosea*, but in pattern more like *Cratoplastis diluta* of Felder.

Sect. 2. APYRE, *Walker*.

2. R. SEPARATA = Apyre separata, *Walker, Lep. Het.* ii. p. 491.
Ega (*Bates*). Type, B.M.

Excepting that the primaries are veined with whitish and not barred with yellow, this species has somewhat the aspect of *Apiconoma opposita*.

Sect. 3. RHIPHA, *Walker*.

3. R. STRIGOSA = Euchromia (Rhipha) strigosa, *Walker, Lep. Het.* i. p. 273.
Eucyrta subulifera, *Felder, Reise der Nov. Lep.* iv. pl. cii. fig. 3.
Rio Janeiro (*Stevens*). Type, B.M.

The wings of this species are peculiar in marking; I know of nothing similarly coloured; the body, however, approaches *Eucereon* and *Galethalea*.

Genus EMPUSA, *Hübner*.

1. EMPUSA VITREA = Phalæna vitrea, *Cramer, Pap. Exot.* iii. pl. 276. fig. C.
Rio Janeiro (*Stevens*). B.M.

2. E. TYBRIS=Phalæna tybris, *Cramer, Pap. Exot.* iii. pl. 92. fig. D.
Surinam.

Eucyrta albicollis of Felder is probably a third species of this genus.

Genus GALETHALEA, n. gen.

General aspect of *Halesidota*, excepting in the abdomen, which is like that of *Eucereon*; venation of *Charidea*; but the more robust thorax and longer antennæ preclude the possibility of referring it to that group. Type *G. pica*, Walker.

1. GALETHALEA PICA=Halesidota pica, *Walker, Lep. Het.* iii. p. 743. n. 19.
Rio Janeiro (*Stevens*). Type, B.M.

2. G. TIGRATA=Charidea tigrata, *Herrich-Schäffer, Auss. Schmett.* i.
Brazil?

Unfortunately I have lost my reference to the figure of this species.

3. G. CONFINIS=Charidea confinis, *Herrich-Schäffer, Auss. Schmett.* i. pl. 51. fig. 277.
Brazil.

Walker made a decided mistake in attempting to correct Herrich-Schäffer's view respecting this species; for although unlike *Charidea* in colouring, the structure is almost identical.

Genus CERCOPIMORPHA, n. gen. Pl. XXIX. fig. 16.

Allied to *Galethalea* and to *Acridopsis*, differs from the latter as regards neuration as follows:—subcostal branches placed upon a footstalk; lower discocellular short, but well defined; radial nearly straight; false radial running clear of the true radial, its recurrent continuation extending to base of median nervure. Type *C. homopteridia*, n. sp.

1. CERCOPIMORPHA HOMOPTERIDIA, n. sp.
Euchromia (Anycles) pectinata, var.?, *Walker, Lep. Het.* i. p. 254.
Pará (*J. P. G. Smith & Bates*). Type, B.M.

An obscure-looking species, with the general aspect of an Homopterous insect. It has nothing to do with Gmelin's species.

Genus Anycles, *Walker*. Pl. XXIX. fig. 15.

Dipænæ *and* Pelochyta, *Walker* (*nec Hübner*).

1. Anycles contenta = Euchromia (Dipænæ) contenta, *Walker*, *Lep. Het.* i. p. 258.
Dipænæ lateralis, *Walker*, *Lep. Het.* vii. p. 1634.
Pará (*Bates*). Type, B.M.

2. A. rhodura, n. sp.
Euchromia (Dipænæ) acharon, var.?, *Walker*, *Lep. Het.* i. p. 258.
Pará (*Bates*). Four examples, B.M.

The *Z. acharon* of Fabricius is a *Procris* from Australia. This will be the type of the genus.

3. A. ferruginosa = Euchromia (Dipænæ) ferruginosa, *Walker*, *Lep. Het.* i. p. 259.
—— ? Type, B.M.

I much doubt if this species will ever be recognized; the type is in bad condition.

4. A. mœsta = Euchromia (Dipænæ) mœsta, *Walker*, *Lep. Het.* i. p. 259.
—— ? Type, B.M.

5. A. diffinis = Pelochyta diffinis, *Walker*, *Lep. Het. Suppl.* i. p. 105.
Pará (*Bates*). Type, B.M.

Mr. Walker places Hübner's first species of *Pelochyta* at the end of his group *Dipænæ*; it seems to me, however, to be a *Eucereon*; therefore Walker's genus *Amerila* must give place to *Pelochyta*, Hübner.

Genus Metanycles, n. gen. Pl. XXIX. fig. 19.

Allied to the preceding genus and to *Cercopimorpha*; in neuration it differs from the latter in the arrangement of the subcostal branches of secondaries, the first being emitted from the nervure some distance before the end of the cell, and the second at the anterior extremity; the upper discocellular is also subangulated. Type *M. contracta*, Walker.

1. Metanycles contracta = Aclytia contracta, *Walker*, *Lep. Het. Suppl.* i. p. 102.
Sierra Leone (*Foxcroft*). Type, B.M.

Genus Epanycles, n. gen. Pl. XXIX. fig. 18.

Allied to *Anycles*, which it resembles, but only differs from *Cerco-*

pimorpha in neuration as follows:—cell longer, radial more curved, second and third median branches not emitted from a footstalk, but (with the radial) from posterior extremity of cell.

Type *E. imperialis*, Walker.

1. Epanycles imperialis = Euchromia (Pampa) imperialis, *Walker*, *Lep. Het.* i. p. 241.

Tapajos, Santarem, and Ega (*Bates*). Type, B.M.

Genus Sciopsyche, n. gen. Pl. XXIX. fig. 20.

Wings long, narrow, subhyaline, neuration of secondaries only differing from *Epanycles* in the following respect—branches of the subcostal nervure emitted together from the anterior extremity of the cell, and not from a footstalk; the three medians and the radial are emitted from the cell exactly as in *Epanycles*; antennæ very strongly plumose, more especially in the males.

Type *S. tropica*, Walker.

1. Sciopsyche tropica = Euchromia (Calonotos) tropica, *Walker*, *Lep. Het.* i. p. 236.

Santa Martha (*Bouchard*), Ega and Santarem (*Bates*), Brazil (*Becker*), Honduras (*Dyson*). Type, B.M.

2. S. cinerea, n. sp.

Primaries semitransparent, black, with the nervures black, a dull metallic greenish spot at base; secondaries hyaline, with grey borders: head thorax, and antennæ black; frons, back of head, and front margin of prothorax minutely dotted with metallic green (only noticeable with a lens); abdomen dark grey, light grey at the sides, with one or two lateral minute green dots: primaries below paler than above, with a bright metallic-green streak along the subcostal nervure; secondaries with a green streak along basal half of costal area and abdominal margin: expanse of wings 38 millims.

Espiritu Santo (*Higgins*). Type, B.M.

We have two examples of this species; it is allied to Walker's *S. tropica*, but is altogether duller in colour and more transparent, the body having scarcely any metallic colouring upon it.

Genus Androcharta, *Felder*.

1. Androcharta meones = Sphinx meones, *Cramer*, *Pap. Exot.* iv. pl. 325. f. E.

Glaucopis comta, *Sepp*, *Surinam.* pl. 37.

Bogota (*Stevens*), Santa Martha (*Bouchard*). ♂ et ♀, B.M.

2. A. brasiliensis, n. sp.

♀. Allied to the preceding species, but duller, the metallic-green spots on the abdomen smaller; no cream-coloured spots on the shoulders primaries with a well-defined hyaline white spot just beyond the middle of the cell; the usual spot below the cell larger; the large discal spot rounded, bifid, only cut by the third median branch: expanse of wings 47 millims.

Brazil. Two examples, B.M.

This species was confounded with the preceding by Mr. Walker; but it is readily distinguished by the absence of the whitish shoulder-spots, as also by the other characters above mentioned.

3. A. diversipennis = Euchromia (Hippola) diversipennis, *Walker, Lep. Het.* i. p. 225. n. 34.

♂. Tapajos (*Bates*). Type, B.M.

This species and the following have no white shoulder-spots.

4. A. Stretchii, n. sp.

♂. Allied to the preceding species, but the male with much larger secondaries; no scarlet spots on metathorax and base of abdomen; the metallic spots much more bluish; primaries with only one very small scarlet stria at base below the median nervure, the discoidal cell metallic blue-green, with the usual hyaline white spot, also a green line below the scarlet submedian litura; an interno-median oblique hyaline white spot towards the base; large discal hyaline patch, almost equally broad at both extremities; secondaries white, base and costal area brownish: primaries below with a large interno-median white patch as in *A. meones* (in *A. diversipennis* it is brown), no scarlet costal streak: expanse of wings 49 millims.

♀. Chiefly differs from the male in the larger interno-median spot of primaries, the rounded hyaline discal spot, the normal female secondaries, and in the presence of crimson spots at base of abdomen in the centre: expanse of wings 46 millims.

♂, Tabatinga, Peru (*Degand*); St. Paulo, Amazons (*Bates*), Type, B.M.

This species and the following are probably found over the same or nearly the same region; they cannot, however, be easily confounded together, as the secondaries in *A. Stretchii* ♂ are large as in *A. meones*; but *A. parvipennis* is probably the Upper-Amazon type of *A. diversipennis*, and has the same small male secondaries.

5. A. parvipennis, n. sp.

♂. Only differs from *A. diversipennis* in the more oblique and trifid discal hyaline spot of primaries, and the smaller discoidal spot: expanse of wings 43 millims.

♀. Very like *A. meones* ♀, but without the white shoulder-spots, and with an oblique trifid or even quadrifid hyaline discal patch in primaries: expanse of wings 47 millims.

♂, St. Paulo (*Bates*); ♀, Ega (*Bates*), Tabatinga (*Degand*).

Type, B.M.

It is a curious circumstance that our male *A. Stretchii* came in the same Peruvian collection with female *A. parvipennis*, and our male *A. parvipennis* in the same St.-Paulo collection with *A. Stretchii* ♀. Still the localities are not widely sundered; and therefore the value of the two species need not on that account be called in question. The genus may be divided as follows:—

Div. A. Secondaries of male large.

a. Shoulders of both sexes cream-coloured ..... *A. meones.*

b. Shoulders of both sexes black, discal spot of female rounded, scarlet abdominal spots small .... *A. brasiliensis.*

c. Scarlet colouring obsolescent, dorsal abdominal spots only present at the base in both sexes; hyaline wing-spots larger. *A. Stretchii.*

Div. B. Secondaries of male small.

a. Hyaline discal wing-spot of male quadrifid, small at costa, and gradually enlarging to second median branch; scarlet wing-streaks well defined .... *A. diversipennis.*

b. Hyaline discal spot more oblique, trifid in male, sometimes quadrifid in female, subcostal hyaline spot small. *A. parvipennis.*

The last two may prove to be synonymous; but if so, the species must have a tremendous range. Still there is no doubt that, at most, *A. parvipennis* can only be regarded as the Upper-Amazon type of Walker's species, although the appendices of the male differ as much as in the other forms in this genus.

6. A.? LATERALIS = Euchromia lateralis, *Guérin, Ic. Régne Anim.* p. 503.

Pará.

Genus Scepsis, *Walker.*

This genus scarcely differs from *Sciopsyche* in the neuration of secondaries; I only know one species of the group, although I have little doubt that several species recently described by American authors are referable to it.

1. Scepsis fulvicollis=Glaucopis fulvicollis, *Hübner, Samml. exot. Schmett.* i. pl. 164. figs. 1–4.
Glaucopis semidiaphana, *Harris, Descr. Cat. Am. Sph.* p. 38.
E. Florida (*Doubleday*), Canada West. B.M.

Subfamily Ctenuchiinæ.

(*See notes at end of this genus.*)

Genus Philoros, *Walker.*

1. Philoros rubriceps=Ctenucha (Philoros) rubriceps, *Walker, Lep. Het.* ii. p. 283.
New Granada (*Jurgens*), Venezuela (*Becker*). Type, B.M.

2. P. neglecta = Tipulodes neglecta, *Boisduval, Astrolabe*, pl. 3. f. 8.
Peru. B.M.

In one of the boxes of Lepidoptera obtained through the sale of Mr. Norris's collection, I found an example of *P. neglecta* labelled "*peruviana*" in Mr. Walker's handwriting; but I feel uncertain as to whether it is described under that name.

3. P. venosa=Ctenucha (Philoros) venosa, *Walker, Lep. Het.* ii. p. 284.
Venezuela (*Becker*), Mexico (*Glennie*). Type, B.M.

4. P. ruficeps=Ctenucha (Philoros) ruficeps, *Walker, Lep. Het.* ii. p. 284.
Mexico (*Hartweg*). Type, B.M.

Thus I conclude the first genus of typical Ctenuchinæ; but whether this subfamily is sufficiently distinct to be separated from the Charideinæ I will not decide; in venation it most nearly approaches *Charidea* and the allied genera.

In order that I may clear up satisfactorily the position of some of Walker's species, I will enumerate, so far as I know them, the forms referable to various genera of Ctenuchinæ, and (following on from *Philoros*) will arrange them in what appears to me to be their natural order.

Genus Ctenucha, *Kirby.*

Includes *Ctènucha latreillana*, Kirby; *Automolis inornata*, Walker; *Glaucopis rubroscapus*, Ménétriés (*Apistosia*? *multifaria*, Walker); and *Glaucopis bombycina*, Perty. We also have an undetermined species from Mexico.

Genus Leucopsumis, *Hübner*.

Includes *Phalæna collaris*, Drury, *P. circe*, Cramer, and five undermentioned species confounded with them by Walker.

Genus Epidesma, *Hübner*.

Phalæna ursula, Cramer.

With this species Walker confounded an insect with a white band across primaries and quite distinct neuration.

Genus Onythes, *Walker*.

Onythes pallidicosta, Walker.

Excepting in the shape of the secondaries and more plumose antennæ, this genus scarcely differs from the preceding.

Genus Cratoplastis, *Felder*.

Includes *Cratoplastis diluta*, Felder, and *Automolis crassa* of Walker.

Genus Theages, *Walker*.

Theages leucophæa, Walker, *Zygæna scyton*, Fabricius, *Theages quadricolor*, Walker.

This genus is closely allied to, if, indeed, distinct from, the following.

Genus Eucereon, *Hübner*.

Contains *Sphinx pierus*, Cramer; *Carales abdominalis*, Walker; *Phalæna setosa*, Sepp; *Euchromia varia*, Walker; *Sphinx Archias*, Stoll; *Sphinx Sylvius*, Stoll; *Euchromia rosa*, Walker; *Euchromia rosina*, Walker; *Carales imprimata*, Walker; *Halesidota strigosa*, Walker; with three other undetermined species.

Genus Percote, *Walker*.

Percote signatura, Walker, and *Sphinx arontes*, Cramer.

Genus Hyaleucerea, *Butler*.

Includes *Glaucopis erythrotelus*, Walker, and *H. vulnerata*, Butler.

Genus Lymire, *Walker*.

Lymire melanocephala, Walker, from Jamaica.

Genus Thysanoprymna, *Butler.*

Eucerea pyrrhopyga, Walker, from Brazil.

New genus.

Includes *Phragmatobia albicosta*, Walker, from Mexico.

Genus Gippius, *Walker.*

Gippius sumptuosus, Walker, from Honduras.

New genus allied to Glanycus.

Includes *Glanycus nigro-rufus*, Walker, from Bogota.

Genus Glanycus, *Walker.*

Glanycus insolitus, Walker, said to come from Silhet.

Genus Scaptius, *Walker.*

Scaptius ditissimus, Walker, from Ega.

Genus Evius, *Walker* (restricted). See *Neritos.*

Contains *Evius auro-coccineus*, Walker, from Para, and *Phalæn Hippia* of Stoll. *P. bifasciata* of Cramer is unknown to me.

Genus Idalus, *Walker.*

Phalæna admirabilis of Cramer, and *Idalus rufo-viridis* of Walker, from Bogota.

Genus Neritos, *Walker* (remodelled).

Neritos repanda, Walker, from Rio; *Phalæna psamus*, Cramer; *Evius flavo-roseus*, Walker, from Honduras; and a new species confounded with the latter, from Para.

Genus Amaxia, *Walker.*

Amaxia pardalis, Walker, from Ega.

Genus Baritius, *Walker.*

Baritius discalis, Walker, from Rio Janeiro.

Genus Elysius, *Walker* (restricted).

Contains *E. conspersus*, Walker, from Para; this may be considered the type. The other species associated with it by Walker, are clearly not congeneric. I have hitherto seen none of them.

Genus Pitane, *Walker.*

Pitane fervens, Walker; no locality given. This genus is closely allied to the preceding, although placed by Walker in the Lithosiidæ, and said to be allied to the Noctuidæ.

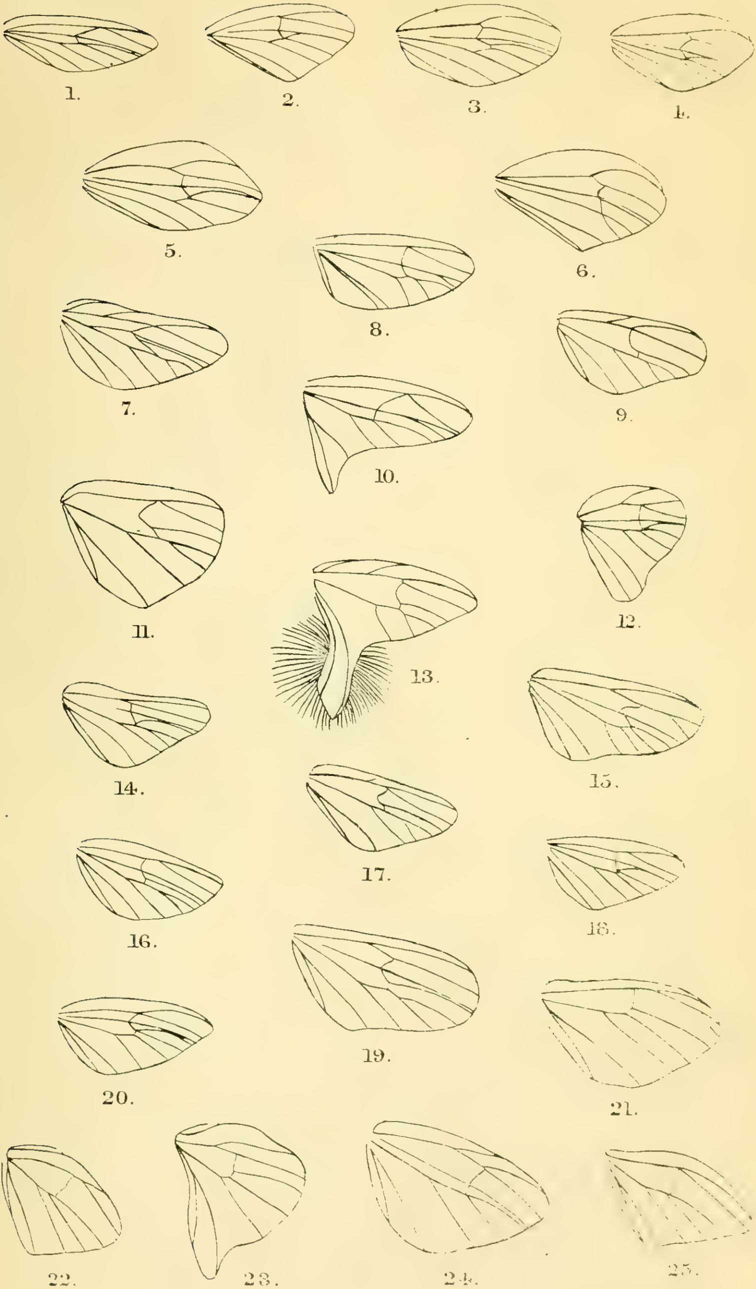
Genus Ammalo, *Walker* (remodelled).

Ammalo fervidus, Walker (*Halesidota megapyrrha*, part, Walker); *Phalæna helops*, Cramer, confounded by Walker with *A. fervidus* and *H. megapyrrha*; and *H. chrysogaster*, Walker, from Bogota.

Walker originally described his *A. fervidus* from a large ♀ example purchased at the sale of Mr. Milne's collection; he, however, took the measurements from two poor specimens of the *Phalæna helops* of Cramer without any locality-tickets; but as he neglected to label his type, it got mixed up with the other Arctiidæ in the collection; and the label appeared in the cabinet with no specimens to represent Walker's species. In his Supplement, Walker referred the three examples to *Halesidota*, and described them again as *Halesidota megapyrrha*, with the addition of a fourth example from St. Domingo, which seems to have suggested to him the locality "N. America"! In this instance the description is taken from one of the representatives of *P. helops*.

But the confusion does not end here. In the interim between the appearance of the Catalogue and its Supplement, a fine new species of *Apantesis*, Walker *, was added to the collection, and by chance was placed above the label "*Ammalo helops*;" therefore, in the Supplement, Mr. Walker described, as a new species of *Ammalo*, an insect somewhat resembling the supposed *A. helops* in appearance (although referable to a distinct genus), but which, of course, has nothing whatever in common with the *Phalæna helops* of Cramer or the *Ammalo fervidus* of Walker. This supposed new *Ammalo* is labelled as coming from "Nauta," on the Amazons, wrongly read by Walker as Nanta; he therefore names it *Ammalo nantana*. But, unfortunately, it is now known that the insects said to have come from Nauta were all collected in E. Peru; so that Walker's designation ought to drop, unless it be accepted as a nonsense name.

* I may here remark that *Aloa colorata* of Walker is identical with *Apantesis radians*, the type of Walker's genus.



GENERA OF ZYGÆNOID ARCTIIDÆ

Subsequent to the publication of the Supplement, Mr. Walker seems to have discovered that two of the examples referred by him to *Halesidota megapyrrha* were identical with Cramer's *Phalæna helops*; for he separated the specimens by the addition of written labels, suggesting as a name for the St.-Domingo species (*A. fervidus* of Walker) the new designation of *Halesidota impunctus* (*sic*); whether he has published the latter name I have not hitherto been able to ascertain, but probably not.

Genus MAZÆRAS, *Walker* (enlarged).

Mazæras conferta, Walker, from Venezuela, and *Halesidota sanguineata*, of Walker, from Bogota.

Genus AMELES, Walker (enlarged).

Ameles rubriplaga, Walker, from Venezuela, and *Halesidota palpalis*, Walker, from Jamaica.

Then will follow *Halesidota* and other well-known groups of the family Arctiidæ.

EXPLANATION OF PLATE XXIX.

Fig. 1. Neuration of secondaries of *Chloropsinus*.
2. Ditto of *Illipula*.
3. Ditto of *Ceramidea*.
4. Ditto of *Passineura*.
5. Ditto of *Antichloris*.
6. Ditto of *Eriphia*.
7. Ditto of *Aclytia*.
8. Ditto of *Ixylasia*.
9. Ditto of *Heliura apicalis*.
10. Ditto of *Pterygopterus*.
11. Ditto of *Charidea*.
12. Ditto of *Telioneura*.
13 & 17. Ditto of *Heliura solicauda*.
14. Ditto of *Acridopsis*.
15. Ditto of *Anycles*.
16. Ditto of *Cercopimorpha*.
18. Ditto of *Epanycles*.
19. Ditto of *Metanycles*.
20. Ditto of *Sciopsyche*.
21. Ditto of *Rhipha*.
22. Ditto of *Apiconoma*.
23. Ditto of *Creatonotus*.
24. Ditto of *Belemnia*.
25. Ditto of *Automolis*.

On the Cloacal Bladders and on the Peritoneal Canals in Chelonia.

By John Anderson, M.D., F.L.S., &c.

[Read February 17, 1876.]

The cloaca in the Chelonia, as is generally known, is an elongated saccular dilatation intervening between the termination of the rectum and the orifice at the base of the tail, or external anus, and into which certain important structures open. It is of considerable length and transverse capacity, and has exceedingly thin walls, and is directly continuous with the rectum. But on the floor, concealed by closely apposed folds is an anteriorly and downwardly directed dilatation or chamber, terminating in the orifice of the bladder, and having, opening on its lateral walls, the orifices of the seminal tubes or of the oviducts, according to the sex, and also the openings of the ureters. The folds which close in this chamber for the general cavity of the cloaca are backwardly continued to the base of the glans, enclosing the urino-genital groove. By this arrangement of the folds, the fæcal matter in its transit outwards is prevented from having access to the orifices of those important structures the generative organs and the kidneys, and to the urino-genital groove. In certain Chelonia another fold exists above and slightly posterior to the termination of the rectum, having above it on either side the large patulous openings of the cloacal bladders. This fold springs from either lateral wall of the cloaca ; and those two segments of it meet in the mesial line and constitute an arched forwardly directed fold. In some species the centre of the arch is tacked to the roof of the cloaca by a narrow longitudinal fold or septum which divides the area which overlies the fold into two halves, into each of which opens a cloacal bladder ; while in others the septum does not exist, and of course the area overlying the fold is continuous.

At the extremity of the urino-genital groove on the floor of the cloaca is the large glans of the penis, and in the opposite sex the identically formed but less developed clitoris. Springing from the sides and base of the glands is a crescentic fold of the mucous membrane, which passes backwards tending towards the mesial line to meet its fellow of the opposite side, thus constituting a hood or rudimentary præputium for the isolation of the glans penis or clitoridis from the fæcal matter of the common cavity of the cloaca, and thus simulating the structure of the Monotremes and of some Struthious birds. The penial and clitorid portion of the cloaca in Trionychidæ and Emydidæ is richly coloured with a purplish-black pigment, which invests the whole of the glans and the hood or præputium and a considerable portion of the pillars of the penis and clitoris anterior to the glans. A similarly coloured pigment also occurs in the openings of the oviducts of some of the Trionychidæ. But in the Southern-Asiatic species of land-tortoise referable to the subgenus *Peltastes* the cloaca and the glans are devoid of black pigment, and are generally pale yellow. The glans penis appears to have a form peculiar to each leading group, and is doubtless in its construction specially adapted to ensure the most perfect efficiency of function in special relation to the habits of life of the animal. There is a terrestrial and there is an aquatic glans penis, the latter having essentially the character of a grasping organ.

It is not the object of this paper to describe the copulative organ, so far as the glans is concerned; but I may be permitted to remark that perhaps in no class of animals is the glans clitoridis so perfect a reproduction of the glans penis as in this most interesting group of vertebrates. So alike are they in young Chelonians, that a direct appeal to the peritoneal cavity is necessary to determine the sex.

Before I take up the question of the peritoneal canals and their relation to the other parts of the penis, the title of this paper necessitates that the cloacal bladders should be first described.

The anal pouches, or cloacal bladders, as they might be more properly called, were first accurately described by Bojanus*, in his account of the anatomy of the common Emyde of Southern Europe, *Emys europæa*; but since his day they do not appear to have received that attention which their importance apparently demands, and which is indicated by the circumstance that they occur in some of the well-marked types and are absent in others. They are the structural equivalents of the similar bladders or vessels which are met with in the crocodiles, and in most lizards and snakes, in various degrees of development; but they attain the highest differentiation in this group.

I have recently had the opportunity to examine a number of Asiatic species belonging to different genera; and I find that these bladders occur in *Emys trijuga*, *E. crassicollis*, *Batagur dhongoka*, *B. lineatus*, *B. fuscus*, *B.* (*Morenia*) *ocellata*, *B.* (*Morenia*) *beru-*

* Anat. Testud. europ. 1819-21.

morei, *Pangshura tecta*, *P. tentoria*, *P. smithii*, *P. flaviventris*, *P. sylhetensis*, *Cuora amboinensis*, *Cyclemys dentata*, *Geoemyda depressa*, *G. grandis*, and *Platysternum megacephalum*. In *Pangshura*, *Cyclemys*, *Platysternum*, and *Geoemyda* the inner walls of these bladders are covered over with long villi of different forms, and which in some are not confined to the bladders, but enclosed between them over the fold of the upper wall of the cloaca; whereas in all the true Emydes and in the Batagurs their inner walls appear to be smooth.

It is a noteworthy fact that the cloacal bladders do not occur, as far as my researches go, in *Testudo*, *Pyxidea*, *Trionyx*, *Chitra*, and *Pelochelys*. This is a significant circumstance, which suggests the reflection that these bladders are related to the habits of life of the animals possessing them, because on viewing their distribution, as indicated by these observations, it is evident that they are confined to the forms which lead a semiterrestrial and semiaquatic life, those animals which are essentially terrestrial in their habits and those which are truly aquatic being unprovided with them. It would thus seem, *à priori*, that it is owing to their existence in the Emydes and Batagurs that these forms are endowed with a diversity of habit above their fellows—because there is no very wide line of distinction, apart from these bladders, between the general anatomy of an Emyde and a terrestrial tortoise, beyond perhaps that the lung of an Emyde, like that of a *Trionyx*, is more invested with muscular substance, and the disposition of the nostrils differs somewhat.

These bladders are capacious sacs, opening, as I have stated, on each side of the cloaca, near its anterior extremity; and they occupy the groin and project into the peritoneal cavity, covered, of course, by the peritoneum, and having the lung in certain species lying directly in contact with a considerable extent of their upper border. By the nature of the fold which intervenes between their openings, the portion of the cloaca anterior to them can be shut off by the apposition of the fold to the floor of the cloaca, so that, for the time being, the bladders may be in direct communication with the cloaca, to the complete exclusion of all the other openings except the external anus. These circumstances seem also to favour the supposition that these bladders are in some way functionally related to the aquatic aspect of their existence, since it is an acknowledged fact that some Chelonia draw in and eject water from the cloaca, like the Holothuridæ and other allied invertebrates—an observation which was made by Townson three quarters of a century ago, but which has been verified by other naturalists and what I have myself noticed. Indeed the cloaca in different species of Southern-Asiatic Emydes is not unfrequently observed dilated with water, which they squirt out in considerable jets when they retract their limbs and tail, as they generally do when suddenly removed from that medium. Although I have examined, immediately after death, nearly one hundred individuals belonging to those genera which are furnished with cloacal bladders, yet in no instance have the cloacal bladders been distended with water; whereas they have frequently yielded a yellowish grumous substance, most especially abundant in those forms which have these bladders provided with villi. It is also important to note that they are in no way connected with any other viscus, and that their only orifice is in the cloaca. On the other hand, the azygos or partially divided bladder is generally more or less filled, frequently to distention, in animals recently taken from the water, with a clear limpid fluid not pure water. In the Crocodilia the equivalents of these pouches are filled with a substance which has the odour of musk; but I have never particularly observed that the Chelonia possessing these pouches are more characterized by a peculiar odour than the pouchless forms.

The function, however, which these bladders perform in the economy of the semiterrestrial and semiaquatic Chelonia remains yet to be determined by careful observation and experiment.

One observation on the importance of their structures as an indication of the habits of these animals, as illustrated by the genus *Pyxidea*. The form *Pyxidea mouhottii* has been classed with the Emydes; but an examination of its cloaca reveals that, unlike those animals, it is unprovided with cloacal bladders. And what are its habits of life? This is a question which I am enabled to answer from the circumstance that I had two specimens under my observation over nine months, during which period they never entered water, and did not exhibit any aquatic tendencies.

All the Chelonia of South-eastern Asia which I have examined, belonging to the genera *Testudo*, *Geoemyda*, *Pangshura*, *Emys*, *Batagur*, *Cuora*, *Cyclemys*, *Platysternum*, *Emyda*, *Trionyx*, *Chitra*, and *Pelochelys*, are distinguished by the presence of a pair of peritoneal canals which traverse the cloaca to the base of the glans of the penis and clitoris.

Cuvier* has fully indicated the nature of these canals in the male tortoise; but it is to Is. Geoffroy St.-Hilaire and Martin† that we are indebted for an account of those structures in the female, although some of the results of these observers may not be altogether accepted. Cuvier has described the peritoneal canal of the male as terminating in a *cul-de-sac* at the base of the glans; whereas Is. Geoffroy St.-Hilaire and Martin supposed that they had established a much more intricate arrangement in the female. But before mentioning their views I shall say a few words about the peritoneal canals and their relations.

These canals commence on each side of the pyriform neck of the bladder, within the perivisceral cavity; and they are in reality diverticula for that cavity, being lined with a serous membrane. Each canal begins in the depression or pit in the visceral cavity, external to the neck of the bladder. When distended by a probe, the orifice of the canal (or, more correctly, the diverticulum) is found to have considerable capacity, and to lie along the inside of each corpus cavernosum, at first crossing the spongy bulb of the male organ, and then lying between the corpora cavernosa and in position immediately external to the genito-urinal groove traversing the floor of the cloaca, or in reality the dorsum of the penial tract. In all the foregoing genera these diverticula of the perivisceral cavity are prolonged to the base of the glans, both of the penis and clitoris, and without any apparent diminution in capacity. Isidore Geoffroy St.-Hilaire and J. G. Martin, in examining an example of *Emys trijuga* quite recently dead, state that they perfectly succeeded in injecting the two peritoneal canals with mercury, and that they certainly saw it penetrate into the corpora cavernosa, and also into the small conduits of the glans, which became inflated, rising upwards to a level with the surface of the organ. Moreover they considered that they had established the existence of a communication between the peritoneal canals and the corpora cavernosa, by being able to propel a globule of mercury from the peritoneal cavity either into the little conduits of the glans or into the cavernous bodies, and as by an inverse movement they made the globule reenter into the peritoneal canals. Thus globules contained in the little conduits of the glans, ascending them, might be propelled into the peritoneal canals, thence into the cavernous bodies; and, reciprocally, those

* Anat. Comp. vol. v. p. 114.

† Ann. des Sc. Nat. vol. xiii. (1828) pp. 153, 201.

contained in the corpora cavernosa might be transmitted by the peritoneal canals into the little conduits of the glans, thence into the cavity of the cloaca. They therefore held that the little conduits of the glans were the terminal branches of the peritoneal canals.

They had previously stated that in *Testudo indica** the conduits of the glans terminated near the summit of the clitoris; but from their experiments on *E. trijuga* they found that the orifice of the peritoneal canal terminated nearer to the base of the clitoris than to its summit; and they mention that the position of the opening in *E. trijuga* is intermediate between what they observed in *Testudo indica* and its position in the crocodile, but more resembling the latter, in which the peritoneal canals open at the base of the glans. They arrived, therefore, at the following conclusion—that the peritoneal canals in the tortoise and the crocodile divide at their extremity into two branches, one going to open into the cloaca, and the other tending towards the corpus cavernosum. But according to Is. Geoffroy St.-Hilaire and Martin, there was this important physiological difference—that the second branch opened into the cavity of the corpus cavernosum in tortoises, whilst it terminated in a *cul-de-sac* in the crocodile. I observe that Professor Owen† states that the peritoneal canals of the crocodile, besides communicating with the corpus cavernosum, open outwardly upon papillæ situated on each side of the base of the penis and clitoris, thus conforming, according to his view, with the structure of the tortoises as described by Is. Geoffroy St.-Hilaire.

Having lately directed my attention to these remarkable diverticula from the peritoneal cavity, and finding that my observations on their structure do not agree altogether with either those of Cuvier, Is. Geoffroy St.-Hilaire, or Owen, I shall here record a few of the examinations I made on some species of different genera and of both sexes. Before doing so, I may mention that Is. Geoffroy St.-Hilaire used mercury for his injections; but the membrane lining the walls of these diverticula is so delicate, and mercury so heavy and penetrating, that I am not surprised at the results which he obtained. In injecting the canals I have used only water coloured with a solution of carmine. I was most careful not to

* They were not perfectly satisfied with the identification of the species, but state that the subject of their observation was one nearly allied to *T. indica*.

† Comp. Anat. vol. i. p. 433.

rupture the inner linings by too strong pressure, whilst at the same time I fully distended them.

1st experiment.—This was made on a male of *Geoemyda grandis.* The fluid, injected into the peritoneal canal from about the upper third of the length of the penis, flowed freely through it, appearing at an opening situated immediately at the base of the glans and close to the inside of the genito-urinal groove. Repeated slight pressure was exercised on the dilated canal, and then the corpus cavernosum of its side was laid open to ascertain if any fluid had passed into it; but whilst the interior of the peritoneal canal was richly coloured with the carmine, no trace of colour could be detected in the corpus cavernosum. At the point where the canal terminated externally there were indications of an orifice even before the injection was applied, in the absence of pigment at that point; but I failed to detect any communication between the peritoneal canal and the corpus cavernosum.

2nd experiment.—In a male *Emys Hamiltonii* the coloured injection appeared like a jet from a fine artery, issuing from a very minute orifice in the same position as the orifice of *Geoemyda grandis*; and no trace of carmine could be observed in the corpus cavernosum, or the presence of any orifice leading from one canal to the other.

3rd experiment.—In a male specimen of *Trionyx ocellatus*, in which the penis was very flaccid, the orifices of the peritoneal canals are wide orifices situated more anterior to the base of the glans than in *Emys* and *Geoemyda*, and more on the side of the penis, further away from the urino-genital groove. The mixture flowed through them in a great stream, the penis being that of a much larger animal than any *Geoemyda.* No trace of injection could be found in the corpus cavernosum of the side injected; nor could any orifices be detected, even with the aid of a pocket-lens, between the peritoneal and the corpus cavernosum of the opposite side when they were laid open to near the termination, nor in any other portion of their walls. Moreover, when the corpora cavernosa were injected, no trace of carmine appeared in the peritoneal canals, or at the tips of the lobes of the glans, which are white, and form the termination of the branches of the urino-genital groove.

4th experiment.—In a female of *Trionyx gangeticus* the coloured injection passed at once through the peritoneal canal, appearing at a spot situated some little distance above the base of the glans and external to the urino-genital groove. No communication could be discovered to exist between the corpora cavernosa, which are very small in the large female.

5*th experiment.*—A female of *Batagur thurgi* had the orifice situated on a small papilla immediately external to the base of the glans, on the inner margin of the so-called preputial fold or hood of the clitoris; and no trace of communication was discernible between the corpus cavernosum and the canal of the peritoneum.

6*th experiment.*—In a female of *Chitra indica* the opening of the peritoneal canal was a very minute orifice situated at the bottom of a deep pit with puckered margins, external to the base of the clitoris. The peritoneal canal had its inner walls more or less coloured, near its distal end, with fine dark lines of the same pigment as that of the clitoris itself, thus indicating the continuity of the lining membrane with that of the external surface. The canal was also partially filled near its end with a grumous substance, but quite different from the coagulated blood that filled the corpus cavernosum.

7*th experiment.*—In a female *Emys trijuga* from Burma, which was rather shrunk from preservation in spirit, the injection would not pass; but when the canal was laid open nearly to its extremity, no difficulty was experienced in passing a fine bristle, which appeared in much the same position as in *Geoemyda grandis.*

8*th experiment.*—A similar result was experienced in a female of *Testudo platynotus*, Blyth.

9*th experiment.*—In a female of *Batagur lineatus* the injection passed freely; and the orifice occupied the same place as in *B. thurgi*, and there was no indication whatever of the existence of an orifice between the peritoneal canals and the corpora cavernosa.

10*th experiment.*—*Platysternum megacephalum* and *Cyclemys dentata* were so hardened and shrivelled by spirit that no orifice for the well-developed canals could be detected.

I should have been more satisfied with these experiments had I succeeded in passing the injection freely through the peritoneal canals of all the species examined; but I attribute my want of success in these two instances chiefly to the circumstances that the parts were hardened and contracted with spirit, and that the orifices were very minute. I am not prepared, however, to go the length of saying that there is invariably a communication between the peritoneal canals and the cloaca in the males; but at the same time there can be no doubt that in the males of *Geo-*

emyda grandis, *Emys Hamiltonii*, and *Trionyx ocellatus* such a communication does exist. In this respect these animals conform to the course of these canals in the crocodile. Now *Geoemyda grandis* and *Trionyx ocellatus* belong to two widely separated groups of Chelonia; and the fact that the peritoneal canals open into the cloaca in both would lead us to anticipate that this arrangement was common to all the Chelonia which resembled them in habits of life and general structure. But a more extended series of experiments will be necessary to establish this point; and all I insist on is, that in the males, as in the females, experimented upon these canals do open into the cloaca, and in this respect conform to the general type of structure distinctive of the peritoneal canals of Crocodilia, and of the so-called abdominal pores of the Cyclostomous and Ganoid fishes.

But the view of the structure of these canals to which I wish to direct more particular attention is, that in the foregoing experiments no trace of any communication between the peritoneal canals and the corpora cavernosa could be observed. I was at first very sceptical regarding the results I had obtained, after the very emphatic statement of Is. Geoffroy St.-Hilaire, that in his experiments on *Emys trijuga* the mercury injected flowed freely between the peritoneal canal and the corpora cavernosa and *vice versâ*, and from the glans into the peritoneal canal; but as my experiments were conducted with great care, I have thought it well to record them, because there are great difficulties in accepting Is. Geoffroy St.-Hilaire's explanation of the relations which, he states, subsist between the peritoneal canals and the corpora cavernosa. In claiming for the peritoneal canals the existence of a series of minute sieve-like orifices intervening between them and the corpora cavernosa, he would thus establish a direct communication between the blood-vascular system and the peritoneal cavity—a condition of things which would be unique in the animal kingdom. Moreover, as he adduces the passage of the mercury as a proof of the existence of these orifices between the large blood-conduit, the corpus cavernosum and the peritoneal canal, we are led to suppose that the blood would follow a similar course, which means that it passes backwards and forwards over the serous or peritoneal lining of the canal and the structurally different inner wall of the corpus cavernosum. Such a view of the relation of these two canals is opposed to the first principles of physiology. Is. Geoffroy St.-Hilaire was quite aware of these practical difficulties to the acceptance of the view which he had propounded regarding the relations of these structures, and he remarks that he had never observed blood in the peritoneal canal; but to account for this, he conjectured that the supposed minute orifices leading into the corpora cavernosa were related to the cavity of that tube much in the same way that the openings of the seminal tubes are to the urethral canal of the higher vertebrates, the orifices of which are so protected that the urine in its passage outwards is efficiently denied access to them. This comparison leads to the supposition that their orifices exist only for the transmission of fluid from the peritoneal canal to the corpora cavernosa, which would remove one aspect of the difficulty. But as there is no analogy between the closed spongy substance of the glans which is directly continuous with the corpora cavernosa into which the blood-vessels pour the fluid, and the excreting tract of the urethra, the theory implied in the comparison instituted by Is. Geoffroy St.-Hilaire, that a fluid passes from the peritoneal canals into the corpora cavernosa, is a practical difficulty of the greatest moment. What is the fluid which would so pass? If, as he allows, there exists in the female tortoise a direct communication between the peritoneal canals and the cloaca, and, as I have proved, in the male *Geoemyda grandis* and *T. ocellatus*, as these orifices are not valvular, the likelihood is, that as the cloaca is distended with water this fluid finds its way into those canals, it may be even into the peritoneal cavity; and we should thus have to accept the conclusion that the fluid they transmit to the corpora cavernosa, and thus to the blood, was partly composed of the secretion of the peritoneal cavity diluted with water.

It is unnecessary to say any more regarding these views, my purpose not being controversy, but merely to direct more attention to the structures which have, doubtless, an important bearing on the economy of these remarkable animals. My own opinion is that they are in no way related to the generative functions, but that they are, as has been suggested by Duméril and Bibron *, probably accessory and subordinate to transpiration, admitting water into the peritoneal cavity, which adapts the animal to the change to which it is subjected when exposed to the air in too high or too dry a temperature.

Little or nothing is known regarding the development of these canals in the Chelonia; but as they have associated with them in the adult condition a pair of generative tubes and well-defined

* Erpét. Gén. vol. . p. 195.

ureters opening by distinct orifices into the cloaca, they have probably an origin quite distinct from the Müllerian ducts; and the likelihood is that they are strictly homologous with the abdominal pore of the Selachians and Ganoids. The true nature and origin of these pores is little understood; but Mr. F. M. Balfour* has suggested that they are probably the openings of a pair of segmental organs. Embryology, however, must be the ultimate interpreter of their origin and meaning.

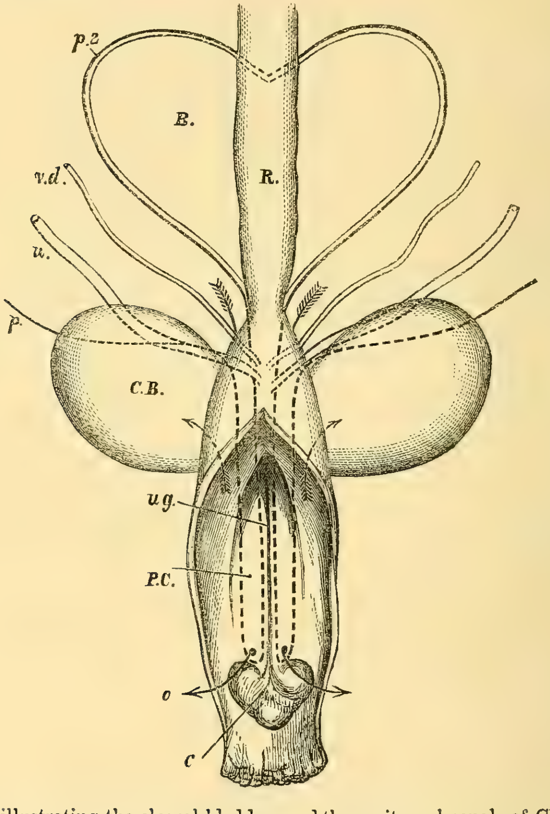


Diagram illustrating the cloacal bladders and the peritoneal canals of Chelonia.

B, urinary bladder; R, rectum; C. B, cloacal bladder (arrows are represented on either side entering these from the cloaca); P. C, peritoneal canals (arrows descend and have exit therefrom at *o*, orifice); *p*, peritoneum; p^2, peritoneal covering of bladder; *u*, ureter; *v. d*, vas deferens; *ug*, urinogenital groove; *c*, clitoris.

* Journ. Anat. Phys. vol. x. pt. 1, 1875, p. 34.

Observations on Ants, Bees, and Wasps.—Part III.

By Sir JOHN LUBBOCK, Bart., F.R.S., F.L.S., M.P., D.C.L., Vice-Chancellor of the University of London.

[Read November 4, 1875.]

ANTS.

IN my second paper on this subject I gave some cases which show that if ants find stores of food, they do not by any means in all instances bring friends to assist in securing the treasure.

Experiments with Larvæ.

Again, Feb. 7, I put some larvæ in three porcelain cups in the feeding-box of a frame containing a nest of *Formica flava*, about 6 inches from the entrance of the frame, and put at 8 and 8.29 A.M. respectively two ants to the larvæ in the left-hand cup. They each carried off a larva and returned as follows:—

No. 1.	No. 2.		
At 8.35	....	returned again and	took another.
9. 0	....	,,	,,
	9. 7	,,	,,
	9.20	,,	,,
9.30	....	,,	,,
	9.43	,,	,,
9.54	....	,,	,,
	9.56	,,	,,
	10.20	,,	,,
10.25	....	,,	,,

At 10.43 a strange ant came to the larvæ in the right-hand cup. I imprisoned her.

At	11. 0	returned again and	took another.
11. 1	....	,,	,,
	11. 9	,,	,,
11.15	....	,,	,,
	11.20	,,	,,
	11.29	,,	,,
11.37	....	,,	,,
	11.40	,,	,,
	11.52	,,	,,

At 12.2 a stranger came to the larvæ in the left-hand cup. I imprisoned her.

No. 1.	No. 2.	
At 12. 3	. . . .	returned again and took another.
	12.15	” ”
	12.30	” ”
12.37	. . . .	” ”
	12.41	” ”
	12.50	” ”
	15.58	” ”
1. 0	. . . .	” ”
	1. 7	” ”
1.12	. . . .	” ”
	1.16	” ”
	1.28	” ”
1.32	. . . .	” ”
	1.35	” ”
	1.44	” ”
1.50	. . . .	” ”
	1.55	” ”
	2. 6	” ”
2. 9	. . . .	” ”
	2.17	” ”
	2.29	” ”
2.39	. . . .	” ”
	2.42	” ”
2.49	2.49	” ”
3. 0	. . . .	” ”
	3. 3	” ”

At 3.10 a stranger came to the left-hand cup. I imprisoned her.

At	3.14	returned again and took another.
3.15	. . . .	” ”
	3.24	” ”
3.31	. . . .	” ”
	3.34	” ”
3.36	. . . .	” ”

At 4.10 a stranger came to the middle cup. I imprisoned her.

At 4.45	. . . .	returned again and took another.
	5.50	” ”
6. 2	6. 2	” ”
	6.17	” ”

No. 1.	No. 2.		
At	6.26 returned again and took another.		
	6.46	,,	,,
	6.52	,,	,,
7. 4	. . . .	,,	,,
	7. 7	,,	,,
	7.13	,,	,,
	7.18	,,	,,
7.48	7.48	,,	,,

After this they were not watched any more. It will be observed that the second ant made many more visits than the first—namely, forty-two in about eleven hours, as against twenty-six in eleven hours and a half. During this time two strangers came to the larvæ in the cup they were visiting, and three to the other two cups.

The following case is still more striking. On July 11, at 11 A.M., I put a *F. flava* to some pupæ of the same species, but from a different nest. She made eighty-six journeys, each time carrying off a pupa, with the following intervals. Commencing

at 11. 0,	At 1.33 again
11. 5 she returned.	1.43 ,,
11. 9 returned again.	1.49 ,,
11.16 again	1.52 ,,
11.20 ,,	1.56 ,,
11 24 ,,	2. 2 ,,
11.29 ,,	2.10 ,,
11.36 ,,	2.17 ,,
11.49 ,,	2.25 ,,
11.55 ,,	2.29 ,,
12. 0 ,,	2.32 ,,
12. 5 ,,	2.35 ,,
12.16 ,,	2.37 ,,
12.30 ,,	2.40 ,,
12.40 ,,	2.43 ,,
12.44 ,,	2.47 ,,
12.50 ,,	2.53 ,,
1. 1 ,,	2.56 ,,
1.10 ,,	2.59 ,,
1 19 ,,	3. 2 ,,
1.27 ,,	3. 7 ,,

At 3.10 again.	At 4.30 again.
3.13 ,,	4.33 ,,
3.16 ,,	4.40 ,,
3.20 ,,	4.43 ,,
3.25 ,,	4.45 ,,
3.33 ,,	4.49 ,,
3.35 ,,	4.53 ,,
3.38 ,,	4.55 ,,
3.40 ,,	4.58 ,,
3.47 ,,	5. 3 ,,
3.53 ,,	5. 7 ,,
3.57 ,,	5.12 ,,
4. 0 ,,	5.19 ,,
4. 3 ,,	5.22 ,,
4. 5 ,,	5.25 ,,
4. 8 ,,	5.28 ,,
4.12 ,,	5.32 ,,
4.15 ,,	5.35 ,,
4.18 ,,	5.39 ,,
4.20 ,,	5.50 ,,
4.23 ,,	7. 5 ,,
4.26 ,,	7.12 ,,

After which she did not come again till 8, when we left off watching. During the whole of this time she did not bring a single ant to help her. Surely it would have been in many respects desirable to do so. It will be seen that some of the pupæ remained lying about and exposed to many dangers from 11 A.M. till 7 P.M.; and when she left off working at that time, there were still a number of the pupæ unsecured; and yet, though she had taken so much pains herself, she did not bring or send others to assist her in her efforts or to complete her work.

Experiments with Pupæ.

July 11. I had put out some pupæ of *F. flava* in the central park. At 5.55 a *F. fusca* found them and carried one off.

At 6. 0	she returned and	took another.	Again
6. 1	,,	,,	
6. 3	,,	,,	
6. 4	,,	,,	
6. 5	,,	,,	

At 6. 6 she returned and took another. Again

6. 7	"	"
6. 8	"	"
6. 9	"	"
6.10	"	"
6.11	"	"
6.12	"	"
6.14	"	"
6.15	"	"
6.16	"	"
6.17	"	"
6.19	"	"
6.20	"	"
6.21	"	"
6.23	"	"
6.25	"	"
6.27	"	"
6.29	"	"
6.30	"	"
6.31	"	"
6.33	"	"
6.35	"	"
6.36	"	"
6.37	"	"
6.38	"	"
6.40	"	"
6.41	"	"
6.45	"	"
6.47	"	"
6.49	"	"
6.50	"	"
6.51	"	"
6.52	"	"
6.53	"	"
6.55	"	"
6.56	"	"
6.57	"	"
7. 0	"	"
7. 1	"	"
7. 2	"	"
7. 6	"	"

After the 45 visits, she came no more till 8; but when I returned at 10 I found all the pupæ gone. During the time she was watched, however, she brought no other ant to assist.

Experiments with Larvæ.

I also made similar experiments with *Myrmica ruginodis*, imprisoning (as before) all ants that came except the marked ones.

Sept. 24. I put out two lots of larvæ; and to one of them I placed two specimens, which I will call 1 and 2. They returned as follows, carrying off a larva on each journey:—

No. 1.	No. 2.	
10.23		
	10.26	
10.28		
	10.32	
10.34		
	10.37	
10.40		
	10.41 bringing a friend.	
10.50		
	10.55	
	11. 6	
	11.16	
11.40		
	11.44	
11.45		
		11.46 a stranger came alone.
	11.56	
12. 0		
	12. 6 bringing a friend.	
12.11		
	12.15	
12.16		
		12.17 a stranger came alone.
	12.22	12.22 „ „
	12.29	
	12.34	
12.36		
	12.40	
		12.45 a stranger found the second lot of larvæ.
	12.47	
	12.53	

No. 1.	No. 2.	
		12.58 two strangers found the second lot of larvæ.
	12.59	
	1. 5	
1. 6		
		1. 7 a stranger found the second lot of larvæ.
	1.16	
1.20		
	1.21	
	1.26	
	1.35	
1.42		
	1.47	
	1.54	
1.55 with 2 friends.		
	1.59	
2. 2		
		2. 3 a stranger found the larvæ.
	2. 4	
2. 9 with a friend.		
	2.10	
2.16		
	2.18	
2.24		
	2.25	2.25 a stranger found the second lot of larvæ.
	2.34	
2.36		
	2.41	
2.44		
	2.45	
	2.50	
2.51		
	2.55	
	3. 0	
3. 1		
	3. 6	
3.10	3.10	
	3.17	
3.18		
	3.22	
	3.27	

No. 1.	No. 2.
3.28	
	3.36
3.40	
	3.47
3.48	
	3.53
3.55	
	3.59
4. 0	
	4. 7
4. 8	
	4.14
4.16	
	4.20
4.27	
	4.31
4.35	
	4.39 with a friend.
4.42	4.42
	4.47
4.53	4.53
	4.58
	5. 3
5. 5	
	5. 9
5.17	5.17
5.25	
5.32	
5.40	
5.46	
5.55	
6. 5	
	6. 8
6.11	
	6.16
6.20	

They came no more up to 7.30, when we left off watching. The following morning at 6.5 I found No. 1 wandering about, and evidently on the look-out. I put her to some larvæ; and shortly afterwards No. 2 also found them. Their visits were as follows :—

No. 1.	No. 2.	
6.10		
6.21		
6.36		
	6.42	
6.44		
6.52		
7. 1	7. 1	
	7. 8	
7.11		
	7.12	
	7.22	
	7.29	
		7.30 a strange ant
	7.35	found the larvæ.
7.40		
7.49		
	7.54	
8. 5		
8.13		
8.25		
8.31		
8.39		
8.44		
8.48		

Thus, during this period these two ants carried off respectively 62 and 67 larvæ; 10 strangers found the larvæ, half of them exactly coming to the lot visited by the ants under observation.

Again. Sept. 27, at 3.55 P.M., I put a *F. nigra* to some larvæ of *F. flava*. She returned as follows:—

4. 3	4.52
4.11	4.56
4.21	5
4.25	5. 5
4.28	5.10
4.31	5.14
4.37	5.18
4.40	5.23
4.44	5.29
4.48	5.40

5.43	5.54
5.46	5.59
5.50	

when she met with an accident. During this time no other ant came to the larvæ.

On Oct. 1, at 6.15 A.M., I put three specimens of *F. nigra* to some larvæ of *F. flava*. One did not return; the other two behaved as follows:—

No. 1 returned to the larvæ at	No. 2 at	Strangers came at
6.52		
	7.12	
		7.14 to lot 2.
	7.22	
7.30		
	7.32	
7.42	7.42	
		7.45 to lot 3.
	7.50	
7.54		
	8. 0	
8. 1		
8. 6 with a friend.	8. 6	
	8. 9	
8.10		
8.17		
		8.19 to lot 1.
		8.23 ,,
8.25		
	8.26	
8.32		
8.36		
		8.37 ,,
	8.38	
8.39		
	8.41	
8.44		
		8.45 ,,

Here I left off watching for half an hour.

9.22		
	9.28	

No. 1 returned to the larvæ at	No. 2 at	Strangers came at
9.29		
9.35	9.35	
9.41		
	9.45	
9.47		
9.50		
	9.52	
9.54 with a friend.		
9.57		
		9.58 to lot 1.
	10. 0	
10. 1		
10. 9		
	10.11	
10.13 with a friend.		
10.16	10.16	
	10.25	
	10.30	
	10.36	
	10.46	
	10.50	
10.55		
	10.58	
11. 0		
	11. 2	
11. 3		
11. 7		
	11. 8	
	11.15	
11.16		
11.19	11.19	
11.23		
	11.25	
11.27		
	11.29 with a friend.	
		11.30
11.33		
	11.35	
11.37		
11.41		

No. 1 returned to the larvæ at	No. 2 at	Strangers came at
	11.42	
11.45		11.47 to lot 1.
	11.48	
11.49		
11.53		
	11.59	
12. 1		
12. 4		
12. 8		
	12. 9	
12.11		
		12.14 "
12.15	12.15	
12.18		
		12.19 "
	12.20	
12.21		
12.25		
	12.29 with a friend.	
12.30		
12.35		
	12.36	
12.39		
12.42		
	12.43	
12.45		
	12.47	
12.48		
12.51		
	12.53	
12.54		
		12.56 "
12.57	12.57	
1. 0 with friend.	1. 0	
1. 2		
1. 5		
1. 7		
	1. 9	
1.10		
		1.11 "

No. 1 returned to the larvæ a	No. 2 at	Strangers came at
1.13		
	1.14	
1.15		
1.18	1.18	
1.21		
1.24		
1.27		1.27
	1.28	
1.30		
1.33		
	1.35	
1.36		
1.39		
1.42	1.42	
1.45		
		1.46
1.48	1.48	
1.51		
	1.53	
1.57		
	1.59	
2. 1		
2. 4		
	2.15	
2.17		
2.21		
	2.22	
2.25		
2.29		
	2.31	
2.33		
2.37		
	2.39	
2.40		
	2.43	
2.44		
2.47		
	2.49	
2.50		
2.54		

No. 1 returned to the larvæ at	No. 2 at	Strangers came at
2.57		
3. 0		
	3.4 with a friend	
3. 6		
3. 9 with a friend.		
3.12		
3.14		
3.16	3.16	
3.20		
	3.21	
3.23		
3.26	3.26	
3.30	3.30	
3.33	3.33	
3.35	3.35	
3.37		
	3.38	
3.39		
3.41		
3.43		
	3.45	
3.46		
	3.48	
3.49		
3.54		
4. 0		
4. 3		
	4. 4	
4. 7		
4.12		
4.15		
4.20		
4.26		
4.29		
4.31		
		4.32
4.34		
4.36		
4.39		
	4.40	

No. 1 returned to the larvæ at	No. 2 at	Strangers came at
4.42		
		4.43
	4.44	
4.45		
4.49	4.49	
	4.55	
4.56		
	4.58	
4.59		
5. 2	5. 2	
	5. 6 with two friends, after which she came no more.	
5. 7		
5.10		
5.13		
5.15		
5.18		
5.21		
5.25		
5.28		
5.31		
		5.33 to lot 2.
5.35		No. 1 returned to the larvæ at
5.38		7.14
5.41		7.18
5.45		7.21
5.51		7.24
5.54		7.25
6. 0		7.28
6. 4		7.31
6. 7		7.34
6.14		7.38
6.17		7.41
6.20		7.44
6.28		7.47
6.31		7.51
6.48		7.55
6.54		7.59
7. 0		8. 2
7. 3		8. 5
7. 6		8.12
7.11		8.15

No. 1 returned to the larvæ at	No. 1 returned to the larvæ at	
8.18	8.38	
8.20	8.42	
8.24		8.44 stranger
8.28	8.45	came.
8.32	9.44	
8.35		

We continued to watch till 10.15, but she came no more. She had, however, in the day carried off to the nest no less than 187 larvæ. She brought 5 friends with her; less than 20 other ants came to the larvæ.

October 3. I put a *F. nigra* to some larvæ of *F. flava*. She returned as follows, viz.:—

1.42	3.35
1.48	3.38
1.52	3.41
2. 0	3.49 with a friend.
2. 4	3.51
2. 8	3.54
2.12 with a stranger.	3.57
2.15	4. 1
2.19	4. 4
2.24	4. 7
2.27	4.10
2.32	4.12
2.36	4.15
2.40	4.18
2.44	4.22
2.49	4.25
2.57	4.29
3. 1	4.32
3. 4	4.35
3. 7	4.38
3.10	4.43
3.13	4.46
3.15	4.49
3.18	4.54
3.20	4.57
3.23	5. 0
3.31	5. 3

5. 6
5.10
5.14
5.18
5.22
5.26
5.29
She dropped on the floor; I picked her up; and she returned at
6.40
6.50
6.54
7. 4
7. 7 with 3 friends.
7.11. She now fell into some water.

Experiments with Honey.

In addition to the above experiments with larvæ, I tried the following with syrup.

April 19. I put out a little syrup on eleven slips of glass, which I placed on eleven inverted flower-pots on the lawn. At 8.35 a *F. nigra* found the honey on one of the flower-pots.

8.50 she returned to the honey, and at 9. 5 went back to the nest.

9.21	,,	,,	9.30	,,
9.42	,,	,,	9.50	,,
10.12	,,	,,	10.21	,,
10.35	,,	,,	10.46	,,
11. 9	,,	,,	11.20	,,
11.45	,,	,,	11.50	,,
11.57	,,	,,	12. 2	,,
12·20	,,	,,	12.30	,,
12.45	,,	,,	12.53	,,
1. 8	,,	,,	1.18	,,
1.34	,,	,,	1.43	,,
1.57	,,	,,	2. 7	,,
2.28	,,	,,	2.33	,,
2.49	,,	,,	2.53	,,
2.59	,,	,,	3. 2	,,
3. 9	,,	,,	3.11	,,
3.29	,,	,,	3.30	,,
3.59	,,	,,	4. 8	,,

After which we watched till 6 P.M.; but she did not return again to the honey. During the above time 8 ants came to the same honey, and 21 to the other ten deposits.

On July 11 I put one of my specimens of *F. nigra* to some honey at 7.10. She fed till 7.25, when she returned to the nest

At 7.32	she returned.	At 7.36	another ant	came, whom I imprisoned.
7.47	,,	7.50	,,	,,
8. 0	,,	8.11	,,	,,
8.18	,,			
8.36	,,			
8.59	,,			
9.17	,,			
9.38	,,			
9.53	,,			
10.10	,,			
10.27	,,			
10.44	,,			
11. 6	,,			
11.16	,,			
11.38	,,			
12. 0	,,			
12.36	,,	12.45	,,	,,
12.56	,,			
1.21	,,			
1.44	,,			
2.10	,,			
2.21	,,			
2.29	,,			
2.50	,,	2.51	,,	,,
3. 5	,,			

After this she did not come back any more up to 8 P.M.

April 25 was a beautiful day. At 9 A.M. I put some syrup in the same way on five inverted flower-pots, and at

9.10 put an ant to one of the deposits of syrup. At

9.34 another ant came to the same syrup. This one I will call No. 2. At

9.40 No. 1 returned.

10.45 No. 2	,,	At 11 one came to the same honey; this I will call No. 3.		
11. 7 No. 1	,,	but did not come back any more.		
12.31 No. 2	,,	and at 12.47 went.		
1.15 No. 3	,,	,,	1.25	,,
1.22 No. 2	,,	,,	1.48	,,
1.54 No. 3	,,	,,	2. 3	,,
2.18 No. 2	,,	,,	2.30	,,

2.35 No. 3 returned, and at 2.36 went.
2.56 No. 2 „ „ 3. 1 „
3.24 No. 2 returned.
4.19 No. 2 „

After which I went on watching till 7, but none of these three returned. During the day 7 ants came to this honey, and 27 to the other four deposits. Here, therefore, it is evident that the three watched ants did not communicate, at any rate, any exact information to their friends.

June 27. I placed four inverted glasses (tumblers) on the grass, and on the top of each placed a little honey. I then, at 8 o'clock, put two ants, belonging to *F. nigra*, to the honey on one of the glasses.

At 8.25 No. 1 came back, and at 8.45 she returned to the nest, but did not come to the honey any more.

At 9.5 No. 2 came out and wandered about; I put her to the honey again; she fed and at 9.22 returned to the nest.

At 9.28 she returned to the honey, and at 9.45 went back to the nest.

10.42	„	„	10.50	„
10.58	„	„	11.10	„
11.21	„	„	11.39	„
12.45	„	„	12.59	„
1.40	„	„		

I continued to watch till 7 P.M., but neither of them returned any more.

Aug. 7. I put out four small deposits of honey (which I continually renewed) on slips of glass placed on square bricks of wood and put an ant (*F. nigra*) to one of them at 9.20. She fed an went away.

At 9.35 she returned, and fed till 9.43

10.14	„	„	10.17
10.25	„	„	10.27
10.37	„	„	10.40

This time a friend came with her.

At 10.47 she returned, and fed till 10.53

11. 0	„	„	11.14
11.35	„	„	11.40
11.52	„	„	11.55
12.13	„	„	12.16
1. 0	„	„	1. 5

At 1.15	she returned,	and fed till	1.18	
1.26	,,	,,	1.29	
1.45	,,	,,	1.48	
1.58	,,	,,	2. 1	
2. 9	,,	,,	2.14	
2.20	,,	,,	2.21	She was dis-
2.25	,,	,,	2.30	[turbed.
2.37	,,	,,	2.40	
3. 2	,,	,,	3. 8	
3.16	,,	,,	3.20	
3.39	,,	,,	3.41	
3.58	,,	,,	4. 2	
4.13	,,	,,	4.20	
4.29	,,	,,	4.36	

At this time there was a shower of rain, so I removed the honey for half an hour.

At 5. 2	she returned,	and fed till	5.10
5.20	,,	,,	5.25
5.33	,,	,,	5.37
5.42	,,	,,	5.45
5.50	,,	,,	5.52
5.58	,,	,,	6. 6
6.15	,,	,,	6.18
6.21	,,	,,	6.23
6.25	,,	,,	6.27
6.32	,,	,,	6.35
6.40	,,	,,	6.44
6.49	,,	,,	6.53
7.15	,,	,,	7.20
7.25	,,	,,	7.27
7.30	,,	,,	7.33
7.36	,,	,,	7.37

During the whole of this time only three other ants came to the honey.

Aug. 13. At 11 A.M. I placed a *F. fusca* from one of my nests, which I had kept for some days without food, to some honey; she fed for some minutes, leaving at 11.6.

At 11.14	she returned,	leaving at	11.20
11.30	,,	,,	11.35
11.40	,,	,,	11.45

At 11.55 she returned,		leaving at	11.58
12. 7	,,	,,	12.11
12.18	,,	,,	12.21
12.28	,,	,,	12.31
12.38	,,	,,	12.41
12.47	,,	,,	12.51
12.56	,,	,,	12.59
1. 9	,,	,,	1.15
1.24	,,	,,	1.27
1.32	,,	,,	1.35
1.46	,,	,,	1.52
1.59	,,	,,	2. 3
2.12	,,	,,	2.15
2.26	,,	,,	2.30
2.38	,,	,,	2.43
2.55	,,	,,	3. 2
3.17	,,	,,	3.24
3.35	,,	,,	3.43
3.55	,,	,,	4. 0
4.13	,,	,,	4.17
4.35	,,	,,	4.51
5.15	,,	,,	5.26
6.29	,,	,,	6.45

I continued to watch till 8, but she came no more. During the whole time no other ant came to the honey; indeed very few left the nest at all. I kept my eye on this ant for some days, and she visited the honey every now and then, while very few others came to it.

As to Power of Communication.

With reference to the cases above recorded, in which, when ants had discovered a store of food or larvæ, others also found their way to it, I was anxious to ascertain in what manner this was effected. Some have regarded the fact as a proof of the power of communication; others, on the contrary, have denied that it indicated any such power. Ants, they said, being social animals, naturally accompany one another; moreover, seeing a companion coming home time after time with a larva, they would naturally conclude that they also would find larvæ in the same spot. It seemed to me that it would be very interesting to determine whether the ants in question were brought to the larvæ, or whether they came casually. To solve this question, I tried the following experiments during the latter days of October. I took three tapes, each about 2 feet 6 inches long, and arranged them parallel to one another and about 6 inches apart. One end of each I attached to one of my nests (*F. nigra*), and at the other end I placed a glass. In the glass at the end of one tape I placed a considerable number (300 to 600) of larvæ. In the second I put two or three larvæ only; in the third none at all. The object of the last was to see whether many ants would come to the glasses under such circumstances by mere accident; and I may at once say that scarcely any did so. I then took two ants and placed one of them to the glass with many larvæ, the other to that with two or three. Each of them took a larva and carried it to the nest, returning for another, and so on. After each journey I put another larva in the glass with only two or three larvæ to replace that which had been removed. Now, if other ants came under the above circumstances as a mere matter of accident, or accompanying one another by chance, or if they simply saw the larvæ which were being brought and consequently concluded that they might themselves also find larvæ in the same place, then the numbers going to the two glasses ought to be approximately equal. In each case the number of journeys made by the ants would be nearly the same; consequently, if it was a matter of scent, the two glasses would be in the same position. It would be impossible for an ant, seeing another in the act of bringing a larva, to judge for itself whether there were few or many larvæ left behind. On the other hand, if the strangers were brought, then it would be curious to see whether more were brought to the glass with many larvæ, than to that which only contained two or three. I should also mention that every stranger was imprisoned until the end of the experiment. The results were as follows:—

Exp. 1.—Time occupied, 1 hour. The ant with few larvæ made 6 visits and brought no friends. The one with many larvæ made 7, and brought 11 friends.

Exp. 2.—Time occupied, 2 hours. The ant with few larvæ made 13 journeys, and brought 8 friends. The one with many larvæ did not come back.

Exp. 3.—Time occupied, 3 hours. The ant with few larvæ made 24 journeys, and brought 5 friends. The one with many larvæ made 38 journeys, and brought 22 friends.

Exp. 4.—Time occupied, 2½ hours. The ant with few larvæ did not come back. The one with many made 32 journeys, and brought 19 friends.

Exp. 5.—Time occupied, 1 hour. The ant with few larvæ made 10 journeys, and brought 3 friends. The other made 5 journeys and brought 16 friends.

Exp. 6.—Time occupied, 1½ hour. The ant with few larvæ made 15 journeys, but brought no friends. The other made 11 journeys and brought 21 friends.

Exp. 7.—I now the reversed the glasses. Time occupied 3 hours. The ant with few larvæ made 23 journeys and brought 4 friends.

Exp. 8.—Time occupied, 1½ hour. The ant with few larvæ made 7 journeys and brought 3 friends. The one with many larvæ made 19 journeys and brought 6 friends.

Exp. 9.—Time occupied, 1 hour. The ant with few larvæ made 11 journeys and brought 1 friend. The one with many larvæ made 15 journeys and brought 13 friends.

Exp. 10.—I now reversed the glasses, the same two ants being under observation; but the ant which in the previous observation had few larvæ, now consequently had many, and *vice versâ*. Time occupied 2 hours. The ant with few larvæ made 21 journeys and brought 1 friend. The one with many larvæ made 32 journeys and brought 20 friends. These two experiments are, I think, very striking.

Exp. 11.—Time occupied, 5 hours. The ant with few larvæ made 19 journeys and brought 1 friend. The one with many larvæ made 26 journeys and brought 10 friends.

Exp. 12.—Time occupied, 3 hours. The ant with few larvæ made 20 journeys and brought 4 friends. The one with many larvæ brought no friends and made 17 journeys.

Exp. 13.—Time occupied, 1 hour. The ant with few larvæ made 5 journeys and brought no friends. The one with many made 10 journeys and brought 16 friends.

Exp. 14.—I now reversed the glasses. Time occupied, 2½ hours The ant with few larvæ made 10 journeys and brought 2 friends. The other made 41 journeys and brought 3 friends.

Exp. 15.—Time occupied, 4½ hours. The ant with few larvæ made 40 journeys and brought 10 friends. Of these, 8 came at the beginning of the experiment, and I much doubt whether they were brought; during the last hour and a half she only brought 1 friend. However, I think it fair to record the observation.

The ant with many larvæ made 47 journeys and brought 1 friend.

Exp. 16.—Time, 4½ hours. The ant with few larvæ made 20 journeys and brought 1 friend. She did not return after the first 2 hours. The other ant made 53 journeys and only brought 2 friends. This latter was the same one as in the previous experiment, when, however, she had the glass with only two or three larvæ.

Exp. 17.—Time, 1 hour. The ant with few larvæ made 6 journeys and brought no friend. The one with many larvæ made 11 journeys and brought 12 friends.

Exp. 18.—Time, 1½ hour. The ant with few larvæ made 25 journeys and brought four friends. The one with many larvæ made 20 journeys and brought 15 friends.

Exp. 19.—Time, 4½ hours. The ant with few larvæ made 74 journeys and brought no less than 27 friends. This is quite in opposition to the other observations; and I cannot account for it. She was the ant who brought 15 friends in the previous experiment, and it certainly looks as if some ants were more influential than others. The ant with many larvæ made 71 journeys and only brought 7 friends.

Exp. 20.—Time, 2 hours. The ant with few larvæ made 35 journeys and brought 4 friends. The one with many larvæ made 34 journeys and brought 3 friends.

Exp. 21.—I now transposed the two glasses. Time, 1½ hour. The ant with few larvæ made 15 journeys and brought no friends. The other made 35 journeys and brought 21 friends.

Exp. 22.—I now transposed the glasses again. Time, 2 hours. The ant with many larvæ made 37 journeys and brought 9 friends. The ant with few larvæ made 18 journeys and brought no friend. This, I think, is a very striking case. She was under observation 5½ hours; and the scene of her labour was the same throughout. The first 2 hours she had few larvæ and brought 4 friends; then for 1½ she had many larvæ and brought 21 friends; then again for 2 hours she had few larvæ and brought no friend.

Exp. 23.—Time, 1½ hour. The ant with few larvæ made 25 journeys and brought 3 friends. The other made only 9 journeys, but brought 10 friends.

Exp. 24.—I now transposed the glasses. Time occupied, 2 hours. The ant which now had few larvæ made 14 journeys, but brought no friends. The other made 37 journeys and brought 5 friends.

Exp. 25.—Time 3 hours. I put an ant for an hour to a full glass; she made 10 journeys and brought 4 friends. I then left only two or three larvæ: in the second hour she made 7 journeys and brought no friend. I then again filled the glass; and during the third hour she made 14 journeys and brought 3 friends.

The results of the above experiments are shown at a glance in the following Table.

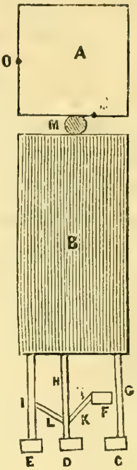
Tabular View of Experiments on Power of Communication.

Ants.	Glass with many larvæ.			Glass with one or two larvæ.		
	Time observed.	Number of journeys.	Number of strangers.	Time observed.	Number of journeys.	Number of strangers.
	hours.			hours.		
1.	1	7	11			
2.	...	...	...	1	6	0
3.	...	...	...	2	13	8
4.	...	...	...	3	24	5
5.	3	38	22	1	10	3
6.	2½	32	19			
7.	1	5	16			
8.	1½	11	21	3	23	2
9.	...	...	...	1½	7	3
10.	1	15	13	2	21	1
11.	2	32	20	1	11	1
12.	5	26	10			
13.	...	...	...	5	19	1
14.	...	...	...	3	20	4
15.	2½	41	3	2	5	0
16.	1	10	16	2½	10	2
17.	4½	53	2	4½	40	10
18.	...	...	...	2	20	1
19.	1	11	12			
20.	...	...	...	1	6	0
21.	1½	20	15	4½	74	27
22.	...	...	...	1½	25	4
23.	4½	71	7			
24.	...	...	...	2	35	4
25.	2	34	3			
26.	1½	35	21	2	18	0
27.	2	37	9	1½	15	0
28.	1½	9	10	2	14	0
29.	2	37	5	1½	25	3
30.	1½	9	10	2	14	0
31.	2	37	5	1½	25	3
32.	2	24	7	1	7	0

It must be admitted that this mode of observing is calculated to increase the number of friends brought by the ants to the glass with only 2 or 3 larvæ, for several reasons, but especially because in many cases an ant which had for some time had access to a glass with many larvæ was suddenly deprived of it, and it might well be that some time elapsed before the change was discovered. Some stray ants would, no doubt, in any case have found the larvæ; and we ought probably to allow for at least 25 under this head. Again, some would, no doubt, casually accompany their friends: if we allow 25 also in this respect, we must deduct 50 from each side, and we shall have 205 against 37. Nevertheless even without any allowances, the results seem to me very definite. Some of the individual cases, especially perhaps experiments 9 10, 20, 21, and 22, are very striking; and, taken as a whole, during $47\frac{1}{2}$ hours, the ants which had access to a glass containing numerous larvæ brought 257 friends; while during 53 hours those which were visiting a glass with only 2 or 3 larvæ brought only 82 to their assistance.

One case of apparent communication struck me very much. I had had an ant (*F. nigra*) under observation one day, during which she was occupied in carrying off larvæ to her nest. At night I imprisoned her in a small bottle; in the morning I let her out at 6.15, when she immediately resumed her occupation. Having to go to London, I imprisoned her again at 9 o'clock. When I returned at 4.40, I put her again to the larvæ. She examined them carefully, but went home without taking one. At this time no other ants were out of the nest. In less than a minute she came out again with 8 friends, and the little troop made straight for the heap of larvæ. When they had gone two thirds of the way, I again imprisoned the marked ants; the others hesitated a few moments, and then, with curious quickness, returned home. At 5.15 I put her again to the larvæ. She again went home *without a larva*, but, after only a few seconds' stay in the nest, came out with no less than 13 friends. They all went towards the larvæ; but when they got about two thirds of the way, although the marked ant had on the previous day passed over the ground about 150 times, and though she had just gone straight from the larvæ to the nest, she seemed to have forgotten her way and wandered; and after she had wandered about for half an hour, I put her to the larvæ. Now in this case the 21 ants must have been brought out by my marked one; for they came exactly with her, and there were no other ants out. Moreover it would seem that they must have been told, because (which is very curious in itself) she did not in either case bring a larva, and consequently it cannot have been the mere sight of a larva which had induced them to follow her.

Fig. 1.



It remained to ascertain whether the ants which came by themselves to the larvæ found them by scent, or whether the road had been described to them; for it is obvious that the latter would imply a higher intelligence than the former. In many of the above cases ants came by themselves almost straight to the larvæ which were being visited by my marked ants, while other larvæ close by remained entirely unvisited. The stranger ants must therefore either have had the way described to them, or, having been told of the existence of larvæ, have tracked the marked ant by scent, and so found their way to the larvæ. To determine which, I made the following experiment.

In the above figure A is the ants' nest, *o* the door of the nest. M is the section of a pole on which the whole apparatus is supported. B is a board 2 feet long; C, D, E, and F are slips of glass connected with the board B by narrow strips of paper G, H, I. K is a moveable strip of paper, 1½ inch long, connecting the glass F with the strip H; and L is another moveable strip of paper, as nearly as possible similar, connecting H and I. On each of the slips of glass C and F I put several hundred larvæ of *F. flava*. The object of the larvæ on C was to ascertain whether, under such circumstances, other ants would find the larvæ accidentally; and I may say at once that none did so. I then put the ant (A), whom I had imprisoned over night, to the larvæ on F. She took one, and, knowing her way, went straight home over the bridge K and down the strip H. Now it is obvious that by always causing the marked ant (A) to cross the bridge K on a particular piece of paper, and if at other times the papers K and L were reversed, I should be able to ascertain whether other ants who came to the larvæ had had the direction and position explained to them, or whether, having been informed by A of the existence of the larvæ, they found their way to them by tracking A's footsteps. If the former, they would in any case pass over the bridge K by whichever strip of paper it was constituted. On the other hand, if they found the larvæ by tracking, then as the piece of paper by which A passed was transferred to L, it would mislead them and carry them away from the larvæ to I. In every case, then, I transposed the two papers forming the little bridges K and L as soon as the ant A had crossed over.

I put her to the larvæ on F at 6.15 A.M. After examining them carefully, she returned to the nest at 6.34. No other ants went out; but she at once reappeared with 4 friends and reached the larvæ at 6.38. None of her friends, however, crossed the bridge; they went on to D, wandered about, and returned home. A returned to the larvæ at 6.47, this time with one friend, who also went on to D and returned without finding the larvæ.

7. 0. Ant A to larvæ.

7. 8	„	An ant at	7.10	went over L to I.	
7.17	„	with a friend, who at	7.21	„	„
7.25	„	with two friends, one of whom at	7.27	„	„
7.32	„	the other at	7.35	„	„
7.39	„	with a friend who went on to D, and then at	7.41	„	„
7.46	„	An ant at	7.42	„	„
7.55	„	„	7.47	„	„
8. 3	„	„	7.48	„	„
8. 8	„	„	7.54	„	„
8.19	„	„	7.57	„	„
8 24	„	„	9 10	found the larvæ.	
8 39	„	„	9.30	went over L to I.	
8.50	„				
9.12	„				
9.22	„				
9.40	„				
9.47	„				
9.55	„				
10.35	„				

At 10.35 I imprisoned her till 12.30, when I put her again to the larvæ.

12.48 back to larvæ.

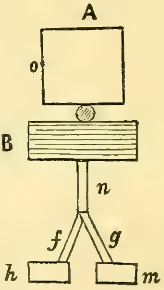
12.55	„	An ant at	12.58	went over L to I.	
1. 0	„	„	1. 1	„	„
1.15	„	„	1.10	„	„
1.20	„	„	1.13	„	„

After this she did not come any more. During the time she made, therefore, 25 visits to the larvæ; 21 other ants came a distance of nearly 4 feet from the nest and up to the point of junction within 2 inches of the larvæ; but only 1 passed over the little bridge K, while 15 went over the bridge L to I. On repeating this experiment with another marked ant, she herself made 40 journeys, during which 19 other ants found their way to the point of junction. Only 2 went over the little bridge to the larvæ, 8 went over L to I, and the remainder on to D.

Another made 16 journeys; and during the same time 13 other ants came to the point of junction. Of these 13, 6 went on to D, 7 crossed over L to I, and not one found the larvæ. Thus altogether, out of 53 ants, 20 went on to D, 30 crossed over in the wrong direction to I, and only 3 found their way to the larvæ.

From Jan. 2 to Jan. 24 (1875) I made a series of similar observations; and during this time 39 strangers came in all. Of these, 10 went straight on to D, 21 across to the paper to I, and only 8 to the larvæ.

Fig. 2.



This, I think, gives strong reason to conclude that, under such circumstances, ants track one another by scent.

I then slightly altered the arrangement of the papers as shown in the accompanying diagram (fig. 2). A, as before, is the nest, *o* being the door. B is the board; *h* is a glass on which are placed the larvæ; *m* is a similar glass, but empty; *n* a strip of paper: to the end of *n* are pinned two other strips *f* and *g* in such a manner that they can be freely turned round, so that they can be turned at will either to *h* or *m*. Under ordinary circumstances the paper *f*, as in the figure, was turned to the larvæ; but whenever a strange ant came, I turned the papers, so that *f* led to *m* and *g* to *h*. The result was so striking that I give the observation in full.

Jan. 24. I put an ant, which already knew her way, on the larvæ at 3.22.

At 3.30 she returned.				
4.15	„	At 3.38 a stranger came; and the bridge *f* being there, she went over it to *m*.		
4.25	„			
4.34	„			
4.42	„	3.50	„	„
4.50	„	4.35	„	„
4.56	„	5.15	„	„

At 5. 5 she returned.
5.14 „
5.25 „

Jan. 25, 6.30 A.M. Put two ants, which knew their way, to the larvæ.

No. 1.	No. 2.	
Returned at 6.55.		
„ 7. 7		
	Returned at 7.11.	
„ 7.15		
	„ 7.27	
„ 7.35		
„ 7.46		
	„ 7.47	
„ 7.49		
	„ 7.51	
„ 7.53		
	„ 7.57	
„ 8. 0		
„ 8. 3		
„ 8. 8		
		8.16 stranger to *m*.
„ 8.17		
	„ 8.18	
„ 8.21		
		8.22 „
„ 8.25	„ 8.25	
		8.27 „
„ 8.29		
	„ 8.30	
„ 8.31		
	„ 8.34	
„ 8.35		
	„ 8.36	
„ 8.40	„ 8.40	
„ 8.44		
		8.45 „
	„ 8.46	
„ 8.47		
„ 8.51	„ 8.51	

No. 1.	No. 2.	
Returned at 8.55		
	Returned at 8.59	
" 9. 3		
" 9. 8		
" 9.18		
" 9.24		
" 9.27		
" 9.30		
" 9.32		
" 9.34		
	" 9.35	
" 9.37		
" 9.43	" 9.43	
		9.44 stranger to *m*.
" 9.45	" 9.45	
" 9.47		
" 9.50		
	" 9.51	
" 9.55	" 9.55	
" 9.58	" 9.58	
" 10. 1	" 10. 1	
" 10. 7	" 10. 7	
" 10.10	" 10.10	
		10.11 "
	" 10.15	
" 10.16		
	" 10.17	
" 10.18		
" 10.20	" 10.20	
" 10.22	" 10.22	
" 10.24		
" 10.28		
	" 10.30	
" 10.32		
	" 10.33	
" 10.35	" 10.35	
" 10.38		
	" 10.39	
" 10.42	" 10.42	
" 10.45		

No. 1.	No. 2.	
	Returned at 10.46	
Returned at 10.48		
	,, 10.49	
,, 10.51	,, 10.51	
,, 10.53	,, 10.53	
,, 10.55		
,, 10.58	,, 10.58	
,, 11. 0		
	,, 11. 1	
,, 11. 2		
,, 11. 5		
,, 11.10		
,, 11.12		
		11.15 stranger to *m*.
,, 11.16		
,, 11.21		
,, 11.23		
	,, 11.24	
,, 11.26	,, 11.26	
,, 11.30	,, 11.30	
,, 11.35	,, 11.35	
,, 11.36		
,, 11.40	,, 11.40	11.40 ,,
		11.42 ,,
	,, 11.43	
,, 11.45	,, 11.45	
,, 11.46		
	,, 11.50	
	,, 11.51	
	,, 11.56	
,, 11.58		
	,, 11.59	
,, 12. 0		
,, 12. 2	,, 12. 2	
,, 12. 6	,, 12. 6	
,, 12.10	,, 12.10	
,, 12.14		
,, 12.16		
,, 12.20	,, 12.20	12.20 ,,
,, 12.24	,, 12.30 dropped.	
	1. 2 imprisoned her.	

Returned at 12.31	12.35 stranger to *m*.
,, 12.36	
,, 12.44	
,, 12.46	
,, 12.50	
,, 12.54	
,, 12.59	
,, 1. 1	

I then put her into a small bottle.

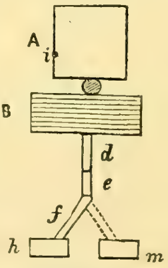
I let them out again at 7.10 on the 27th. Though the interval was so long, they began at once to work; but one unfortunately met with an accident. The other returned as follows, viz. at

7.20	
7.30	
7.40	
	7.48 stranger to *m*.
7.46	
7.51	
7.55	
7.59	

In these experiments, therefore, 17 strangers came; but at the point *n* they all took the wrong turn, and not one reached the larvæ.

Although the observations above recorded seem to me almost conclusive, still I varied the experiments once more (see fig. 3), making the connexion between the board B and the glass containing the larvæ by three separate, but similar strips of paper, *d*, *e*, and *f*, as shown in the figure. Whenever, however, a strange ant came, I took up the strip *f* and rubbed my finger over it two or three times so as to remove any scent, and then replaced it. As soon as the stranger had reached the paper *e*, I took up the strip *d*, and placed it so as to connect *e* with the empty glass *m*. Thus I escaped the necessity of changing the paper *f*, and yet had a scented bridge between *e* and *m*. The results were as follows:—

Fig. 3.



Jan. 27. At 5.30 I let out the same two ants as were under observation in the preceding experiments.

	No. 1.			No. 2.	
Returned at	5.40,	the other	not till	6.49	
,,	6. 0				
,,	6. 8				
,,	6.26				6.22 stranger to *m*.
,,	6.32				
,,	6.37				
,,	6.41				
,,	6.45				
,,	6.48	,,	,,	6.49	6.50 ,,
,,	6.51				6.52 ,,
,,	6.54	,,	,,	7. 0	6.53 stranger to larvæ.
,,	7. 1				
,,	7. 5	,,	,,	7. 6	
,,	7. 9	,,	,,	7.12	
,,	7.17	,,	,,	7.17	
		,,	,,	7.22	7.27 stranger to *m*.
,,	7.25	,,	,,	7.28	
,,	7.29	,,	,,	7.34	

I then put them into the bottle.

Jan. 28. Let them out at 6.45.

	No. 1.	No. 2.	
Back at	7. 0		
,,	....	7. 3	
,,	7. 5		
,,	7.11		
,,	....	7.12	
,,	7.16		
,,	7.21		
,,	7.27		
			7.31 stranger to *m*.
,,	....	7.32	
,,	....	7.42	
,,	7.45	She dropped into	
,,	7.52	some water.	
,,	8. 2		
,,	8.11		
,,	8.20		
,,	8.26		
,,	8.30		
,,	8.36		

No. 1.
Back at 8.40
„ 8.44
„ 8.48

I then put them into the bottle.

Jan. 29. I let them out at 7.35 A.M.

No. 1 returned at 7.47, after which I saw her no more. I fear she must have met with an accident.

No. 2 returned at	No. 3	
7.56		
8. 8		
8.18		
8.28		
8.35		
8.42		
8.48		
		8.50 a stranger came to the larvæ, marked her No. 3.
8.56		
9. 5		
9.19		
	9.20	
9.26		
9.36		
9.46		2 strangers to larvæ.
	9.47	5 strangers to *m*.

At 9.40 I found one of the ants which had been under observation on the 24th, and put her to the larvæ. She returned as follows (No. 4).

		No. 4.
	9.50	
		9.52
	9.55	
9.58		
		10. 3
10.10		
		10.12
	10.15	
10.20		10.20
	10.23	
	10.26	10.26
	10.29	
	10.33	
	10.36	
10.37		
		10.40
10.41	10.41	

No. 2.	No. 3.	No. 4.	
10.44		10.44	
10.48			
		10.51	
10.53			
	10.56		
		10.57	
10.59	10.59		
	11. 2	11. 2	
11. 4			
			11. 5 stranger to larvæ.
	11. 7		
			11. 8 ,, ,,
11. 9	11. 9		
		11.10	
	11.13		
		11.14	
	11.16		
11.17			
		11.18	
	11.20		11.20 ,, ,,
			11.21 ,, ,,
			11.22 stranger to *m*.
11.23	11.23	11.23	
			11.25 stranger to larvæ.
	11.26		
11.28			
	11.30		
11.33	11.33		
			11.35 ,, ,,
11.40			
	11.42		
		11.44	
	11.46		
11.47			
	11.50	11.50	
	11.54	11.54	
			11.55 stranger to *m*.
	11.58	11.58	
12. 0			
	12. 1		
			12. 6 ,, ,,
		12. 7	
	12. 8		
12.10			
	12.13		
		12.14	

No. 2.	No. 3.	No. 4.
12.15		
	12.18	
		12.24
	12.25	
12.27		
	12.30	
12.36	12.36	
		12.39
	12.40	
	12.43	
		12.45
	12.47	
	12.50	
		12.52
	12.53	
	12.56	
		12.57
	12.59	
		1. 0
	1. 7	1. 7
	1.12	
1.13		
		1.18
1.22		
		1.25
		1.33
		1.41
1.44		
		1.51
	1.55	
		1.56
		2. 9
		2.35

I then put her into a small bottle. We kept a look-out for Nos. 2 and 3 till 7.30 P.M.; but they did not return.

Jan. 30. Let No. 4 out at 7 A.M. She returned at 7.45.

No. 3 came of herself at	8. 0	No. 4.	
Returning at	8. 9	8. 9	
		8.15	stranger to larvæ.
,,	8.20		
		8.25	
,,	8.30		
,,	8.36		

	No. 3.	No. 4.	
Returning at	8.40		
		8.43	
		8.51	Stranger to *m*.
„	8.52		
		9. 3	
„	9. 5		

Imprisoned them.

Let them out at 10.55.

Returning at	11. 1		
		11. 3	
		11. 8	
„	11. 9		
		11.14	Stranger to *m*.

And they went on coming regularly till 1, when I put them again in a bottle.

Jan. 31. Let them out at 6.35 A.M.

No. 3.	No. 4.	
6.55		
7.12		
	7.15	
7.21		
	7.29	
7.37		
7.42	7.42	
7.48		
	7.53	
		7.55 stranger to *m*.
		8. 0 „
8. 1		
8.12		
	8.18	
8.20		
		8.24 „
8.27		
	8.28	
8.32		
		8.36 stranger to larvæ.
8.39		
.44		

I imprisoned them.

Jan 31. Let them out at 5.35 P.M.

No. 3.	No. 4.			
	5.47			
6.25				
6.35				
6.48				
6.53				
7. 2				
7. 7				
7.11				
7.16				
7.20				
		7.23	stranger to	larvæ.
7.25				
		7.26	"	"
		7.27	"	*m.*
		7.29	"	"
7.30		7.30	"	larvæ.
Imprisoned her		7.31	"	*m.*

Feb. 1. Let her out at 7.5.

	No. 3.			
She returned at	7.20			
"	7.30			
		7.38	stranger to	*m.*
"	7.40			
"	7.48			
"	7.58			
		7.59	"	
"	8. 6			
"	8.12			
		8.14	"	
		8.17	"	
"	8.22			

Imprisoned her and let her out again at 6.20 P.M.

She returned at	6.35
"	6.52
"	7. 0
"	7. 5
"	7.15

No. 3.

She returned at 7.20
„ 7.25
Imprisoned her.

Feb. 2. Let her out at 6.30 A.M.

She returned at	6.50	
„	7. 0	
		7. 2 stranger to *m*.
„	7. 7	
		7.10 two strangers to *m*.
„	7.13	
„	7.17	
		7.27 stranger to larvæ.
„	7.28	
„	7.36	
		7.38 „ *m*.
„	7.45	
„	7.50	
		7.51 „ „
„	7.55	
„	8. 4	
		8. 6 „ „
„	8.11	
„	8.18	
„	8.25	
„	8.30	
„	8.35	
„	8.45	
„	8.46	

Imprisoned her.

In this experiment, then, the bridge over which the marked ant passed to the larvæ was left in its place, the scent, however, being removed or obscured by the friction of my finger; on the other hand, the bridge had retained the scent, but was so placed as to lead away from the larvæ; and it will be seen that, under these circumstances, out of 41 ants which found their way towards the larvæ as far as *e*, 14 only passed over the bridge *f* to the larvæ, while 27 went over the bridge *d* to the empty glass *m*.

Taking these observations as a whole, 150 ants came to the point *e*, of which 21 only went on to the larvæ, while 95 went away to the empty glass. These experiments, therefore, are in entire accordance with those already laid before the Society, and seem to me to show that when an ant has discovered a store of food and others gradually flock to it, they are guided, in some cases by sight, while in others they track one another by scent.

As to their Intelligence and Provident Habits.

It is generally stated that our northern ants do not store up food. But it must be remembered that their nourishment is, for the most part, of a very perishable character, and could not be preserved. Those ants, however, which collect *Aphides* may fairly be said, in doing so, to provide for themseleves the means of subsistence.

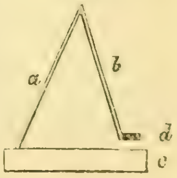
M. Lund tells the following story as bearing on the intelligence of ants *:—

"Passant un jour près d'un arbre presque isolé, je fus surpris d'entendre, par un temps calme, des feuilles qui tombaient comme de la pluie. Ce qui augmenta mon étonnement, c'est que les feuilles détachées avaient leur couleur naturelle, et que l'arbre semblait jouir de toute sa vigueur. Je m'approchai pour trouver l'explication de ce phénomène, et je vis qu'à peu près sur chaque pétiole était postée une fourmi qui travaillait de toute sa force; le pétiole était bientôt coupé et la feuille tombait par terre. Une autre scène se passait au pied de l'arbre: la terre était couverte de fourmis occupées à découper les feuilles à mesure qu'elles tombaient, et les morceaux étaient sur le champ transportés dans le nid. En moins d'une heure le grand œuvre s'accomplit sous mes yeux, et l'arbre resta entièrement dépouillé."

With reference to this interesting account, I tried the following experiment:—

Oct. 15, noon. (See fig. 4.) At a distance of 10 inches from the door of a nest of *F. nigra* I fixed an upright ash wand 3 feet 6 inches high (*a*), and from the top of it I suspended a second, rather shorter wand (*b*). To the lower end of this second wand, which hung just over the entrance to the nest (*c*), I fastened a flat glass cell (*d*) in which I placed a number of larvæ of *F. flava*, and to them I put three or four specimens of *F. nigra*. The drop from the glass cell to the upper part of the frame was only

Fig. 4.



* Ann. des Sci. Nat. 1831, p. 112.

½ an inch; still, though the ants reached over and showed a great anxiety to take this short cut home, they none of them faced the leap, but all went round by the sticks, a distance of nearly 7 feet. At 6 P.M, there were over 550 larvæ in the glass cell, and I reduced its distance from the upper surface of the nest to about ⅖ of an inch, so that the ants could even touch the glass with their antennæ, but could not reach up nor step down. Still, though the drop was so small, they all went round. At 11 P.M. the greater number of the larvæ had been carried off; so I put a fresh lot in the cell. The ants were busily at work. At 3 A.M. I visited them again. They were still carrying off the larvæ, and all going round. At 6 A.M. the larvæ were all removed. I put a fresh lot, and up to 9 A.M. they went on as before.

The following day (Oct. 17), I took two longer sticks, each 6 feet 6 inches in length, and arranged them in a similar manner, only horizontally instead of vertically. I also placed fine earth under the glass supporting the larvæ. At 8 o'clock I placed an ant on the larvæ; she took one, and I then coaxed her home along the sticks. She deposited her larva and immediately came out again, not, however, going along the stick, but under the larvæ, vainly reaching up and endeavouring to reach the glass. At 8.30 I put her on the larvæ again, and as she evidently did not know her way home, but kept stretching herself down and trying to reach the earth under the glass cell, I again coaxed her home along the sticks. At 9.3 she came out again, and again went under the larvæ and wandered about there. At 10 I put her on the larvæ and again helped her home. At 10.15 she came out again, and this time went to the stick, but still wanted some guidance. At 10.45 she again reached the frame, but immediately came out again, and I once more coaxed her round. After wandering about some time with a larva in her mouth, she dropped down at 11.14. After depositing her larva, she came out directly and went under the larvæ. I again coaxed her round, and this time also she dropped off the glass with her larva. At 12.30 she came out again, and for the last time I helped her round. After this she found her way by herself. At 12.20 another (No. 2) found her way round and returned at 12.37. For the next hour their times were as follows:—

No. 1.	No. 2.
12.46	
	12.47
12.54	12.54
	1. 0
1. 1	
1. 7	
	1. 8
1.12	
	1.14
1.19	
	1.21
1.26	
	1.28
1.32	
	1.34
1.38	
	1.41
1.45	
	1.47
1.52	
	1.54

Thus they both made 9 visits in an hour. As regards actual pace, I found they both did about 6 feet in a minute. Soon after these began, other ants came with them. It was a beautiful day, and all my ants were unusually active. At 1 P.M. I counted 10 on the sticks at once, by 1.30 over 30, and at 5 in the afternoon over 60. They went on working very hard, and forming a continuous stream till I went to bed at 11; and at 4 in the morning I found them still at work; but though they were very anxious and, especially at first, tried very hard to save themselves the trouble of going round, they did not think of jumping down, nor did they throw the larvæ over the edge.

Moreover, as I had placed some sifted mould under the glass, a minute's labour would have been sufficient to heap up one or two particles, and thus make a little mound which would have enabled them to get up and down without going round. A mound $\frac{1}{8}$ inch high would have been sufficient; but it did not occur to them to form one.

The following morning (Oct. 18) I put out some larvæ again at 6 A.M. Some of them soon came; and the same scene continued till 11.30, when I left off observing.

Again, on the 22nd Oct. I placed a few larvæ of *F. flava* in a glass, which I kept continually replenished, which was suspended $\frac{1}{3}$ of an inch above the surface of the frame containing their nest, but only connected with it by tapes 5 feet long. I then, at 6.30, put a *F. nigra* to the larvæ; she took one and tried hard to reach down, but could not do so, and would not jump; so I coaxed her round the tapes. She went into the nest, deposited her larva, and immediately came out again. I put her back on the larvæ at 7.15; she took one, and again tried hard, but ineffectually, to reach down. I therefore again coaxed her round. She went into the nest, deposited her larva, and came out again directly as before. I put her back on the larvæ at 7.35, when the same thing happened again. She got back to the nest at 7.40, and immediately came out again. This time she found her way round the string, with some help from me, and reached the larvæ at 7.50. I helped her home for the last time. The next journey she found her way without assistance, and reached the larvæ at 8.26. After this she returned as follows, viz.:—

At 8.50
9. 0
9.10
9.17
9.28

I now made the length of the journey round the tapes 10 feet. This puzzled her a little at first.

She returned as follows:—

9.41	10.35
9.55	10.44
10. 8	10.55
10.16	11. 6
10.26	11.14 with a friend.

I now made the length 16 feet.

She returned at 11.34
„ 12.14
12·20 two strangers found the larvæ.
„ 12.31
, 12.50
„ 1.10
„ 1.30

She returned at	1.46		
,,	1.59		
,,	2.10		
,,	2.20		
,,	2.35		
,,	2.45		
,,	2.52		
,,	3.10		
	3.19		
,,	3.29		
,,	3.40		
,,	3.50	I now put between 700 and 800	
,,	4.14	larvæ in the glass.	
,,	4.31		
		4.33 a stranger came.	
,,	4.44		
,,	4.56		
,,	5. 8		
		5.12	,,
		5.20	,,
,,	5.25		
,,	5.40		
,,	6. 6		
		6.10	,,
,,	6.51		
,,	7. 0		
,,	7.11		
		7.15	,,

It surprised me very much that she preferred to go so far round rather than to face so short a drop.

In illustration of the same curious fact, I several times put specimens of *F. nigra* on slips of glass raised only one third of an inch from the surface of the nest. They remained sometimes three or four hours running about on the glass, and at last seemed to drop off accidentally.

Myrmica ruginodis has the same feeling. One morning, for instance, I placed one in an isolated position, but so that she could escape by dropping one third of an inch. Nevertheless at the same hour on the following morning she was still in captivity, having remained out twenty four hours rather than let herself down this little distance.

In my previous memoir I called attention to M. Forel's interesting statement that when ants quit the pupa stage, they cannot distinguish friends from foes, though three or four days are sufficient to enable them to do so. On this point M. Forel has favoured me with the following interesting explanation :—

"Je prends des fourmis toutes jeunes (blanches encore) de *fourmilières* et *d'espèces* entièrement différentes ; elles se mêlent toutes amicalement les unes aux autres sans distinction, à l'exception d'une *rufibarbis* ☿ qui se trouve être un peu plus âgée et se retire à l'écart avec un cocon ; elle ne se décide à s'allier aux autres que le lendemain. *Dix jours* après le commencement de l'expérience j'établis mes fourmis *qui ont formé une communauté* dans un coin, et je leur apporte de nouvelles jeunes fourmis toutes blanches prises au dehors. Les nouvelles venues elles ne sont pas mal disposées ; elles entrent au contraire dans la fente de mur où sont les autres, mais les anciennes les repoussent, les menacent et les jettent dehors. Cette expérience démontre qu'au bout de dix jours les fourmis distinguent *leurs camarades* des étrangères, tandis qu'elles ne font pas cette distinction dans les premiers jours qui suivent leur éclosion. Si je me suis permis d'écrire qu'il suffit de trois ou quatre jours de vie pour qu'une nouvelle éclose sache reconnaître un ami d'un ennemi, ce n'est pas à la suite d'une expérience directe faite dans le but de fixer ce terme, mais parceque dans les innombrables observations faites sur ces fourmis je me suis assuré qu'il le fallait à peu près ce temps pour atteindre un certain degré de coloration et de consistance, et qu'à ce degré de coloration et de consistance elles commencent à distinguer leurs ennemis, soit qu'elles s'enfuient, soit qu'elles leur montrent les dents. J'aurais du reste peut-être mieux fait de ne pas fixer ainsi ce temps, car il y a tant de variations individuelles, suivant la température &c. que l'on ne peut être assez prudent avant de généraliser. En hiver les jeunes fourmis deviennent beaucoup moins vite adultes qu'en été."

Division of Labour.

In a nest of *F. fusca* which I established in my room on the 13th of December 1874, and in which the females began laying eggs about the middle of April, the pupæ had all come to maturity by the end of August ; and after this very few of the ants came out of the nest. On the 3rd of September I noticed an ant at some honey which I had put out for their use. From that time to the present (Oct. 30) I have observed no other ant at the honey, while, on the contrary, I have found this particular ant feeding over and over again,—for instance, on the 12th, 13th, 14th, 15th, 17th, 19th, 20th, 24th, 25th, 26th, 27th, and 28th of September, 1st, 5th, 12th, 19th, 22nd, 24th, and 30th of October. As I was away sometimes for two or three days together, and am generally only at home in the mornings and evenings, it is very probable that this ant visited the honey every day, and took in stores to her companions. I have already mentioned a somewhat similar though less marked case.

Concerning Affection and Behaviour to Wounded.

As regards the affection of ants for one another, Latreille makes the following statement:—"Le sens de l'odorat," he says*, "se manifestant d'une manière aussi sensible, je voulois profiter de cette remarque pour en découvrir le siége. On a soupçonné depuis longtemps qu'il résidoit dans les antennes. Je les arrachai à plusieurs fourmis fauves ouvrières, auprès du nid desquelles je me trouvois. Je vis aussitôt ces petits animaux que j'avois ainsi mutilés tomber dans un état d'ivresse ou une espèce de folie. Ils erroient çà et là, et ne reconnoissoient plus leur chemin. Ils m'occupoient; mais je n'étais pas le seul. Quelques autres fourmis s'approchèrent de ces pauvres affligées, portèrent leur langue sur leurs blessures, et y laissèrent tomber une goutte de liqueur. Cet acte de sensibilité se renouvela plusieurs fois; je l'observoi avec une loupe. Animaux compatissans! quelle leçon ne donnez-vous pas aux hommes."

"Jamais," says M. de Saint Fargeau†, "une Fourmi n'en rencontre une de son espèce blessée, sans l'enlever et la transporter à la fourmilière. L'y soigne-t-elle? Je ne sais, mais je vois dans ce fait une bienveillance que je ne retrouve dans aucun autre insecte, même social."

I have not felt disposed to repeat M. Latreille's experiment, nor have I been so fortunate as to witness such a scene accidentally. My limited experiences have been of the opposite character. On one occasion (Aug. 13) a worker of *F. nigra*, belonging to one of my nests, had got severely wounded, but not so much so that she could not feed; for though she had

* Hist. Nat. des Fourmis, p. 41.

† Hist. Nat. des Ins. Hymèn. vol. i. p. 99.

lost five of her tarsi, finding herself near some syrup, she crept to it and began to feed. I laid her gently on her back close to the entrance into the nest. Soon an ant came up to the poor sufferer, crossed antennæ with her for a moment, then went quietly on to the syrup and began to feed. Afterwards three other ants did the same; but none took any more notice of her.

Aug. 15. I found at 1 P.M. a *Myrmica ruginodis* which had lost the terminal portion of both her antennæ. She seemed to have lost her wits. I put her into her nest; but the others took no notice of her; and after wandering about a little, she retired into a solitary place, where she remained from 3 P.M. to 8 without moving. The following morning I looked for her at 5.30, and found her still at the same spot. She remained there till 9, when she came out. She remained out all day; and the following morning I found her dead.

Indeed I have often been surprised that in certain cases ants render one another so little assistance. The tenacity with which they retain their hold on an enemy they have once seized is well known. M. Mocquerys even assures us that the Indians of Brazil made use of this quality in the case of wounds; causing an ant to bite the two lips of the cut and thus bring them together, after which they cut off the ant's head, which thus holds the lips of the wound together. He asserts that he has often seen natives with wounds in course of healing with the assistance of seven or eight ants' heads*! Now I have often observed that some of my ants had the heads of others hanging on to their legs for a considerable time; and as this must certainly be very inconvenient, it seems remarkable that their friends should not relieve them of such an awkward encumbrance.

Recognition of Friends.

I have also made some experiments on the power possessed by ants of recognizing their friends. It will be remembered that Huber gives a most interesting account of the behaviour of some ants, which, after being separated for four months, when brought together again, immediately recognized one another, and "fell to mutual caresses with their antennæ." Forel, on the contrary, regards these movements as indicating fear and surprise rather than affection, though he also is quite inclined to believe, from his

* Ann. Soc. Ent. France, 2 Sér. tom. ii. p. 67.

own observations, that ants would recognize one another after a separation of some months. The observation recorded by Huber was made casually; and he does not seem to have taken any steps to test it by subsequent experiments. The fact is one, however, of so much interest that it seemed to me desirable to make further experiments on the subject. On the 4th of August I separated one of my nest of *F. fusca* into two halves, which I kept entirely apart from one another.

Four days afterwards (August 8th) I put an ant from a different nest into one of these at 8 A.M. She was at once attacked; two hung on to her till about 11, when they left her. Before evening she seemed to have fraternized with them.

Aug. 13. I put another stranger into one of these nests at 9 A.M. At 10.30 one of the ants was dragging her about by an antenna; at 1 she was free; and at 2 I found her among the rest, apparently received as a friend. Two days afterwards she was still well.

Aug. 16. I took one of the ants which I had removed from the others on the 4th and replaced her with her old companions. They seemed to take no notice of her, and certainly did not attack her.

Aug. 20. I put in a stranger at 7.30. At 7.45 one of them had hold of her by the mandibles; at 9.30 one was hanging on to her hind leg; at 10.45 she was free; and I did not see them attack her any more.

Aug. 22. At 7.30 put in a stranger and one of their former companions. One of the ants attacked the former; they took no notice of the latter so far as I could see. At 10.45 they both seemed at home. This stranger I saw repeatedly afterwards, and she had evidently been received completely into the community.

Sept. 3. At 7 A.M. I put a stranger in and also one of their old companions. Neither of them was attacked.

Sept. 17. Put in three strangers; but they were not attacked.

Oct. 3. I put in another stranger; but they did not seem to mind her.

As, therefore, in some cases these ants did not appear disposed to attack strangers, I tried similar experiments with a nest of *Myrmica ruginodis*.

On the 20 August I divided a colony of this species, so that one half were in one nest (No. 9) and the other half in another (No. 15), and kept them entirely apart.

On the 3rd Oct. I put into nest 15 a stranger and an old companion from nest 9. One of them immediately flew at the stranger; of the other they took no notice.

Oct. 18. At 10 A.M. I put in a stranger and a friend from nest 9. In the evening the former was killed, the latter was all right.

Oct 19. I put one in a small bottle with a friend from nest 9. They did not show any enmity. I then put in a stranger; and one of them immediately began to fight with her. In the evening the stranger was dead.

Oct. 24. I again put in a stranger and a friend. The former was attacked, but not the latter. The following day I found the former almost dead, while the friend was all right.

Oct. 31. I again put in a stranger and a friend. The former was at once attacked; but in this case the friend also was, after a bit, seized by the leg, but eventually released again. On the following morning the stranger was dead, the friend was all right.

Nov. 7. Again I put in a stranger and a friend. The latter was soon attacked and eventually killed; of the former they did not seem to me to take any particular notice. I could see no signs of welcome, no gathering round a returned friend; but, on the other hand, she was not attacked.

The Senses.

Much has been written on the use of the antennæ of insects. That they serve as organs of touch all are agreed; but it is almost equally clear that this is not in most cases their only function. Some entomologists regard them as auditory, some as olfactory organs. There is, however, a third alternative, which I would venture to suggest, namely that in those insects in which the sense of hearing is highly developed they may serve as ears, while in those which have a very delicate sense of small, they may act as olfactory organs. This view is not in itself so improbable as might at first sight appear. It is evident that, in the Articulata, organs of sense are developed in various parts of the body. Whether the curious organ discovered by Müller in the metathorax of certain Orthoptera be an ear or not, it must surely be an organ of some sense. Hicks and others have described structures in the halteres and wings of various insects which have all the appearance of being organs of sense; while among the Crustacea we find the remarkable case of *Mysis*, which even has an organ of sense in its tail. It is not then so improbable as might at first sight appear, that the antennæ should in some species act as ears and in others serve for the perception of odours. The position, moreover, which they occupy renders them a most advantageous situation for an organ of sense. This suggestion would also explain various experiments and observations recorded by skilful entomologists, and which it is otherwise difficult to reconcile with one another.

The Sense of Hearing.

Many eminent observers have regarded the antennæ as auditory organs, and have brought forward strong evidence in favour of their view. Lespés, for instance, found that a female *Locusta viridissima*, which was very sensitive to sound, lost apparently all power of hearing when the antennæ were removed. She lived a fortnight longer and continued to eat. M. Lespés observed no other result except the loss of hearing.

So far as I am aware, no proof has yet been adduced that ants possess the power of hearing. In order, if possible, to throw some light upon this interesting question, I made a variety of loud noises, including those produced by a complete set of tuning-forks, as near as possible to the ants mentioned in the preceding pages, while they were on their journeys to and fro between the nests and the larvæ. In these cases the ants were moving at a steady pace and in a most business-like manner, and any start or alteration of pace would have been at once apparent. I was never able, however, to perceive that they took the slightest notice of any of these sounds. Thinking, however, that they might perhaps be too much absorbed by the idea of the larvæ to take any notice of my interruptions, I took one or two ants at random and put them on a strip of paper, the two ends of which were supported by pins with their bases in water. The ants imprisoned under these circumstances wandered slowly backwards and forwards along the paper. As they did so, I tested them in the same manner as before, but was unable to perceive that they took the slightest notice of any sound which I was able to produce. I then took a large female of *F. ligniperda*, and tethered her on a board to a pin by a delicate thread about 6 inches in length. After wandering about for a while, she stood still, and I then tried her as before; but, like the other ants, she took no notice whatever of the sounds.

It is of course possible, however, if not probable, that ants, even if deaf to sounds which we hear, may hear others to which we are deaf. On this subject I hope to make some experiments, in which Mr. Spottiswoode has kindly promised to assist me.

The Sense of Smell.

I have also made similar experiments, though with very different results, on the power of smell possessed by ants. I dipped camel's-hair brushes into peppermint-water, essence of cloves, lavender-water, and other strong scents, and suspended them about $\frac{1}{4}$ of an inch above the strips of paper along which the ants were passing in the experiments above recorded. Under these circumstances, while some of the ants passed on without taking any notice, others stopped when they came close to the pencil, and, evidently perceiving the smell, turned back. Soon, however, they returned and passed the scented pencil. After doing this two or three times, they generally took no further notice of the scent. This experiment left no doubt on my mind; still, to make the matter even more clear, I experimented with ants placed on an isolated strip of paper, as described on p. 495. Over the paper, and at such a distance as almost, but not quite, to touch any ant which passed under it, I again suspended a camel's-hair brush, dipped in assafœtida, lavender-water, peppermint-water, essence of cloves, and other scents. In this experiment the results were very marked; and no one who watched the behaviour of the ants under these circumstances could have the slightest doubt as to their power of smell.

I then took a large female of *F. ligniperda* and tethered her on a board by a thread as before. When she was quite quiet I tried her with the tuning-forks; but they did not disturb her in the least. I then approached the feather of a pen very quietly, so as just to touch first one and then the other of the antennæ, which, however, did not move. I then dipped the pen in essence of musk and did the same; the antenna was slowly retracted and drawn quite back. I then repeated the same with the other antenna. If I touched the antenna, the ant started away, apparently smarting. I repeated the same with essence of lavender and with a second ant.

As to Sentiments of Benevolence.

Mr. Grote, in his 'Fragments on Ethical Subjects,' regards it as an evident necessity that no society can exist without the sentiment of morality. "Every one," he says, "who has either spoken or written on the subject has agreed in considering this sentiment as absolutely indispensable to the very existence of society. Without the diffusion of a certain measure of this feeling throughout all the members of the social union, the caprices, the desires, and the passions of each separate individual would render the maintenance of any established communion impossible. Positive morality, under some form or other, has existed in every society of which the world has ever had experience."

If this be so, then ants also must be moral and accountable beings. I cannot, however, of course urge this, because I have elsewhere attempted to show that even as regards man, the case is not by any means clear. In the case of ants, various observers have recorded instances of attachment and affection, some of which have been referred to in my previous papers. With reference to this part of the subject, I have made some further experiments.

Jan. 3, 1876. I immersed an ant (*F. nigra*) in water for half an hour; and when she was then to all appearance drowned, I put her on the strip of paper I mentioned on p. 473. The strip was half an inch wide; and one of my marked ants belonging to the same nest was passing continually to and fro over it. The immersed ant lay there an hour before she recovered herself; and during this time the marked ant passed by 18 times without taking the slightest notice of her.

I then immersed another ant in water for an hour, after which I placed her on the strip of paper as in the preceding case. She was three quarters of an hour before she recovered: during this time two marked ants were passing to and fro; one of them went by 18 times, the other 20 times; and two strangers also went over the paper; but none of them took the slightest notice of their drowned friend.

I then immersed another ant for an hour, and then put her on the strip of paper. She took an hour to recover. The same two marked ants as in the previous observation were at work. One passed 30 times, the other 28 times, besides which five strangers passed by; but not one took the slightest notice.

I immersed three ants for eight hours, and then put them on the strip of paper. They began to recover in three quarters of an hour, but were not quite themselves till half an hour afterwards. During the first three quarters of an hour two marked ants passed, each four times; and two others also went by. During the following half-hour the two marked ants passed 16 times, and three strangers; but none of them took any notice.

I immersed another ant for forty minutes, and put her on the strip of paper. She recovered in twenty minutes, during which time two strangers passed, and the marked ants, which were the same as in the preceding case, went by 14 times without taking any notice.

I immersed two ants for ten hours, and then placed them on the strip of paper. The same two marked ants passed respectively 18 and 26 times, and one stranger passed again, without taking any notice. After this I left off watching.

I immersed two ants for four hours, and then put them on the strip of paper. They began to recover in an hour, during which two marked ants, not the same as in the preceding case, passed respectively 28 and 10 times, and two others went by; but none of them took any notice.

I immersed an ant for an hour, and then put her on the same strip of paper as in the previous cases. A marked ant passed her twelve times; and three others also took no notice; but, on the other hand, a fourth picked her up and carried her off into the nest.

Again, I immersed an ant for an hour, and put her on the string. The marked ant passed twice, after which she did not return. Soon after, another ant came by and, picking up the immersed one, carried her off to the nest.

I do not bring forward these cases as proof or even as evidence that ants are less tender to friends in distress than previous observers have stated to be the case; but they certainly show that tenderness is not invariably the rule; and, especially when taken in connexion with the two following cases, they are interesting illustrations of the individual differences existing between ants—that there are Priests and Levites, and good Samaritans, among them as among men.

Bees.

Their Appreciation of Colour.

Bees soon accustom themselves to look for honey on papers of particular colours. For instance, on Sept. 13, at 11 A.M., I brought up a bee from one of my hives; at 11.40 she returned to honey which I had put on a slip of glass on green paper.

She returned at 11.51. And again

,, 12. 1

,, 12.13

,, 12.22

,, 12.33

,, 12.46

,, 12.58

,, 1.12. This time she lost her way in the room.

,, 1.49

,, 2. 1. This time she got stuck in the honey, and had to clean her.

,, 2.25

,, 2.40. I now put red paper instead of the green, and put the green paper with a similar quantity of honey on it a foot off.

,, 2.51 to the honey on green paper. I then gently moved the green paper with the bee on it, back to the old spot. When the bee had gone, I put yellow paper where the green had been, and put the green again a foot off.

,, 3. to the honey on the yellow paper. I disturbed the bee, and she at once flew to the honey on the green paper; when she had gone, I put orange paper in the old place, and put the green paper about a foot off.

,, 3.10 to the honey on the green paper. I again gently moved the paper, with the bee on it, to the usual place; and when the bee had gone, put white paper in the old place, and put the green a foot off.

,, 3.20 to the honey on the green paper. I again gently moved the green paper, with the bee on it, to the old place; and when she had gone, replaced it by blue paper, putting the green a foot off.

,, 3.30 to the honey on the green paper. I again repeated the same thing, putting yellow instead of blue.

She returned at 3.40 to the green paper. I now reversed the position of the yellow and green papers; but
" 3.51 to the green. After this
" 4. 6
" 4.15
" 4.28, when she left off for the day,

nor were there any bees still working in the garden. The same afternoon a wasp, which I was observing, remained at work till 6.29.

Aug. 20. About noon I brought five bees to some honey at my window. They all soon returned, and numerous friends came with them. One of them I put to some honey on blue paper. She returned as follows, viz. :—

At 12.36	At 2.30
12.42	2.38
12.53	3. 2
1.28	3.10
1.38	3.22
1.49	3.50
2. 2	4. 4
2.11	4.14
2.24	4.23

when I left off watching and shut her out. The longer intervals are due to her having got some honey every now and then on her wings and legs, when she lost a little time in cleaning herself.

Aug. 21. I opened my window at 6 A.M. No bee came till at 7.33 the above one came to the honey on blue paper.

I also placed some honey on orange paper about 2 feet off.

At 7.42 she returned to the honey on blue paper, and again
7.55 she returned to the honey on blue paper.
8. 3 " "
8.14 " "
8.25 " "
8.36 " "
8.44 " "
8.54 " "
9. 5 " "

I then transposed the papers, but not the honey.

At 9.16	she came back to the honey	on blue paper.	I then tranposed the papers again.
9.29	,,	,,	I then transposed them again.
9.39	,,	,,	,, ,,
9.53	,,	,,	I now put green paper instead of orange, and transposed the places.
10. 0	,,	green paper.	I transposed them again.
10. 8	,,	blue	,, ,,
10.21	,,	green	I now put red paper instead of green, and transposed the places.
10.30	,,	blue	I transposed them again.
10.42	,,	,,	,, ,,
10.53	,,	,,	,, ,,
11. 4	,,	,,	,, ,,
11.16	,,	,,	I now put white paper instead of red, and transposed the places.
11.28	,,	,,	I transposed them again.
11.41	,,	,,	,, ,,
11.56	,,	,,	,, ,,
12. 8	,,	,,	,, ,,
12.17	,,	,,	I now put green paper again instead of white, and transposed the places.
12.27	,,	,,	I transposed them again.
12.40	,,	,,	,, ,,
12.50	,,	,,	,, ,,
1. 0	,,	,,	,, ,,
1.13	,,	,,	,, ,,
1.25	,,	,, and then to the green.	,, ,,
1.40	,,	,,	,, ,,
1.47	,,	green.	
1.57	,,	blue, and then to green.	,, ,,
2. 6	,,	blue.	,, ,,
2.17	,,	,,	

The following day I accustomed this bee to green paper. She made 63 visits (beginning at 7.47 and ending at 6.44), of which 50 were to honey on green paper.

The following day, Aug. 23, she began work:—

At 7.12 returning to honey on green paper. I then put some on yellow paper about a foot off.

7.19	she turned to the honey	on green paper.	I transposed the colours.
7.25	,,	,,	I replaced the yellow paper by orange and transposed the places.
7.36	,,	,,	I transposed the colours so that the orange might be on the spot to which the bee was most accustomed.
7.44	,,	,,	I now put white instead of orange.
7.55	,,	,,	Transposed the papers.
8. 1	,,	,,	I now put blue paper instead of white.
8.12	,,	blue paper.	I now put red instead of blue.
8.23	,,	green paper.	
8.25	,,	,,	
8.47	,,	,,	

I then ceased observing and removed the honey.

Thus the bee which was accustomed to green returned to that colour when it was removed about a foot, and replaced by yellow, orange, white, and red; but on the other hand, when blue was so placed, she returned to the blue. I kept this bee under observation till the 28th, but not with reference to colours.

Aug. 24. At 7.45 I put a bee (No. 5) to honey on green paper, to which she kept on returning till 9.44. The next day (Aug. 25) she came at 7.38, and I let her come to the green paper till 9. The following morning she returned at 6 A.M., coming back as follows, viz.:—

At 6.10
6.18
6.25
6.35
6.45

6.54
7. 3
7.13

I now put orange in place of green, and put the green a foot off.

At 7.24	she returned	to the	green.	I replaced the paper with the bee on it; and when she had gone I put light blue in place of the green, and again moved the green a foot off.
7.36	”	”	blue.	I again replaced the paper with the bee on it; and when she had gone I put yellow in place of the green, and again moved the green a foot off.
7.44	”	”	green.	I then did exactly the same, only putting vermilion in place of the green.
7.55	”	”	”	I then did exactly the same, only putting white in place of green.
8. 3	”	”	”	

It would almost seem, from these observations, as if there was less distinction in the eye of the bee between green and blue than between green and other colours. If this should be confirmed, it would have an interesting bearing on the colours of flowers.

April 4. A fine day, but cold. I brought a bee to some honey at my window. She returned at the following times:—

1. 1	2.18
1.17	3.11
1.24	3.20
1.41	3.31
1.50	3.38
2. 1	3.50
2. 6	

But during this time only one other bee came to the honey; and, indeed, after 2 no other bees were at work.

I had on Aug. 20 introduced some bees to honey in my room, since which it had been much visited by them. On the 24th I put a bee to some honey inside a flower-pot 5 inches high and 5 wide at the base. The flower-pot was laid on its side, and the mouth closed, so that the bee had to come out through the hole in the bottom, which was about $\frac{1}{2}$ an inch in diameter. To make things easier for her, I made her a small alighting-board of wood, the top of which was level with the hole. I then placed the flower-pot on the spot where she was accustomed to find the honey. She had made her first visit that morning at 6.45, returning

at 6.55
7. 5
7.14
7.23 And when I put her, while feeding, into the flower-pot, she found her way out without difficulty.
At 7.40 she returned, but did not seem able to find her way; so I put her in. The same thing happened again at
7.50
8. 6
and 8.20
but at 8.38 she found her way in easily, and had no further difficulty. She returned at
8.53
9. 5
9.14
9.25
9.41
9.55
10. 6 This time a friend came with her and followed her in. I captured her. No. 2 took no notice, but returned

At 10.19	At 12. 9
10.30	12.25
10.44	12.37
10.54	12.50
11. 6	1. 2
11.20	1.14
11.31	1.25
11.44	1.36
11.55	1.47

At 1.57	At 4.44
2. 9	4.55
2.19	5.10
2.31	5.24
2.43	5.35
2.59	5.46
3.23	5.58
3.33	6. 9
3.44	6.20
3.56	6.42
4. 7	7. 0
4.21	7.15
4.34	making 59 visits.

After which she came no more that day. With the one exception above mentioned, during the whole time no other bee came to the honey. I might also mention that I had put out six similar flower-pots in a row, and that this seemed to puzzle the bee a good deal; she frequently buzzed about before them, and flew from one to the other before entering. When she went in, she generally stood still just inside the entrance for about thirty seconds, buzzing loudly with her wings. I thought at first whether this could be intended as a sort of gong to summon other bees to the feast; but, though several were flying about, at any rate none came. The following day (Aug. 25) she came at 6.51, and had made nine journeys up to 8.41, when I left off watching. During this time no other bee came.

Aug. 26.	She came at	6.32,	and up to	8.43	had made	13	journeys.
27	,,	6. 7	,,	8.43	,,	14	,,
28	,,	6.17	,,	7.11	,,	5	,,

It was a gloomy morning. No other bee came.

Wasps.

In my previous paper I endeavoured to show that wasps are entitled to at least as much credit as bees for industry. Indeed, as far as my experience goes, they both begin to work earlier in the morning and continue later in the evening. But without making any invidious comparisons, the following cases which I give as showing that wasps do not by any means always bring friends to share any good things they may have discovered, also prove their great industry. Thus:—

July. I marked a wasp (*V. vulgaris*, ♀) and put her to some honey. All day she kept coming back till past 8 in the evening, but brought no friend. I do not think it necessary to give the times of all her visits; but I may give the times for a few. For instance,

At 3.13 she came to the honey, and at 3.14 returned to her nest.

3.16	„	„	3.18	„
3.20	„	„	3.21	„
3.24	„	„	3.25	„
3.27	„	„	3.28	„
3.29	„	„	3.30	„
3.32	„	„	3.33	„
3.35	„	„	3.36	„
3.40	„	„	3.41	„
3.43	„	„	3.44	„
3.46	„	„	3.47	„
3.49	„	„	3.50	„
3.53	„	„	3.54	„
3.56	„	„	3.57	„
4. 0	„	„	4. 1	„
4. 3	„	„	4. 4	„
4. 6	„	„	4. 7	„
4.10	„	„	4.11	„
4.14				

Thus having made no less than 19 journeys in one hour.

On the 10th of September, 1875, I marked a wasp. On the 11th she came to the honey for the first time,

returning at	7.25,	and left at	7.27,
„	7.34	„	7.37
„	7.41	„	7.44
„	7.49	„	7.51
„	7.56	„	7.58
„	8. 3	„	8. 6
„	8.13	„	8.16
„	8.20	„	8.23
„	8.30	„	8.32
„	8.37	„	8.40
„	8.46	„	8.51

She was disturbed.

Returning at 9. 4, she left at 9. 5
,, 9. 9 ,, 9.10
,, 9.15 ,, 9.16
She was disturbed.
,, 9.30 ,, 9.32
,, 9.50 ,, 9.54
She was disturbed.
,, 10. 0 ,, 10. 2
,, 10.10 ,, 10.13
,, 10.20 ,, 10.23
,, 10.26 ,, 10.28
,, 10.33 ,, 10.35
,, 10.41 ,, 10.43
,, 10.47 ,, 10.49
,, 10.54 ,, 10.56
,, 11. 0 ,, 11. 2
,, 11. 7 ,, 11. 9
,, 11.14 ,, 11.16
,, 11.20 ,, 11.22
,, 11.26 ,, 11.29
,, 11.33 ,, 11.35
,, 11.39 ,, 11.41
,, 11.45 ,, 11.47
,, 11.53 ,, 11.54
,, 11.59 ,, 12. 0
,, 12. 6 ,, 12. 8
,, 12.14 ,, 12.16
,, 12.20 ,, 12.22
,, 12.28 ,, 12.30
,, 12.35 ,, 12.37
,, 12.42 ,, 12.44
,, 12.49 ,, 12.52
,, 12.55 ,, 12.57
,, 1. 0 ,, 1. 3
,, 1. 8 ,, 1.10
,, 1.14 ,, 1.15
,, 1.19 ,, 1.21
,, 1.25 ,, 1.27
,, 1.31 ,, 1.33
,, 1.37 ,, 1.39
,, 1.43 ,, 1.45

Returning at	1.51,	she left at	1.53
,,	1.58	,,	2. 0
,,	2. 4	,,	2. 6
,,	2.11	,,	2.13
,,	2.19	,,	2.20
,,	2.28	,,	2.30
,,	2.33	,,	2.35
,,	2.40	,,	2.42
,,	2.45	,,	2.47
,,	2.53	,,	2.56
,,	3. 0	,,	3. 2
,,	3. 4	,,	3. 5
,,	3. 9	,,	3.11
,,	3.15	,,	3.17
,,	3.23	,,	3.25
,,	3.30	,,	3.32
,,	3.37	,,	3.39
,,	3.45	,,	3.47
,,	3.52	,,	3.54
,,	4. 0	,,	4. 2
,,	4. 6	,,	4. 9
,,	4.15	,,	4.17
,,	4.22	,,	4.24
,,	4.29	,,	4.31
,,	4.35	,,	4.37
,,	4.41	,,	4.43
,,	4.50	,,	4.52
,,	4.57	,,	4.59
,,	5. 2	,,	5. 5
,,	5.10	,,	5.12
,,	5.17	,,	5.19
,,	5.23	,,	5.25
,,	5.30	,,	5.32
,,	5.37	,,	5.39
,,	5.44	,,	5.46
,,	5.50	,,	5.52
,,	5.56	,,	5.58
,,	6. 2	,,	6. 4
,,	6. 7	,,	6. 9
,,	6.13	,,	6.15
,,	6.20	,,	6.22

Returning at	6.28,	she left at	6.30
„	6.34	„	6.36
„	6.41	„	6.43

This was her last visit for the evening, making no less than ninety-four visits in the day, during which time only two other wasps found the honey, though it was lying exposed on a table at an open window. The following morning she came at 6.18 and made twenty visits up to 8.18, after which I did not record them. During this time no stranger came.

No doubt, however, if a wasp is put to honey in an exposed place, other wasps gradually find their way to it. To determine, if possible, whether they were purposely brought, I tried the following experiment. On the 20th of September I marked a wasp and put her to some honey, which she visited assiduously. The following morning I opened my window at 6, and she made her first visit at 6.27, the temperature being 61° Fahr. I then placed the honey in a box communicating with the outside by an india-rubber tube 6 inches long and $\frac{1}{3}$ inch in diameter. The wasp, however, soon got accustomed to it, and went in and out without much loss of time. The 22nd was finer; and when I opened my window at 6 in the morning, she was already waiting outside, the temperature being 61°. The 23rd was rather colder, and she came first at 6.20, the temperature being 61°.

I was not at home during these days; but, as far as I could judge from watching in the mornings and evenings, no other wasp found the honey. On the 24th I had a holiday and timed her as follows. It was rather colder than the preceding days, and she did not come till 6.40, when the temperature was 58°. She returned as follows:—

6.49	8.19
6.58	8.26
7.12	8.35
7.22	8.45
7.32	8.52
7.40	9. 2
7.50	9.12
8. 0	9.45
8. 9	

I had almost closed the window; so that she had a difficulty in finding her way.

9.58	10.32
10.10	10.51

The temperature was still only 60°, and it was raining, scarcely any other wasps about.

11. 1	2.59
11.11	3. 8
11.21	3.14
11.29	3.23
11.40	3.32
11.46	3.40
11.56	3.48
12. 6	3.57
12.14	4.12
12.25	4.20
12.33	4.29
1.21	4.39
1.32	4.47
1.42	4.58
1.53	5. 6
2. 0	5.17
2.11	5.28
2.26	5.35
2.35	5.42
2.51	5.52

This was her last visit. During the whole day no other wasp found the honey. I also tried other wasps, concealing the honey in the same manner, and with a similar result.

I have no doubt some wasps would make even more journeys in a day than those recorded above.

Power of distinguishing Colours.

As regards colours, I satisfied myself that wasps are capable of distinguishing colour, though they do not seem so much guided by it as bees are.

July 25. At 7 A.M. I marked a common worker wasp (*V. vulgaris*) and placed her to some honey on a piece of green paper 7 inches by 4½. She worked with great industry, as recorded on p. 506. After she had got well used to the green paper, I moved it 18 inches off, putting some other honey on blue paper, where the green had previously been. She returned to the blue. I then replaced the green paper for an hour, after which I moved it 18 inches as before, and put brick-red paper in its place. She returned to the brick-red paper. But although this experiment indicates that this wasp was less strongly affected by colours than the bees which I had previously observed, still I satisfied myself that she was not colour-blind.

I moved the green paper slightly and put the honey, which, as before, was on a slip of plain glass, about 4 feet off. She came back and lit on the green paper, but finding no honey, rose again, and hawked about in search of it. After 90 seconds I put the green paper under the honey, and in 15 seconds she found it. I then, while she was absent at the nest, moved both the honey and the paper about a foot from their previous positions, and placed them about a foot apart. She returned as usual, hovered over the paper, lit on it, rose again, flew about for a few seconds, lit again on the paper, and again rose. After 2 minutes had elapsed, I slipped the paper under the honey, when she almost immediately (within 5 seconds) lit on it. It seems obvious, therefore, that she could see green.

I then tried her with red. I placed the honey on brick-red paper, and left her for an hour, from 5 P.M. to 6, to get accustomed to it. During this time she continued her usual visits. I then put the honey and the coloured paper about a foot apart; she returned first to the paper and then to the honey. I then transposed the honey and the paper. This seemed to puzzle her. She returned to the paper, but did not settle. After she had hawked about for 100 seconds I put the honey on the red paper, when she settled on it at once. I then put the paper and the honey again 18 inches apart. As before, she returned first to the paper, but almost immediately went to the honey. In a similar manner I satisfied myself that she could see yellow.

Again, on August 18th I experimented on two wasps, one of which had been coming more or less regularly to honey on yellow paper for four days, the other for twelve—coming, that is to say, for several days, the whole day long, and on all the others, with two or three exceptions, for about three hours in the day. Both therefore had got well used to the yellow paper. I then put blue paper where the yellow had been, and put the yellow paper with some honey on it about a foot off. Both the wasps returned to the honey on the blue paper. I then moved both the papers about a foot, but so that the blue was somewhat nearer the original position. Both again returned to the blue. I then transposed the colours, and they both returned to the yellow.

Very similar results were given by the wasp watched on the 11th of September. After she had made twenty visits to honey on blue paper, I put it on yellow paper and moved the blue 12 inches off. She came back to the yellow. I then put vermilion instead of yellow; she came back to the vermilion. I transposed the colours; she came back to the vermilion.

I put	white	instead of	vermilion;	she	returned to the	blue.
„	green	„	white	„	„	„
„	orange	„	green	„	„	„
I transposed the colours				„	„	orange.
I put	white	instead of	orange	„	„	white.
„	green	„	white	„	„	blue.
„	purple	„	green	„	„	purple.
„	orange	„	purple	„	„	orange.
„	green	„	orange	„	„	green.
I transposed the colours				„	„	blue.
„	„			„	„	green.

So far therefore she certainly showed no special predilection for the blue. I then left her the rest of the day to visit honey on blue paper exclusively. She made fifty-eight visits to it. The following morning I opened my window at 6.15, when she immediately made her appearance.

I let her make ten more visits to the honey on blue paper, moving it about a foot or so backwards and forwards on the table. I then put orange paper instead of the blue, and put the blue about a foot off. She returned to the orange.

I put	yellow	instead of	orange;	she	returned to the	yellow.
„	vermilion	„	yellow	„	„	vermilion.
„	white	„	vermilion	„	„	white.
„	green	„	white	„	„	green.
I transposed the colours;				„	„	blue.
I now put vermilion instead of green, and moved both of them a foot, but so that the vermilion was nearest the window, though touching the blue;				„	„	vermilion.

Again, September 11, I marked a wasp. She returned to the honey over and over again with her usual assiduity. The following morning I put the honey on green paper; she came backwards and forwards all day. On the 13th I opened my window at 6.8, and she came in immediately. During an hour she made ten journeys. On her leaving the honey for the eleventh time, I placed some honey on vermilion paper where the green had been, and put the honey and the green paper about a foot off.

She returned at

7.25	to the	vermilion.	I then put	orange	instead of	vermilion.
7.34	„	orange	„	blue	„	orange.
7.40	„	blue	„	white	„	blue.
7.47	„	white	„	yellow	„	white.
7.55	„	yellow and then to the green. I transposed the colours.				
8. 2	„	green. I then moved both colours about a foot,				

but so that the yellow was a little nearer to the old place.

She returned at 8.9 to the yellow.

I then removed the yellow paper and honey, and placed the honey which had been on the green paper about a foot from it on the table.

At 8.15 she returned and lit on the green paper, but immediately flew off to to the honey. I then transposed the honey and the paper.

At 8.24 she returned and again lit on the paper, but immediately flew off to the honey.

Thus, therefore, though it is clear that wasps can distinguish colours, they appear, as might be expected from other considerations, to be less guided by it than is the case with bees.

Direction of Flight.

Every one has heard of a "bee-line." It would be no less correct to talk of a wasp-line. On the 6th of August I marked a wasp, the nest of which was round the corner of the house, so that her direct way home was not out at the window by which she entered, but in the opposite direction, across the room to a window which was closed. I watched her for some hours, during which time she constantly went to the wrong window and lost much time in buzzing about at it. Aug. 7, I was not able to watch her. Aug. 8th and 9th, I watched her from 6.25 A.M., when she made her first visit. She still constantly went to the closed window. Aug. 10th and 11th, I was away from home. Aug. 12th, she made her first visit at 7.40, and still went to the closed window. Aug. 13th, her first visit was at 6.15; she went to the closed window and remained buzzing about there till 7, when I caught her and put her out at the open one by which she always entered. Aug. 15th and 16th she continued to visit the honey, but still always, even after ten days' experience, continued to go to the closed window, which was in the direct line home; though on finding it closed, she returned and went round through the open window by which she entered.

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CONTENTS.

LONDON:

SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON HOUSE;

AND BY

LONGMANS, GREEN, READER, AND DYER,

AND

WILLIAMS AND NORGATE.

1876.

honey over and over again with her usual assiduity. The following morning I put the honey on green paper; she came backwards and forwards all day. On the 13th I opened my window at 6.8, and she came in immediately. During an hour she made ten journeys. On her leaving the honey for the eleventh time, I placed some honey on vermilion paper where the green had been, and put the honey and the green paper about a foot off.

She returned at

7.25 to the vermilion. I then put orange instead of vermilion.
7.34 „ orange „ blue „ orange.
7.40 „ blue „ white „ blue.
7.47 „ white „ yellow „ white.
7.55 „ yellow and then to the green. I transposed the colours.
8. 2 „ green. I then moved both colours about a foot, but so that the yellow was a little nearer to the old place.

She returned at 8.9 to the yellow.

I then removed the yellow paper and honey, and placed the honey which had been on the green paper about a foot from it on the table.

At 8.15 she returned and lit on the green paper, but immediately flew off to the honey. I then transposed the honey and the paper.

At 8.24 she returned and again lit on the paper, but immediately flew off to the honey.

Thus, therefore, though it is clear that wasps can distinguish colours, they appear, as might be expected from other considerations, to be less guided by it than is the case with bees.

Direction of Flight.

Every one has heard of a "bee-line." It would be no less correct to talk of a wasp-line. On the 6th of August I marked a wasp, the nest of which was round the corner of the house, so that her direct way home was not out at the window by which she entered, but in the opposite direction, across the room to a window which was closed. I watched her for some hours, during which time she constantly went to the wrong window and lost much time in buzzing about at it. Aug. 7, I was not able to watch her. Aug. 8th and 9th, I watched her from 6.25 A.M., when she made her first visit. She still constantly went to the closed window. Aug. 10th and 11th, I was away from home. Aug. 12th, she made her first visit at 7.40, and still went to the closed window. Aug. 13th, her first visit was at 6.15; she went to the closed window and remained buzzing about there till 7, when I caught her and put her out at the open one by which she always entered. Aug. 15th and 16th, she continued to visit the honey, but still always, even after ten days' experience, continued to go to the closed window (which was in the direct line home), though on finding it closed she returned and went round through the open window by which she entered.

Note on the Plastron of the Gangetic Mud-Turtle (*Emyda dura* of Buchanan Hamilton). By John Anderson, M.D., F.L.S.

[Read March 16, 1876.]

On removing a living embryo of *Emyda dura* *, B. H., from the egg, it was found doubled on itself through the middle of the plastron, the fold passing transversely a short way before the umbilical area, traversing the line of junction of the two halves of each hyoplastron and the interval between them and the hypoplastron. The abdominal surfaces of the two halves of the body were opposed to each other; the neck and head of the embryo rested by their under surfaces on the abdominal aspect of the postumbilical portion of the plastron, the limbs being applied to the sides of the head. Straightening the embryo, I removed the plastron entire, and was astonished to find that it differed materially in one respect from the generally accepted views regarding the structure of the plastron of the Chelonia. All the bones, with the exception of the first pair, were arranged around the membranous or semicartilaginous area of the umbilicus, and were well ossified. But instead of finding only nine bones in the plastron, eleven bones were discovered to be present. The two additional elements, occurring in the position of each hyoplastron, were due to the circumstance that the latter elements had originated in two ossific centres. All the other bones were the same as in the plastron of *Trionyx* †. Each hyoplastron consisted

* I have applied this term to the Gangetic *Emyda*, because it appears to me to be distinct from the Madras species to which the names *E. granosa* and *E. punctata* are more correctly referable.

† Compare Parker's figures &c., from Rathke, of the plastron of the young of this and other genera, pl. xii. figs. 11–17 ('Monog. Shoulder-girdle and Sternum of Vert.' Ray Soc. 1868).

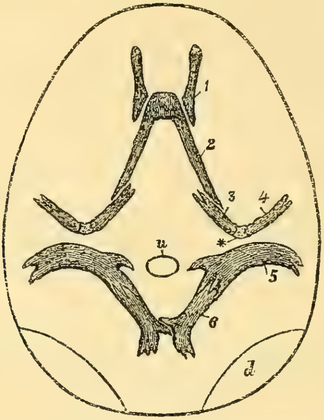
of two small bony spicules, the most external (4, see sketch, p. 516) corresponding to the outer wing of the hyoplastron of *Trionyx*, and the internal spicule (3) to the forwardly and inwardly projecting process of the hyoplastron of that genus of freshwater turtle, to the outside of which the backwardly and outwardly directed ramus of the entoplastron is applied.

These two bones or elements of the hyoplastron of *Emyda dura*, in the two individuals examined, were separated from each other posteriorly, opposite to the hypoplastron, by a cartilaginous interval (*) which permitted of their being freely moved one upon the other. At this point, or their angle of convergence, a membranous interval existed between them and the hypoplastron, corresponding to the fold of the embryo. The plastron of this genus, therefore, if these observations are verified by further research, and if none of the other elements are of a compound nature, may prove to consist of eleven distinct bones, two of which occupy the position of the hyoplastron of *Trionyx*. This peculiar character of the plastron of *Emyda*, if of general occurrence (which has yet to be ascertained), does not at any rate extend many hours beyond embryonic life—because in recently born individuals I have never observed the hyoplastron in any other condition but that of a single bone which unites at an early age with the hypoplastron, while in *Trionyx* and *Clutra* the embryos which I have examined have the hyoplastron consisting of one piece, which only unites with the hypoplastron at an advanced period of life.

Whatever may be the explanation of these two instances of a compound hyoplastron in *Emyda dura*, there can be no doubt of the accuracy of the observation, which was verified by one of my assistants; but it is of sufficient importance, whatever be its cause, to be recorded and to receive further investigation.

P.S.—Interested in the foregoing fact of development and of its value at issue, I append the subjoined memorandum from a palæontologist.

"The condition of the hyosternal bone described in this young specimen by Dr. Anderson is suggestive of several fossil types. In an undescribed genus from the London Clay, known as *Emys levis*, as well as in *Platemys Bowerbankii*, there are distinct lateral elements in the plastron which occupy the position of the lateral ossifications of Dr. Anderson's specimen, being placed between the hyo- and hypo-sternal elements and the marginal bones. In the London-Clay fossil *Platemys Bullocki*, and in the *Pleurosternon* from the Purbeck limestone, these elements extend right across the plastron, so as to entirely separate the hyosternal from the hyposternal bones."—H. G. SEELEY.



Diagrammatic sketch, about natural size, to illustrate the condition of the plastron in the embryonic specimen of *Emyda dura* above described. 1 to 6, the six separate ossific pieces of one side, the second counting but one on both sides, = 11 in all; 3 and 4, the double bony centres of the hyoplastron united by (*) a cartilaginous element, ultimately forming an ossific union between the parts in question; 5 and 6, hypoplastron; *u*, umbilicus; *d*, depression on the general surface of the plastron.

Notes on Lowe's MS. List of Webb's Type Shells from the Canaries (1829), and on the Annotations thereon of D'Orbigny (1839), and Lowe (1860). By the Rev. R. BOOG WATSON, F.R.S.E. & F.G.S. Communicated by J. GWYN JEFFREYS, Esq., Treas.L.S.

[Read April 6, 1876.]

IN the year 1829 Mr. Webb sent to Mr. Lowe, in Madeira, various sea-shells which he had got in the Canaries.

Some ten years later the whole of the fuller material accumulated by Mr. Webb and by M. Berthelot were published under the title 'Mollusques, &c. &c., recueillis aux îles Canaries, par MM. Webb et Berthelot, et décrits par Alcide d'Orbigny.'

In this work M. d'Orbigny refers more than once to unique specimens as among those which Mr. Webb had sent to Mr. Lowe, and implies dissatisfaction at Mr. Lowe's retention of these, the absence of which marred the completeness of his work.

In 1860 Mr. Lowe published in the 'Proceedings of the Linnean Society' (Zoology, vol. v. pp. 169–204) a List of the Shells observed or collected at Mogador &c., with most valuable notes and observations. In this paper Mr. Lowe makes very frequent reference to D'Orbigny (see pp. 171–174, 188, 189, 190, 197–199); and the whole tone of these references shows that, apart from indignation at the manner in which M. d'Orbigny had done his work, Mr. Lowe resented keenly the way in which allusion had been made to himself.

In 1873 the 'Liberia,' in which Mr. Lowe had sailed for Madeira, disappeared utterly in the Bay of Biscay; and Mr. Lowe's accumulations of marine shells from Madeira, the Canaries, and the Cape-Verds, which seem to have gone on from 1826, were forwarded to me for publication by his executor, Mr. T. V. Wollaston. Among these I have found the identical Canarian shells sent by Mr. Webb, and Mr. Lowe's annotated list, which he had sent back to Mr. Webb—in short, the very material which M. d'Orbigny complained of Mr. Lowe's having retained, and the information which Mr. Lowe objected to M. d'Orbigny having, without acknowledgment, used.

In the interests, then, of truth, as bearing on both these parties, and as needed for the fuller knowledge of the marine Mollusca of the Canaries, this list is of value *. It is as follows:—

"Marine Mollusca from Grand Canaria, Lancerotte, and Fuerteventura, sent by P. B. Webb, Esq. Oct. 29, 1829.

"1. *Lucina pensylvanica.* Differing in the entire, not crisped, epidermis. Var. an sp.?"

D'Orbigny published this as *L. Adansonii*, D'Orb., remarking that "Cette espèce a, par ses lames, encore beaucoup de rapports avec la *L. pensylvanica*; mais une différence notable entre elles, c'est que les lames sont recourbées du côté du sommet dans la *L. pensylvanica*, tandis qu'elles le sont au contraire dans l'espèce qui nous occupe du côté de l'ouverture des valves."

It is not found in Madeira.

"2. *Cardium tuberculatum.*"

This is so given by D'Orbigny. It is also found in Madeira.

* The shells themselves I propose to deposit in the British Museum.

"3. *Mactra pullastrina*, nob., *rugosa*, Lamk. A worn shell, and the only one broken. More. New."

This D'Orbigny published as *M. rugosa*, Chemnitz. In Mr. Lowe's note, *Lutraria rugosa*, Lamk., had been first written; then *Lutraria* had been scored out, the words "*rugosa*, Lamk." being left. Then a score was drawn under all these words. Then *Mactra pullastrina*, nob., was written above the line, and the word "New" was written over the word *rare*, so as to erase it.

This species is not found in Madeira.

"4. *Lima squamosa*."

This is so given by D'Orbigny. It is also Madeiran.

"5. *Mactra Adansoni*, nob. Adans. t. 17. f. 17. 'Le Fatan.' Not taken up by Lamk. or any other author. Sadly worn specimens."

This is published by D'Orbigny as *M. striatellata*, Lam. It is not found in Madeira.

"6. *Cardium costatum*. 'Coquille rare et précieuse, surtout lorsqu'on possède les deux valves du même individu,' Lamk."

D'Orbigny publishes this species with the remark that, "MM. Webb et Berthelot l'ont recueillie à Lancerotte."

This is probably one of the exotic species bought at Lancerotte, and the place of whose origin is very doubtfully Canarian. (See Lowe, Mogador shells, p. 188.) It is not found in Madeira.

"7. *Mytilus edulis*, var. denticulis cardinalibus subbinis, answers exactly to Adanson's, p. 212, t. 15. f. 4. 'Le Fouet,' a synon. not heretofore identified. Specimens of *Balanus punctatus* attached to it."

D'Orbigny publishes this as *M. elongatus*, Chem. and Lam., while Weinkauff (Conchyl. d. Mittelmeeres, i. 227) denies that it is the *M. elongatus* of Lam., and gives for it *M. pictus*, Born. Dunker (Index, Moll. p. 47) says it is *M. smaragdinus*, Chem.

I have some very young shells from Madeira, which may possibly be this species.

"8. *Venus verrucosa*."

D'Orbigny identifies this with the *Elonisse* of Adanson, which is a misprint for *Clonisse*.

Madeiran.

"9. *Dolium olearium*, Lamk. The larger size you mention may be *D. galea*. Look well after it."

This species is not enumerated by D'Orb.; and Mr. Edgar Smith, of the British Museum, who has kindly examined for me some of D'Orbigny's types deposited in the British Museum, informs me that *D. olearium* is not in the list, nor among the shells themselves. The specimen sent by Webb is a young shell of *D. galea*, Linn. *D. olearium* is not found in Madeira.

"10. *Dolium perdix*, Lamk."

Webb's type specimen thus named is the young of *Cassis undulata*, Linn., a species which D'Orb. has given under the name of *C. sulcosa*, Lam. He publishes *Dolium perdix*, Lam., as found in the Canaries; and Mr. E. Smith assures me that the type specimen deposited by D'Orbigny in the British Museum is really of this species. It is not found in Madeira.

"11. *Voluta Neptuni*, Lam. Capital!"

D'Orbigny publishes this species under this name as Canarian. In the "List of Shells observed at Mogador," already referred to, Mr. Lowe says that this is the *Voluta olla*, Linn. (that name, of course, having priority over that of *Neptuni* of Lamarck); and enumerating various places for its habitat, he adds, in inverted commas, "Lanzarote (*i. e.* opposite coast of Africa), Webb;" and continues, "D'Orbigny's typical Canarian specimen of his *V. Neptuni* in the British Museum is certainly nothing (as before affirmed) but a wretched bleached and battered shell of *V. rubiginosa*, Sw. Yet I possess a small mottled young example of the true *V. Neptuni*, Gm. (= *V. navicula*, Gm.), 2 inches long by 1 inch and 5 lines broad, sent me by Webb in 1829 from Lanzarotte, which, though doubtless of African origin, suffices to forbid the quotation of *V. Neptuni*, D'Orb., in W. B. ii. 2. 85, together with his *V. porcina*, under *Cymbium rubiginosum*, Sw., var. β, with which, however, the existing types of both his species in the British Museum are all equally identical. For this, his *record* of the species as a Canarian (Lanzarotan) shell, though unsupported by the type in his collection, doubtless rests on the authority of a MS. list by myself, with notes or descriptions of all the Canarian shells received by me from Webb, drawn up for, and communicated many years ago (in 1833) to my late friend, of which D'Orbigny has, without acknowledgment, made unsparing use, borrowing most of the new specific names, and arbitrarily changing others, without reference [Note—except in two instances—*Planaxis lævigata*, p. 79, and *Ranella abbreviata*, p. 94. The

'*Planaxis*' is a young example of a *Nassa*, very abundant at Arecife in Lanzarote, and closely allied to *N. mutabilis* (L.)*] to their real author. In this list the small mottled Lanzarotan example of *V. Neptuni*, Gm., above mentioned was included ; and it still exists, so marked, in my Canarian (Webbian) collection."

V. Neptuni is not found in Madeira.

"12. *Ranella abbreviata*, nob. So nearly allied to *R. marginata* of Sowerby's 'Genera' (*Buccinum marginatum*, Gmel., and *Ranella lævigata*, Lamk.), *a fossil species from Piacenza*, that it is hard to say they are distinct. An excellent shell. More."

M. d'Orbigny quotes this species under Mr. Lowe's name, and adds, "MM. Webb et Berthelot, ayant adressé des Canaries à M. Lowe, une collection des coquilles qu'ils avaient de ces îles, et qui comprenait même des espèces uniques, M. Lowe fait l'observation suivante sur une espèce que nous n'avons pas vue." He then quotes Mr. Lowe's note as above, and adds :—"Il paraitrait prouvé, en conséquence, que cette espèce intéressante se trouve vivante aux Canaries."

This species is the *R. lævigata*, Lam., and is also found at Madeira.

"13. *Bulla ampulla*."

D'Orbigny publishes this species under this name; but it is really a different species, the *B. punctata* of H. Adams. It is also found in Madeira.

"14. *Marginella glabella*. Very pretty, but, alas! very common. The animal is well figured and described by Adanson. It is so nearly allied to *Cypræa* that they will probably one day be united."

D'Orbigny says, "cette espèce . . . . semblerait, au premier abord, devoir être réunie à la *Marginella aurantia*, Lam., en raison de ses couleurs et de sa forme; mais elle s'en distingue par la manque de dents sur sa lèvre," &c. I do not quite understand D'Orbigny here; for both the Canarian (*teste* Webb's types) and the Senegal specimens (*teste* Adanson, text and plate) have these teeth. It is not found in Madeira.

"15. *Columbella rustica*."

M. d'Orbigny gives this species, but spells it *Colombella*. It is Madeiran.

* There is further reference to these two sp. further on. See Nos. 12 & 18.

"16. *Conus guinaicus*, I believe, but sadly worn. More."

This is not among the shells sent to me by Mr. Wollaston.

The species is given by D'Orbigny as Canarian, under this name.

"17 I can find nowhere, and the next had dropped out of the box before it was opened, but was luckily picked up. Do send it me. I dare say it was a N. S.!!!"

"18. *Planaxis lævigata*, nob. Quite new to me, and I believe unpublished. More if you can. There is only one."

In regard to this, D'Orbigny says, "No. 94. Lors de leur séjour aux Canaries MM. Webb et Berthelot envoyèrent une collection de coquilles marines à M. Lowe, qui, en leur adressant la détermination, a signalé une espèce nouvelle de *Planaxe* qu'il nomme *Planaxis lævigata*. Comme la plupart des espèces envoyées par MM. Webb et Berthelot étaient uniques, ou qu'au moins ils ne les ont pas toutes rapportées, celle-ci se trouve de ce nombre et nous ne pouvons la décrire, mais nous croyons devoir la signaler parmi les espèces Canariennes."

How this species came to be set down here as unique is not obvious. It is extremely common on the whole shore from Las Palmas to the Isleta in Grand Canary; and Mr. Lowe, at p. 191, in a note (already quoted at p. 519–20) to his List of Mogador Shells, mentions that it is very abundant at Arecife, in Lanzarote, adding that the shell sent him by Mr. Webb is a young example of a *Nassa*, closely allied to *N. mutabilis*, Linn. Since a shell so common as this *Nassa* was unlikely to be overlooked, it seemed to me probable that M. d'Orbigny had in this instance also followed Lowe, and that it was this species he had in view at p. 90 as "No. 133. *Buccinum mutabile*, Linn. Hab. les îles Canaries (les individus plus petits);" but Mr. Edgar Smith assures me that D'Orbigny's type specimen from Canary is a genuine *N. mutabilis*, L., and that this species, sent by Mr. Webb to Lowe, is *Buccinum conspersum*, Philippi (Zeitsch. f. Malacologie, 1848, p. 139; and also in his Abbildungen, &c., neuer Conchylien, vol. iii. Lief. v. p. 44, pl. i. f. 6).

It is not found at Madeira; but at the Selvagens, three small islands about 150 miles S.S.E. from Madeira, and 100 miles N. of Teneriffe, it seems to be abundant. I judge so at least from its presence among a few marine shells procured thence by the Baron do Castello de Paiva, and forwarded by him to Mr. Lowe, which have been handed on to me by Mr. Wollaston.

"19. *Littorina vulgaris* (*Turbo littoreus*, Linn.)."

D'Orbigny has published this as a new species, *L. canariensis*; but it is the *L. striata*, King, which name has the priority.

It is also found in Madeira.

"20. *Turbo rugosus*, Linn. & Lamk."

D'Orbigny gives this species, which is also Madeiran.

"21. *Natica porcellana*, nob. *N. mamillæ* and *N. effusæ* affinis. Found also in Madeira. I want it of all things with the operculum. As many more as you can spare."

M. d'Orbigny spells this name with one *l*. In the text it bears no name; but on the plate it has that of "d'Orb."

"22. *Cerithium lineolatum*, nob. Adans. t. 10. f. 5, 'le Degon,' not taken up by Lamk. More."

M. d'Orbigny refers to a small var. of *C. vulgatum*, Brug., which is, no doubt, this species. It is not found in Madeira, but, like the *Nassa* above mentioned, seems to abound in the Selvagens.

"31. —— *vulgatum*, Lamk., Adans. t. 10. f. 3. 'Le Goumier,' p. 156. 'J'ai trouvé cette espèce dans les endroits vaseux de l'isle Ténérif et de celle de Fayal.'"

It is thus given by D'Orbigny.

It is not found in Madeira.

"23. *Buccinum scrobiculator*, nob.; *Triton scrobiculator*, Lamk.; *Murex scrobiculator*, L."

This is *Ranella scrobiculator*. It is given by D'Orb., and is found in Madeira.

"24. *Mitra melaniana*, Lam. Much higher-coloured than in Madeira."

D'Orbigny publishes this as *M. nigra*, Chem. It is the *M. lutescens*, Lam., of the Mediterranean, and the *Mitra fusca*, Reeve. It is found at Madeira, as Mr. Lowe mentions; but the difference of colour he adverts to is not found in the better specimens.

"25. *Voluta porcina*, Lamk."

D'Orbigny has published this species under this name; but, according to Lowe, in his very able paper on *Cymbium*, given in his notes to his Mogador shells, this is an erroneous identification, and the species here in question is really *Cymbium* (*Voluta*) *rubiginosum*, Swains. Further, Mr. Lowe rejects this altogether as a Canarian shell, founding his decision, not merely on circumstantial evidence, which is strong, but also on a letter of Mr. Webb's, who wrote (in 1830):—"The reason why many of the shells I sent are in a bad state is that they are *collected by the fishermen on the opposite continent of Africa.*" Mr. Lowe, accordingly, referring this specimen and those of D'Orb. to the *V. rubinosa*, var. *β. incurva*, gives as its "Hab. Mogador and coast of Africa, opposite Lanzarote. Webb; Lowe."

Neither of these species is Madeiran.

"26. *Buccinum olearium*, nob. *Murex olearium*, L. Can you not get me a live specimen of this size?"

D'Orbigny publishes this as the *Triton pileare* of Linn. and Gmelin, and gives *T. succinctus*, Lam., as a synonym. It seems generally admitted that *T. pileare* is a different species, from the Indian Ocean, and that *T. succinctus*, Lam.=*T. olearium* (Linn. part), Desh., must give place (see Weinkauff, Conch. d. Mittelmeeres, ii. 77, and Monterosato, Notiz. i. a. Conchiglie Mediterr.) to the older name given by V. Salis, of *T. parthenopeus*.

It is also Madeiran in a dwarf form.

Along with this specimen is another shell in bad condition, which Mr. Lowe had evidently accepted as the same species. I believe it to be a large form of a Madeiran species, which I propose to publish as new under the name of *T. anceps*.

"27. *Triton nodiferum*, Lamk."

Thus given by D'Orbigny. It is also Madeiran.

"28. *Haliotis tuberculata*."

Thus given by D'Orbigny. It is also Madeiran.

"29. *Patella solida*, nob.; *P. aspera*, Lam.? Plentiful in Madeira."

The paper thus numbered and named by Mr. Lowe contains two shells, of which the one is *P. Lowei*, D'Orb., = *P. aspera*, Lam.; and the other is *P. cærulea*, Linn.,=*P. crenata*, Gmel. Both are common in Madeira.

There is a great deal of confusion regarding the synonymy of these two; but without going into that question, and without discussing the correctness of D'Orbigny's names for them, this is certain, both from the shells and from the animals both in Madeira and in the Canaries, that there are two well-marked species demanding the recognition of distinct names, and that D'Orbigny has done well to distinguish them. If the names *aspera* and *crenata* are really nothing but different names for the same shell, as Weinkauff asserts, it is quite certain that the *Patella* which D'Orbigny has described under the name of *P. Lowei*, is a separate species.

"30. *Cypræa spurca*, Linn."

Thus given by D'Orbigny. It is also Madeiran.

"31. *Cerithium vulgatum*. See above."

"32. *Cypræa lurida*."

"Thus given by D'Orbigny. Also Madeiran.

"33. }
34. } 0."
&c. }

I suppose this implies that these numbers were not represented by specimens.

"41. *Conus grandis*, Sowerby, Gen. Capital. More."

This is published by D'Orbigny under the name of *C. prometheus*, Brug.; and Mr. E. Smith informs me that the type from Canary deposited by D'Orbigny in the British Museum is "a small specimen of this species belonging to the variety which has been named *C. siamensis*." The species is unknown in Madeira. Is it really Canarian?

"Sent afterwards."

"*Patella guttata*, nob. From Isleta of Grand Canary."

To this is added in pencil, "common in Madeira."

D'Orbigny publishes this species under this name. In the text no name of authorship is given; but in the plate (vii. 13–15) it is attributed to "d'Orb."

It is (*fide* J. Gwyn Jeffreys in litt.) the *P. rustica*, L. & Dill., = *P. lusitanica*, Gmel., = *P. punctata*, Lam., = *P. nigropunctata*, Reeve.

An account of some New Species, Varieties, and Monstrous Forms of Medusæ. By GEORGE J. ROMANES, M.A., F.L.S., &c.

[Read April 6, 1876.]

WHILE engaged last summer on an experimental inquiry into the distribution and physiology of the nervous system in Medusæ, I observed that several of the naked-eyed species which I happened to procure were forms which had not been previously described. Unfortunately I omitted to make any drawings of these new species; but probably I shall have the opportunity of doing so next year, and, if so, shall then hope to have the privilege of submitting the drawings to the consideration of this Society. Meanwhile, however, it seems desirable to communicate to the Society a brief verbal account of these hitherto undescribed species. They were all obtained between the months of May and August, in the Cromarty Frith on the east coast of Scotland.

1. A species of the genus *Tiarops*.—Nectocalyx about an inch and a half in diameter, and of a hemispherical form. Manubrium of great proportional size (viz. about $\frac{5}{8}$ inch long), and in general shape somewhat resembling that of *Geryonia appendiculata*. Tentacles numerous, and proportionally shorter than in *T. diademata*. Diadems eight in number, and disposed as in *T. diademata*. Pearly nodules twelve. The animal is luminous when irritated—the light being of a pale phosphorescent hue, and restricted in its position to a narrow but continuous line all round the margin of the nectocalyx. Individuals of the species are very numerous in the locality above mentioned. For the species itself I propose the name *Tiarops indicans*.

2. Another species of the same genus.—Nectocalyx about half the size of that in the species just described, and, together with the manubrium, in general form resembling that of *Thaumantias lucida*. Diadems eight in number, and disposed as usual. The pearly nodules in each diadem vary from 6 to 8. Tentacles 22. Animals non-luminous, and of tolerably frequent occurrence. For this species I propose the name *Tiarops oligoplocama*.

3. Another species of the same genus.—Nectocalyx intermediate in size between those of the two above-described species, while in form it is considerably more concavo-convex, resembling a deeply shaped bowl. Manubrium so small as to be almost invisible, and, together with the nutritive tubes, ovaries, and tentacles, of a rich rose-colour. Tentacles 45 in number, and arranged in two series, in one of which the tentacles are long, and in the other short. Unlike all the known species of this genus, the present one has *four* diadems between each pair of radial tubes—there being thus altogether *sixteen* diadems, or twice the usual number. All the diadems are arranged in a strictly symmetrical manner, and each contains about 30 pearly nodules. The animal is brilliantly luminous when stimulated, the light,

as in the case of *T. indicans*, being confined to a narrow and continuous line round the margin of the nectocalyx. In colour, however, the light emitted by this species is much more blue than that which is emitted by *T. indicans*. This Medusid is somewhat rare, and is certainly the most beautiful with which I am acquainted. For it I propose the name *Tiarops polydiademata*.

4. A species of the genus *Sarsia*, in general form resembling *S. tubulosa*; but having its "umbilicus" and eye-specks of a bright red colour, and its manubrium and tentacles of a rose-pink. It is perhaps doubtful whether these distinctions are sufficient to justify me in assigning to this form a specific character. At any rate, in the absence of information concerning the life-history of this Medusid, it is better, I think, to leave it an open question whether we have here a distinct species, or a mere variety of *S. tubulosa*. Should the possession of red eye-specks, however, eventually prove to be a specific character, I would suggest *Sarsia erythrops* as an appropriate name for the species. The form in question is probably the same as that to which Forbes alludes * as having been met with by Mr. Patterson at Larne.

5. A species of *Bougainvillea* (*Hippocrene*), closely resembling *B. superciliaris*, except in being from three to four times the size which L. Agassiz describes as natural to that species. As mere size, however, is an extremely unsafe criterion of specific difference in the case of the Medusæ, I think it is better provisionally to regard this form as a variety of *B. superciliaris*. *Bougainvillea gigantea* would seem a suitable name for this Medusid, if it should ever certainly prove to be a distinct species.

6. Another species of *Bougainvillea*, also resembling *B. superciliaris* in general, but differing from that species in the following particulars:—(*a*) in being about twice the size; (*b*) in having many more tentacles in each of the four tentacular groups —*i. e.* between 30 and 40 tentacles in each group; and (*c*) in having its manubrium much more richly branched. I am inclined to regard this as a new species, and propose for it the name *Bougainvillea fruticosa*.

To this brief description of new and probably new species I may add a few words upon certain varieties of known species.

(*a*) *Stomobrachium octocostatum*, as described and figured by Forbes, differs somewhat from the varieties I met with in the

* Monograph of British Naked-eyed Medusæ, p. 56.

Cromarty Frith. The size of specimens full of ripe ova was only about two thirds that represented by Forbes; and instead of having the ovaries, manubrium, and tentacles of an orange-colour, the specimens I observed had these organs of a bluish-white tint. Further, the ovaries did not present the denticulated margins which are to be seen in Forbes's drawings. Lastly, the tentacles are arranged in a double series (*i. e.* long and short tentacles alternating with one another), and not in a single series as described by Forbes. The number in the large series, however, agrees with Forbes's description. There can thus be no doubt that this is the variety which Ehrenberg met with (*vide* loc. cit. p. 31 *), more especially as each of the smaller tentacles bears at its base the vesicular body which Ehrenberg describes as occurring in that position. These bodies are remarkable structures, being apparently simple globular cavities without pigments or visible contents of any kind. I do not think, therefore, that they are proper ocelli or eye-specks, as Forbes was very naturally inclined to suppose from Ehrenberg's description of them. Another interesting feature in the histology of this animal is a number of radiating (muscular?) bands, one of which runs to the base of each of the 64 large tentacles. Lastly, the external parts of the ovary are distinctly ciliated, the ciliary action persisting for 20 hours or more after the death of the animal.

(*b*) Professor L. Agassiz describes as of very rare occurrence upon the American coast a peculiar variety of *Sarsia*, presenting six radial tubes, six ocelli, and six tentacles. It therefore becomes the more interesting to state that I met with a precisely similar variety on the east coast of Scotland. Moreover the occurrence of this variety appears to be as rare in the one locality as in the other; for of all the many thousands of *Sarsia* which fell within my observation last summer, I only met with one specimen of the variety in question.

(*c*) In nearly all the species of naked- and covered-eyed Medusæ which I had the opportunity of examining, there was a remarkable absence of monstrous or misshapen forms. In the case of one species, however, such forms were of frequent occurrence. This species was *Aurelia aurita*; and the monstrosities showed them-

* It may also be the variety of which Hugh Miller speaks: but his description is not sufficiently precise to admit of determining which of the two varieties he saw.

selves both as abnormal multiplications and abortions of parts. In all the cases of asymmetrical multiplication which I observed, the peculiarity was confined to the lithocysts, and always showed itself in the same manner. That is to say, I have several times observed, in otherwise normal specimens of *A. aurita*, the presence of nine instead of eight lithocysts; and in all these cases the supernumerary lithocyst, which was always fully formed and provided with the usual hood, was placed beside and in close contact with one of the normal lithocysts. This latter fact appears to me important when considered in relation to the theory of Pangenesis; for upon this theory it would follow that if a supernumerary lithocyst is to be developed at all, we should expect it to be developed in apposition with one of the normal lithocysts rather than in any other position. Our ground for expecting this is, of course, that the theory of Pangenesis supposes similar gemmules to have a mutual affinity for one another; and as lithocyst-gemmules would naturally be plentiful in the region of any normal lithocyst during the process of its development, or of its repair if injured, if any thing went slightly wrong in either of these processes, facilities would be offered for the adhesion of improper gemmules at the point where the disturbing cause acted; and these improper adhesions having once taken place and being then followed by normal adhesions of proper gemmules, the result would probably be a duplex organ.

I have said that in all the cases of asymmetrical multiplication of parts which fell under my notice it was the lithocysts alone that were affected. But besides these cases of asymmetrical multiplication of parts in *Aurelia*, I saw several instances of strictly symmetrical multiplication; and in all these instances every part of the organism was equally, or rather proportionally, affected. That is to say, as in the single instance of multiplication of parts which I observed in *Sarsia*, all the organs of the nectocalyx (eye-specks, tentacles, and nutritive tubes) were similarly affected, so in the several instances of multiplication of parts which I observed in *Aurelia*, all the organs of the umbrella were similarly affected. If any one will turn to the admirable plates contained in Professor L. Agassiz's third contribution to the Academy of Arts and Sciences, and representing a normal specimen of the genus *Aurelia*, he will see that the nutritive canals bear a very definite and symmetrical arrangement with reference to one another, and also with reference to the ovaries and lithocysts. In particular, there are 16 principal radial tubes that proceed, in straight lines and without branching, from the centre to the circumference of the umbrella. Of the 16 tubes, one passes directly to each of the eight lithocysts, while the remaining eight tubes alternate with these. Thus the 16 radial tubes together mark out, as it were, the whole umbrella into 16 equal segments. Well, in all the examples which fell under my notice of abnormal multiplication of parts in *Aurelia* (other than those of mere duplication of lithocysts), the precise and peculiar symmetry just described was strictly adhered to: in all these examples the undue multiplication extended proportionally to ovaries, nutritive tubes, lithocysts, and tentacles; so that its effect was to increase the *number* while adhering to the *type* of the natural segments above alluded to. It is further remarkable that in all the instances I met with, the degree of abnormal multiplication was the same; for in all the instances the ovaries were 6, the principal or unbranched radial tubes 24, and the lithocysts 12. All the parts, and therefore all the natural segments, were thus in all the observed instances increased by one third of their normal number. It is curious to note that we have here the same proportional increase as that which has already been described in the case of *Sarsia*. This, of course, is probably a mere accident; but whether or not it is so, I think that, as there is certainly no reason either in the case of *Sarsia* or of *Aurelia* to regard the forms in question as distinct species, it becomes worth while to draw attention to the very definite manner in which the abnormal multiplication of parts seems always to occur in these, the only genera of Medusæ in which such multiplication has as yet been observed. It is, perhaps, also worth while to add that in all the cases where I noticed this undue multiplication of parts, both in *Sarsia* and in *Aurelia*, the animals were remarkable for the unusual amount of nervous energy which they displayed. There can be no doubt that this fact is to be attributed to the unusually large supply of nervous matter that was secured to the organism by the multiplication of its marginal bodies.

As regards abortion of parts in *A. aurita*, I cannot say that I have ever observed this to occur in any organs other than the ovaries. In these, however, suppression to a greater or less extent is of pretty frequent occurrence. Most usual is the case where one of the four ovaries is of smaller size than the other three. Often the abnormal diminution extends to two alternate or adjacent ovaries, and occasionally to three. More rare is the case of total suppression of one ovary. Only on about a dozen occasions have I seen total suppression of two ovaries; and in these it was sometimes the adjacent, but more frequently the opposite, organs that were missing. Lastly, on one occasion I observed, in an otherwise well-grown specimen, a total absence of three out of the four ovigerous pouches. In no case, it may be added, did I observe that a deficiency or absence of ovigerous pouches entailed any corresponding deficiency or absence of any other organs.

I have said that, so far as my experience extends, neither reduction nor complete suppression of parts appears to occur in any organs of *A. aurita* other than the ovaries. It therefore becomes necessary to add that one or more of the lithocysts, together with their hoods, are frequently to be seen of smaller size than the others. As these variations, however, are usually attended with a deficiency of the general tissue of the umbrella in the neighbourhood of the affected lithocyst, I am inclined to believe that in these cases the small lithocyst is one that has been reproduced to repair the loss of the original organ, which I suppose to have been removed by mechanical violence of some kind—a mutilation which seems well indicated both by the deficiency just alluded to of umbrella-tissue in the parts concerned, and also by the cicatrix-like appearance which is presented at the confines of these parts by such tissues as remain.

In conclusion, I may state that towards the end of August all the individuals of this species began to undergo a marked diminution in size. Concurrently with this diminution in size, the intensity of the pink colour (which in this species is characteristic of the ovaries, nutritive system, and tentacles) underwent a marked decrease; so that at last I was only able to obtain specimens one half or one quarter the ordinary size of *Aurelia aurita*, and having nearly all their natural rose-pink colour discharged. I believe that these two phenomena—the loss of colour and the diminution in size—are related to one another in a very intimate manner. Just at the time of year when these two phenomena began to manifest themselves, I observed that all the specimens of *Aurelia* I met with were infested by a species of crustacean (*Hyperia galba*), which lodged chiefly in the ovaries and nutritive canals. These crustaceans appeared to devour with avidity all the coloured parts of their hosts; and I think it was probably due to the ever increasing numbers of these parasites that the size of the individuals composing the incoming generations of *Aurelia* continued to become more and more diminutive. I shall, however, attend to all these points more closely next year, after which I shall doubtless be able to speak with more certainty regarding them.

Notes on the Venous System of Birds.

By Charles H. Wade, F.L.S.

[Read April 6, 1876.]

I propose in the present paper briefly to draw attention to certain structural features in the anatomy of some birds. I cannot claim that my discoveries are original, except in so far as they were made without knowledge of previous work done in the same field by other observers; but, as I hope to show, the points of which I shall particularly treat are so important, and have obtained so little recognition hitherto, that no apology seems necessary for introducing them to the notice of this Society.

My interest in this subject was first excited a few weeks ago, when, in dissecting a specimen of a common Tomtit (the Marsh-Titmouse, *Parus palustris*) I was surprised to find present, as it appeared, only one jugular vein, the right. A second specimen showed a like deviation from the normal type; and, noting this, I made a regular excursion through the well-known text-books, in the hope they might contain some explanation which had before escaped my reading. I may briefly detail the results of my search.

Owen contents himself with saying (Anatomy of Vertebrates, ii. 203), "The vein of the right side exceeds the other in size; it is often twice as large." To what considerable extent the statement needs modifying I will show directly.

Milne-Edwards says (Leçons sur la Physiologie &c., vol. iii. p. 466) "The jugular veins are placed superficially on the sides of the neck; sometimes they are (both) of pretty nearly the same calibre; but in general that of the left side remains very attenuated, while that of the right side presents a considerable volume."

Gegenbaur, who seems closely to have followed Milne-Edwards, says (I quote from the French translation by Carl Vogt, p. 804), "there is atrophy of one of the jugular veins (the left); it is by the transverse trunk the passage of the blood into the right jugular is effected." Van der Hoeven does not, in his 'Handbook of Zoology,' enter on the question at all; nor is it referred to in the other frequently used books, such as Rymer Jones's 'Animal Kingdom' &c.

Such meagre references were not sufficient in face of the very emphatic results of my own observation, continued dissections forcing on me the desirability of further investigation. I will therefore now give the facts with which I have become acquainted.

In the common Red-wing (*Turdus iliacus*) the right jugular is very apparent, offering a diameter of one eighth of an inch, while the corresponding vein of the left side needs for its demonstration a very delicate dissection under water, when it may be traced forwards from its point of union with the great transverse trunk at the base of the skull. A safe guide to its homology is found in the accompanying vagus nerve. Figure 1 shows the course of the two veins.

In the Short-tailed Tit (*Parus britannicus*) this suppression of the left jugular attains the extreme limits compatible with its existence *as* a vessel, and a lens is necessary to enable one to trace it downwards with the pneumogastric nerve. In one specimen a very fine streak of included blood gave some assistance in determining the presence and course of the tube; but even it disappeared at a point about 3 lines above the clavicle.

Diagrams of cervical blood-vessels in two British birds.

Fig. 1. Fig. 2.

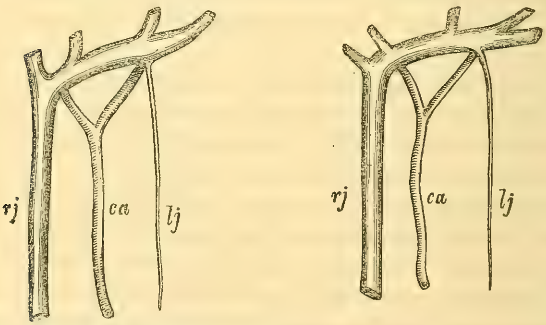


Fig. 1. The Redwing (*Turdus iliacus*).
2. The Short-tailed Titmouse (*Parus britannicus*): *rj*, right, and *lj*, left jugular vein; *ca*, carotid artery.

In effect, I concluded that in this bird the left jugular vein is a mere *rudimentary structure*, physiologically valueless, while at the same time the full morphological equivalent of the vein of corresponding name on the dextral side. Fig. 2 depicts the appearance presented by my dissection; and, as in the former diagram, there is noticeable a peculiar lozenge-shaped space between the two branches of the divided single carotid artery. This is existent, too, in all the birds, so far that I have examined, in which occurs the peculiar suppression of the left jugular vein, although in some the bifurcation is more nearly in relation with the great transverse venous trunk than in others.

With these facts before me, I was advised by Dr. Rolleston, to whom I gratefully express my indebtedness for much valuable assistance and unceasing kindness, to consult the memoir by Neugebaur contained in the 'Nova Acta,' vol. xxi., and entitled 'Systema venosum Avium cum eo mammalium, et imprimis hominis, collatum;" and in this little-known but exhaustive and pains-taking paper I found the following passages. (Before proceeding to quote, I may say I took occasion to verify the references to Barkow's own papers.)

" Barkow has three laws concerning the relative thickness and the presence of the jugular veins in birds:—

"1. A single jugular vein exists on each side of the neck, the one equal with the other.

" 2. There is one on each side, of which one is greater (*fortior*) than the other. Or, lastly,

" 3. One side only is provided with a jugular vein, the other has none (*alterum nulla*)."

Neugebaur, commenting on these rules, ventures to distrust the truth of the *third*, and imagines that instances adduced will fall under the second rule. In this connexion I much regret that I am unable to speak concerning the four species of Woodpecker (*Picus martius*, *P. viridis*, *P. major*, *P. medius*) with which Neugebaur associates Rathke as holding a view opposed to his own; and I shall be grateful to any one who will supply me with specimens of these birds. The Great Spotted Woodpecker (*P. major*) and *P. minor* (the Lesser Spotted Woodpecker) are said by Yarrell to frequent the neighbourhood of Kensington Gardens; but *P. martius* (the Great Black Woodpecker) is rare in this country.

Neugebaur's words on these birds are as follow:—"Quod denique attinet ad regulam tertiam, mihimet non contigit, ut avem ullam singula tantum vena jugulari præditam invenerim, et saltem *Picum viridem*, cujus quidem generis alias species tres, *P. martium*, *P. majorem*, et *P. medium*, una tantum vena jugulari et quidem dextra præditas esse Rathkius docet, non huc, sed ad regulam secundam pertinentem cognovi."

I conceive it is quite possible Barkow might have made the error of supposing only one vein present, if his observations had been conducted on such a bird as the Short-tailed Tit, or even on a spirit specimen of a less distinctly atrophied bird. Still more might he have been misled in case of a Sparrow; for in this bird (*Passer domesticus*) but the veriest rudiment of the left vein exists, and it ceases to be a tubular structure at about half the length of the cervix from its origin. I very carefully threw a blue injection into the vessel from the transverse trunk at the skull-base, and got the fluid to run as a fine line so far as I have stated, where it was stayed by a blind ending of the vein, which beneath this point was indistinguishable from the fatty and connective tissue with which the pneumogastric nerve was associated.

In the only example of the Robin (*Erithacus rubecula*) I have had the fortune to examine, the two vessels showed a considerably greater disproportion than that figured by Neugebaur, a fact which leads me to think that *age* may, to great extent, determine the obliteration of an organ in natural atrophy; *i. e.* in this particular instance a young bird will possess a less-attenuated left jugular vein than an adult.

Examination of developmental changes, however, will afford much information in this matter; and I anticipate we shall find the growing embryo to exhibit gradations varying from equality in the size of the veins to the adult differences already noted. This would be in agreement with Von Baer's law of progress from the general to the special; for it is a fact worth knowing that all the birds, so far, exhibiting this considerable suppression of the left jugular vein have been from Prof. Huxley's division of the Ægithognathæ. Moreover Alectoromorphous birds show gradations of structure varying from close equality to differences as as much as one to three, beyond which they would seem not to approach the group named above.

How far the peculiarities I have described are structural adaptations subserving function, I hope to be able to speak with some authority later, as also regarding their full morphological import. I can do no more now than state my full conviction that they possess a definite meaning, and one to be determined by the special functional (?) requirements of the organism. It is these requirements that need further elucidation.

In conclusion, I wish to say this paper is intended to be only preliminary to a more extended series of observations on the points it discusses; and though it may seem a meagre production, I fancied that even such brief notes might claim notice by this Society.

I shall be very grateful to any one who will help me to obtain spirit specimens of the rarer birds, and especially of the genus *Picus*.

A List of Marine Shells, chiefly from the Solomon Islands, with Descriptions of several new Species. By Edgar A. Smith, F.Z.S., Zoological Department, British Museum. Communicated by Dr. J. Murie, F.L.S.

[Read April 6, 1876.]

(Plate XXX.)

The shells enumerated in the following paper have been presented to the British Museum by Mr. John Brazier, of Sydney. A list of them was thought worthy of publication, as precise localities, in most instances, are attached to them, the majority having been collected by Mr. Brazier himself. At the same time, the habitats originally assigned to the various species by the authors are quoted, since so many which are given to species in the Cumingian collection are erroneous.

1. Conus magus, *Linn.* *Kiener, Coq. Viv.* pl. 67. f. 1–1 *c*; *Reeve, Conch. Ic.* f. 190 *a–e*; *Sowerby, Thesaurus Conch.* f. 508–512 & f. 513, 514, & 525 (as *C. circæ*); *Weinkauff in Küster's Conch.-Cab.* pl. 6. f. 1 & 3, pl. 15. f. 3, 4, pl. 19. f. 5, 6, pl. 57. f. 8–11.—Var. = C. indicus, *Chemnitz, Conch.-Cab.* x. f. 1295.—C. clandestinus, *Chemnitz, l. c.* f. 1296.— C. circæ, *Chemnitz, l. c.* xi. f. 1778–9.— C. fenellus, *Chemnitz, l. c.* xi. f. 1782–3; *Küster,* pl. 26. f. 12, 13.—C. raphanus, *Hwass, Sowerby, Thesaurus,* f. 494; *Küster,* pl. 2. f. 3.—C. carinatus, *Swainson, Reeve, Conch. Ic.* f. 175; *Kiener,* pl. 27. f. 2–2*a*; *Sowerby,* f. 495.—C. ustulatus, *Reeve,* f. 239; *Sowerby,* f. 516 & 647; *Küster,* pl. 52. f. 3, 4.—C. epistomium, *Reeve,* f. 227 *a, b*; *Kiener,* pl. 55. f. 6; *Sowerby,* f. 515.—C. epistomioides, *Weinkauff, Küster's Con.-Cab.* pl. 57. f. 6–7.—C. striolatus, *Kiener,* pl. 105. f. 1; *Reeve, Suppl.* pl. 6. f. 262; *Sowerby,* f. 327, 328 (as ustulatus).—C. borneensis,

Sowerby (name preoccupied!), *Thesaurus*, f. 648.—C. Frauenfeldi, *Crosse, Journal de Conch.* 1865, vol. xiii. p. 307, pl. x. f. 1–10.—C. assimilis, *A. Adams, Proc. Zool. Soc.* 1853, p. 118; *Sowerby*, f. 505; C. consul, *Boivin, Journal de Conch.* 1864, vol. xii. pl. 1. f. 5, 6.

Hab. Strong Island, Caroline Group (*Brazier*).

This polymorphous species is almost as widely distributed, geographically, as it is variable in form and coloration. In the British Museum there is a very large series, consisting of about eighty examples, from various authentic localities, viz. Philippine Islands, Moluccas, Night Island, North Australia, Louisiade archipelago, Borneo, New Holland, New Guinea, and Madagascar.

Of the preceding pseudo-species the types of *epistomium* of Reeve, and *ustulatus* of the same author, *Frauenfeldi*, of Crosse, *assimilis* of A. Adams, and *borneensis* of Sowerby are in the national collection. The last-mentioned author appears to have overlooked the fact of having previously figured a species under the name of *borneensis*, which was originally described (in the Voyage of the Samarang) by A. Adams and Reeve. Weinkauff has erroneously placed Sowerby's species among the synonyms of *C. anemone*.

2. Conus vayssetianus, *Crosse, Journ. de Conchyl.* 1872, xx. pp. 154 & 349, pl. xvi. f. 1; *Weinkauff, in Küster's Conchyl.-Cab.* pl. lxxi. f. 4.

Hab. New Caledonia.

The specimen sent by Mr. Brazier exhibits only the slightest trace of the white markings which are mentioned by Crosse as existing around the middle of the shell; and the colour is a bright orange rather than "castaneo-fusca."

3. C. monachus, *Linn.* *Reeve, Conch. Icon.* f. 122 *a–c*; *Kiener*, pl. 50. f. 1–1*a*; *Sowerby*, f. 506, 507; *Küster*, pl. 34. f. 5, 6.—Var. =Voluta cosmographia, *Martyn, Univ. Conch.* iv. pl. 125. f. on right. —C. achates, *Meuschen.*—C. achatinus, *Chemnitz, Reeve*, f. 191*a*; *Kiener*, pl. 40. f. 1–1*c*, pl. 50. f. 1 *c–d* (as *monachus*, var.); *Sowerby*, f. 335, 336; *Küster*, pl. 5. f. 3 & 9.—C. minimus, *Gmelin* (*non Linn.*), *Syst. Nat.* p. 3382.—C. ranunculus, *Hwass, Reeve*, f. 191 *b*.—C. vinctus, *A. Adams, Proc. Zool. Soc.* 1853, p. 118.

Hab. Solomon Island (*Brazier*).

Other localities for this species are Port Essington, Quail Island, and Paterson's Bay, N. Australia.

4. TEREBRA CANCELLATA, *Quoy & Gaimard.* *Sowerby, Thesaurus Conch.* i. pl. 44. f. 80; *Reeve, Conch. Ic.* vol. xii. f. 58 *a–b.*—T. undatella, *Deshayes, Proc. Zool. Soc.* 1859, p. 300.

Hab. Port Elliot, South Australia (*Brazier*), Philippine Islands (*Cuming*)

5. PLEUROTOMA (—?) DIGITALE, *Reeve.*—Pl. digitale, *Reeve, Conch. Icon.* i. f. 138.

Hab. San Christoval, Solomon Islands (*Brazier*), Philippine Islands (*Cuming*).

6. P. (—?) BIJUBATA, *Reeve, Conch. Icon.* i. f. 87 (bad).

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

7. P. (—?) SOLOMONENSIS, sp. nov. Pl. XXX. fig. 6.

Testa fusiformis, subturrita, albida, inter costas strigis longitudinalibus nigro-fuscis et suturam infra punctis parvis fuscis ornata; anfractus 13, primi duo læves, cæteri infra suturam carina elevata marginati, infra carinam concavi, medio angulati, inferne decliviter contracti, costis 9–10 medio angulatis, superne versus carinam sensim evanescentibus instructi, et striis transversis 5–6 inter costas sculpti; anfr. ultimus versus basim attenuatus, costis inferne attenuantibus, pone labrum subdistantibus, et interdum aliis minoribus in interstitiis ad basim sitis instructus; apertura elongata, augustissima, alba, fusco longitudinaliter strigata, longitudinis testæ totius circiter $\frac{2}{5}$ æquans; labrum medio prominens, superne mediocriter, et prope basim levissime sinuatum; columella subrecta, haud arcuata, tenuiter callosa, ad suturam tuberculo subvalido munita; canalis angustus, paululum elongatus, rectiusculus, vix recurvus. Long. 23 mill., diam. $6\frac{1}{2}$.

Hab. San Christoval, Solomon Islands.

A young specimen of this species was presented to the British Museum, in 1874, by Mr. G. B. Sowerby, junior; and at the time I placed it, with doubt, as a variety of *varicosa*, Reeve. The second example, received from Mr. Brazier, being mature, proves that this form is distinct from Reeve's shell. It displays, at intervals, a slight tendency to varices, but not in such a marked manner as *varicosa*, from which it is well distinguished by the angular ribs, the more attenuated body-whorl, the dark brown stripes between the ribs, and the series of brown dots on the infrasutural keel, one spot being beneath each interstice between the ribs of the whorl above. The aperture in the present species is also narrower and longer, the columella straighter, and the canal rather more elongate. The ribs on the body-whorl near the base, and the interstitial ones between them, which sometimes are present, are slightly nodulous, being traversed by the spiral sulcations.

8. Cythara citharella, *Lamarck.*—Mangelia citharella, *Lamk.*, *Reeve, Conch. Icon.* f. 5.—Cythara striata, *Schumacher, Syst. Vers Test.* p. 245.—Var. = Mangelia lyra, *Reeve, l. c.* f. 3.—M. funiculata, *Reeve, l. c.* f. 7.

Hab. ——? (*Brazier*); Philippine Islands (*Cuming*).

9. C. capillacea, *Reeve.*—Mangelia capillacea, *Reeve, l. c.* f. 10.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

10. C. reticulata, *Reeve.*—Mangelia reticulata, *Reeve, Conch. Ic.* iii. f. 17.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

11. C. zonata, *Reeve.*—Mangelia zonata, *Reeve, l. c.* f. 15.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

12. C. unilineata, sp. nov. Pl. XXX. fig. 13.

Testa breviter fusiformis, dilutissime rufescens vel subalba, circa medium anfractuum albo zonata et infra zonam linea rufo-fusca costis interrupta cincta; anfractus ad 8, convexiusculi, costis 10 gracilibus supra spiram continuis, paululum obliquis (in anfr. ultimo fere ad basin continuis) instructi, et striis spiralibus confertis ubique sculpti; apertura elongata, angusta, longitudinis testæ $\frac{8}{15}$ adæquans; labrum costa ultima incrassatum, intus denticulis 11–12 ornatum, superne leviter sinuatum; columella leviter obliqua, haud arcuata, liris transversis circiter 15 munita. Long. 15 mill., diam. $4\frac{2}{3}$.

Hab. San Christoval, Solomon Islands.

This species must not be confounded with *C. zonata* of Reeve, said to inhabit the shores of the island of Ticao. In that species the ribs are produced upwards, and form an undulating coronation around the top of the whorls, and the reddish transverse band is continuous on and between the ribs, and not interrupted by them as in this species.

13. C. interstriata, sp. nov. Pl. XXX. fig. 11.

Testa ovali-fusiformis, leviter turrita, alba, ad suturas et circa anfr. ultimi medium et prope basim nigro-fusco zonata; anfractus 8, supremi duo læves, cæteri convexiusculi, sutura profunda sejuncti, costis tenuibus 10 aliquanto obliquis (in anfr. ultimo basi continuis) instructi, liris spiralibus circiter 7 supra costas incrassatis (in anfr. ult. ad 18) et striis tenuissimis inter liras ornati; apertura parva, angusta, longitudinis totius testæ ½ æquans; labrum fortiter incrassatum, intus denticulos 10–11 gerens; columella rectiuscula granulis et liris transversis munita. Long. 8 mill., diam. fere 3.

Hab. San Christoval, Solomon Islands.

This is a very pretty species, and at once recognized by the deep-brown suture, the band encircling the middle of the body-whorl, which is continuous and not interrupted by the longitudinal ribs, and the paler band towards the base. The spiral lirations are almost equidistant, and slightly nodulous on traversing the costæ; and the fine striations between them are from two to four in number. The uppermost denticle within the labrum (that is, the one which borders the little sinus) is somewhat larger than the rest. The columella is furnished with numerous small tubercles and transverse lirations, somewhat irregularly situated, the former, however, being near the exterior margin of the thin callosity which spreads out on the columella, and the latter further within the aperture. This species has much resemblance to *Pleurotoma* (*Cithara*) *biclathrata* of Souverbie, Journ. de Conch. xxi. p. 59, and may eventually prove to be but a large variety of it.

14. Clathurella immaculata, sp. nov. Pl. XXX. fig. 7.

Testa elongate acuminato-ovata, turrita, alba; anfractus 8, sutura distinctadiscreti, superne breviter tabulati, ad latera convexiusculi, costis tenuibus 14–15 et liris spiralibus 5 supra costas nodulosis pulcherrime cancellati; anfr. ultimus infra medium constrictus, costis inferne attenuantibus et liris spiralibus circiter 18 cinctus; apertura angustissima, tortuosa, longitudinis testæ quam ½ paulo minor; labrum intus incrassatum, et denticulis 7–8 validis munitum ad suturam subprofunde sinuatum; columella medio haud arcuata sed paululum convexa, versus extremitatem obliqua, liris spiralibus circa caudam ornata; canalis perbrevis, angustissimus, leviter recurvus. Long. 8½ mill., diam. 3½.

Hab. Tarawa Island, Gilbert group.

This snow-white species has somewhat the form of *Pl. vultuosa*, Reeve. It is, however, rather longer in the body-whorl, the longitudinal ribs are more numerous and slender, and the spiral liræ are more distinct.

15. Fusus Brazieri, sp. nov. Pl. XXX. fig. 16.

Testa fusiformis, turrita, alba, liris rufescenti-fuscis cincta; anfractus 8–9 superne anguste excavati, deinde convexi, costis crassis rotundatis ad 8 leviter obliquis superne versus suturam fere obsoletis instructi, et liris rufo-fuscis circiter 9 pulcherrime squamosis transverse cincti;

liræ inferiores 5–6 æquales aliis superioribus crassiores; anfr. ultimus liris spiralibus 23–25 cinctus, quarum duæ versus basim crassiores et fortiter imbricatæ, et infima circa rimam umbilicalem maxima; costæ inferne subobsoletæ; apertura ovalis, intus alba; columella arcuata, alba, tenuiter callosa; canalis obliquus, leviter recurvus, mediocriter angustus. Long. 44 mill., diam. 8.

Hab. —?

The upper part of the whorls of this species is narrowly concave or excavated, and the spiral lirations on it are considerably finer than those below; and the stout rounded ribs are almost obsolete in this excavation. The lower part of the body-whorl has two rather distant lirations, which are very strongly imbricated where they cross the almost obsolete longitudinal ribs; and the margin of the narrow umbilical fissure is still more strongly imbricated. I feel much pleasure in naming this remarkable shell after Mr. Brazier, by whom it was presented to the Museum. I do not know of any species sufficiently closely allied to offer a comparison.

16. Fusus imbricatus, sp. nov. Pl. XXX. fig. 3.

Testa breviter fusiformis, crassiuscula, fusco-albida, longitudinaliter supra costas saturate fusco strigata; anfractus 5, superiores medio angulati et carina undulata prominente ornati, superne late et oblique declives, infra carinam recti, costis crassiusculis circiter 9 superne obliquis et versus suturam sensim attenuantibus instructi, liris paucis (supra angulum 5–6, eum infra circiter 3) pulcherrime imbricatis cincti; anf. ultimus superne robustus, versus basim in caudam brevem contortam recurvam productus, rimatus, costis inferne obsoletis ad angulum tubercula compressa formantibus, et liris spiralibus imbricatis præcipue supra costas ornatus; apertura subovata intus albida; labrum margine crenulato intus liris intrantibus gracilibus ad 9 munitum; columella supra leviter arcuata, saturate fusca, infra contorta; canalis breviusculus, obliquus, angustus, recurvus. Longit. 27 mill., diam. 13.

Hab. New Caledonia.

This species is remarkable for the prominent undulating angulation or keel, which exists a little below the middle of the upper whorls and around the upper part of the body-whorl. The longitudinal ribs or varices are very much produced at this part, and form transversely compressed nodules, which give the shell a very elegantly festooned aspect when viewed with the apex towards the eye. The transverse lirations are very beautifully scaled or imbricated, particularly so upon the costations, and on the last whorl are, at intervals, stouter than one or two in the interstices between them. The labrum is prettily crenulated on the margin; and the nine or ten white liræ within do not quite attain to it.

17. Pisania crenilabrum, *A. Adams, Proc. Zool. Soc.* 1854, p. 138.

Hab. New Caledonia, "West Indies" (*Adams*); Moreton Bay (*coll. Cuming*).

There is not the slightest doubt of the identity of the New-Caledonian shell with the type of this species, which was described as an inhabitant of the West Indies; and therefore I should be inclined to consider the latter locality for this species erroneous, this being another of the very many instances of wrong habitats assigned to specimens described from the Cumingian collection.

18. P. solomonensis, sp. nov. Pl. XXX. fig. 14.

Testa ovato-fusiformis, crassiuscula, alba, interrupte fusco bifasciata; anfractus 7, primi tres læves, cæteri costis longitudinalibus ad 15 et liris spiralibus 6–7 ubique granose reticulati, incrementi lineis striati; anfr. ultimus superne fascia fusca latissima interrupta et infra medium angustiore cinctus, et liris transversis granosis circiter 15 ornatus; apertura oblonga, alba, zonis externis fuscis variegata; labrum incrassatum, intus denticulis 5–6 munitum; columella lævis, callo tenui albo induta, medio rectiuscula, inferne obliqua et tortuosa; canalis brevis, angustus, recurvus. Long. 8 mill., diam. 3¼.

Hab. San Christoval Island, Solomon group.

This small species is chiefly to be distinguished by its granular surface and the style of coloration. The upper whorls are spotted in an irregular interrupted manner with brown; or, rather, at irregular intervals a longitudinal row or two of granules are brown; on the body-whorl the rows of granules are generally brown around the upper part, and two rows also just below the middle, thus forming two brown bands more or less interrupted.

19. Columbella carolinæ, sp. nov. Pl. XXX. fig. 9.

Testa ovato-fusiformis, nitida, lutescens, strigis longitudinalibus irregularibus undulatis fuscis vel olivaceo-fuscis picta, paululum infra suturam linea interrupta nigro-fusca cincta et circa medium anfr. ultimi albo zonata; anfractus 8, convexiusculi, læves, sutura simplici discreti; anfr. ultimus medio obtusissime angulatus, inferne contractus, circa caudam striis spiralibus profundis circiter 11 insculptus; apertura parva, angusta, alba; labrum superne paululum infra suturam leviter sinuatum, margine simplici, extra valde tumide incrassatum, intus denticulato-liratum; columella tenuiter callosa, inferne sulcis circa caudam denticulata; canalis angustus, recurvatus. Longit. 8 mill., diam. 3¼.

Hab. Strong Island, Caroline group.

The coloration of this pretty species is very characteristic. The ground-tint varies from white to yellowish; the spiral interrupted line is situated rather above the middle of the whorls; and the dark olive-brown lines or flammulations are very irregular and flow into one another, thus forming an irregular network. The ultimate whorl is encircled by a white zone at the obtuse angulation near its middle, and at the spiral interrupted line it is also very faintly keeled. The base of the columella is furnished with five or six nodulous lirations; and the tooth-like liræ within the labrum are about eight in number.

20. Engina recurva, *Reeve.*—Ricinula recurva, *Reeve, Conch. Icon.* iii. f. 53.

Hab. San Christoval, Solomon Islands (*Brazier*); Lord Hood's Island (*Cuming*).

The transverse liræ are three in number in the upper whorls, and about eleven in the last. On the labrum there are five or six denticles; and the middle of the columella is very prominent. The backward slope of the outer lip and canal is very remarkable.

21. E. zonata, *Reeve.*—Ricinula zonata, *Reeve, Conch. Icon.* iii. f. 33.

Hab. San Christoval, Solomon Islands (*Brazier*); Gallapagos Islands (*Cuming*).

If the Cumingian habitat be correct, then this species is very widely distributed. The shell from the Solomon Islands is yellow, with black bands, and the short black longitudinal stripes at the base are very constant, and the whole surface of the shell is minutely reticulated with the finest longitudinal and spiral striæ. The labrum is thickened within and without, and bears seven small teeth; and the columella is furnished with about twelve short transverse liræ.

22. E. monilifera, *Pease, Proc. Zool. Soc.* 1860, p. 142.

Hab. San Christoval, Solomon Islands (*Brazier*); "Sandwich Is." (*Pease*).

The ribs on the last whorl of this species are about ten in number and are continuous to the base; and the spiral ridges, which are tubercular on crossing the ribs, amount to 9, including the row of the yellow tubercles beneath the suture. The nodules of the fifth and seventh transverse liræ, reckoning from the suture, are also bright yellow, the upper ones being situated in the purplish band which encircles the whorl, and the lower ones just beneath it; and in specimens from the Sandwich Islands those of the fifth, sixth, and seventh series are yellow.

23. NASSA BICALLOSA, sp. nov. Pl. XXX. fig. 1.

Testa acuminato-ovata, turrita, sordide albida, infra suturam et supra tergum livida; anfractus 10, superiores longitudinaliter oblique costati et paululum infra suturam linea impressa spirali sulcati, inferiores supra coronati, læves; anfr. ultimus magnus, lævis, coronatus, linea incisa superne haud cinctus, circa basim striis transversis 10–12 insculptus; sutura profunda, canaliculata; apertura subovata, intus albida vel pallide fuscescens ad suturam et basim, et paululum labri margine saturate fusco cincta vel zonata; labrum margine tenue, inferne denticulis, superne ad suturam subprofunde incisum, extra albo-varicosum, intus denticulo-liratum; columella valde arcuata, callo crassiusculo superne subtuberculato inferne dentiformi, producto amicta, et supra callum, callo crenulato secundo notabili ornata; canalis brevissimus, mediocriter latus. Long. 24 mill., diam. 12.

Hab. West Australia, (*Brazier*); Swan River, Cape Natal.

This species somewhat resembles *N. algida*, Reeve; but there are several peculiarities which well distinguish it from that form. The spiral striation which encircles the upper whorls does not extend to the last. The tubercles forming the coronation gradually enlarge as the whorls increase. The most remarkable peculiarity in this species is the second callosity upon the columella. It is parallel with the margin of the other, is crenulated or dentate, and extends upward and curves inwards within the aperture upon the wall of the body-whorl; and the lower end of the columella stands out in the form of a prominent callous tooth. The slit in the sutural end of the labrum forms, with the tubercular callosity of the columella, a narrow well-defined sinus. The interior of the aperture is usually whitish or brownish white; but along the suture, and around the base, and in a line with the margin of the labrum, at a little distance from it, it is stained or striped with very deep brown. The lirations within the lip are about twelve in number, and do not quite extend to the margin of it.

24. N. MARRATII, sp. nov. Pl. XXX. fig. 4.

Testa ovata, superne acuminata, albida vel flavescens, maculis irregularibus rufo-fuscis picta et lineis spiralibus rufo-fuscis cincta: anfractus

8–9, levissime convexi, primi duo læves politi, sequentes 2–3 longitudinaliter oblique plicati transversimque sulcati, ultimi duo læves, ultimus circa basim striis transversis subdistantibus insculptus; apertura parva, ovata, intus fuscescens, prope labri marginem alba; columella medio arcuata callo tenui polito supra anfractum expanso induto, superne versus labrum tuberculo elongato parvo munita, ad basim transversim 2–3-plicata; labrum album, fortiter incrassatum, margine tenui, intus liris brevibus circiter 9 haud ad marginem productis armatum; canalis brevis angustus. Long. $14\frac{1}{2}$ mill., diam. 6.

Hab. San Christoval, Solomon Islands. Collected above high water (*Brazier*).

The colour of this species is somewhat variable. There are two varieties, a dark and a pale one. The former is whitish, with numerous reddish brown blotches or irregular stripes, and with the spiral lines of the same colour, five or six on the penultimate whorl and about fourteen on the last, the four or five lowest ones running in the striæ around the base. The paler variety is yellowish, with very pale brown irregular blotches and stripes. In all specimens the upper part of the last three whorls at the suture is slightly crenulated and spotted with dark reddish brown and white, and the three or four apical volutions are of a uniform brown colour. *N. gaudiosa*, of Hinds, is its nearest ally, from which it may be distinguished by its smaller size, narrower form, and difference of coloration. It is with pleasure that I join to this species the name of my friend Mr. F. Marrat, of Liverpool, who is now engaged upon a monograph of this genus.

25. Nassa bifaria, *Baird, 'The Cruise of the Curaçoa'* (Brenchley), 1873, p. 436, pl. 38. f. 1, 2.

Hab. New Caledonia.

26. N. stigmaria, *A. Adams, Proc. Zool. Soc.* 1851, p. 96; *Reeve, Conch. Icon.* viii. f. 42 *a, b*.

Hab. New Caledonia (*Brazier*); Philippine Islands (*Cuming*); Japan (*Capt. St. John*).

Specimens in the Museum from the above localities agree almost precisely in every particular.

27. N. curta, *Gould, Proc. Boston Soc. Nat. Hist.* iii. 1849; *Otia Conchol.* p. 69.

Hab. Strong Island, Caroline group (*Brazier*); Samoa Islands (*Gould*).

28. N. echinata, *A. Adams, Proc. Zool. Soc.* 1851, p. 101; *Reeve, Conch. Icon.* viii. f. 131.

Hab. New Caledonia (*Brazier*); Philippine Islands (*Cuming*).

29. Nassa trinodosa, sp. nov. Pl. XXX. fig. 2.

Testa globoso-conica, crassiuscula, livido-cinerea, fascia angusta utrinque fusco marginata vel lineata ornata; anfractus 8 sutura subprofunda undulata sejuncti, infra eam fortiter marginati et leviter excavati, paululum supra medium aliquanto angulati, deinde convexiusculi, costis ad 10 subobliquis, mediocriter tenuibus, superne attenuantibus ad angulum acute nodosis instructi, et liris spiralibus 4–6 inter supraque costas continuis ornati; anfr. ultimus infra angulum superiorem concavus et triangulatus, costis longitudinalibus ad angulos duos nodosis et infra angulum infimum obsoletis instructus, liris transversis circiter 20 cinctus; apertura parva irregulariter ovata fuscescens, zona alba externa fasciata; labrum margine tenui extra intusque incrassatum versus basim haud profunde sinuatum, intus album liris tenuibus albis 6–7 armatum; columella arcuata callo mediocriter crasso inferne incrassato amicta, superne tuberculo parvo munita; canalis angustus. Long. 13 mill., diam. 7.

Hab. San Christoval, Solomon Islands.

The margination of the whorls beneath the suture is very decided, and in some specimens appears to consist of the two uppermost spiral lirations. It is remarkable that the upper whorls below the superior angle are convex, whilst the last is concave. The ribs on the body-whorl are noduled in three places, the nodules not being very prominent, particularly the two lower ones. The middle one is situated about the centre of the whorl, and the lowest one only at a little distance below it and not so remote as the uppermost. *N. coronula*, A. Adams, is of very much the same form as this; but its much thicker costations, finer transverse lirations, and the absence of the keel-like margination beneath the suture at once define its distinctness.

30. N. interlirata, sp. nov. Pl. XXX. fig. 5.

Testa parva, acuminato-ovata, saturate fusca, infra suturam nigrescens; anfractus 7, leviter convexi, superiores tres læves politi, cæteri costis arcuatis vel flexuosis confertis circiter 24 et liris spiralibus tenuibus 5–6 inter costas ornati; anfr. ultimus liris spiralibus 18–19 ornatus; liræ infimæ 4 circa caudam brevissimam fere contiguæ; apertura parva ovata, intus fusca; labrum extra late varicosum, intus denticulis 7 munitum, versus basim haud profunde sinuatum; columella callo tenui induta, arcuata, superne tuberculum parvum elongatum gerens; canalis brevissimus, angustus. Long. $6\frac{1}{2}$ mill.; diam. $3\frac{1}{3}$.

Hab. San Christoval, Solomon Islands.

This is very distinct from any species hitherto described. The dark uniform brown colour, except just beneath the suture (where a somewhat blackish tinge prevails), the very numerous flexuous ribs and fine spiral liræ are the chief characteristics. The last mentioned do not cross the longitudinal ribs; and around the top of the whorls the first liration below the suture is somewhat remote from it; and also two which encircle the body-whorl near its middle are rather further apart than the others, thus leaving the series of little pits between them somewhat larger than those between the other liræ. *Nassa Wilsoni*, C. B. Adams, from Panama, is the only species which bears any relationship to the present; but there are many distinctive differences between them.

31. Nassa delicata, *A. Adams, Proc. Zool. Soc.* 1851, p. 99; *Reeve, Conch. Icon.* viii. f. 180, *a*, *b*.

Hab. New Caledonia (*Brazier*); Philippine Islands (*Cuming*).

32. N. callospira, *A. Adams, Proc. Zool. Soc.* 1851, p. 102; *Reeve, Conch. Icon.* viii. f. 66, *a*, *b*.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

33. N. pupinoides, *Reeve, Conch. Icon.* viii. f. 162.—Aciculina striata, *A. Adams, Proc. Zool. Soc.* 1851, p. 114.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

Reeve describes the colour of this species as "light brown, encircled with a pale band;" and his figure is tinted a dirty olive, with a bluish band beneath the suture. Neither of these colourings is quite accurate. The type is of a pale purplish horn-colour, the upper whorls with a single pale band round the middle, and the body-whorl with three such zones; the labrum is somewhat thickened, and armed with about seven denticles; the columella is stained with brown, with a small tubercle above, and on that of the Solomon-Island specimen there are one or two at its base.

34. N. mœsta, *Hinds, Voy. Sulphur*, p. 36, pl. 9. f. 18, 19.

Hab. San Christoval, Solomon Islands (*Brazier*); Gulf of Papagayo, west coast of Central America! (*Hinds*).

There is another remarkable instance of wide geographical distribution, supposing both the above localities to be correct. Of the identity of this specimen from the Solomon Islands with examples from Central America there is not the shadow of a doubt. It has been compared with typical examples of *mœsta* received from Sir Edward Belcher and labelled in Hinds's handwriting, and in no respect differs from them. The number of the whorls should be eight, and not six (as described by the author of the species), the three apical ones being smooth, convex, and glossy. The colour also is rather blue slate-colour than "blackish;" and the upper edge of the whorls at the suture is dirty white or yellowish, and a little below it there is a slender, obscure, reddish spiral line. The aperture is very dark rich brown and small; the labrum much thickened, with two pale spots on the exterior, thinnish at the edge, and furnished with four or five denticles within; the columella arcuate, clothed with a brown callus, which is rather broadly reflexed, and provided with a single tooth above and one at the base. The longitudinal plications on the body-whorl are from 20–21 in number, and become somewhat obsolete towards the base, where the transverse fine liræ are not granulous on crossing them as above and on the whorls of the spire (where the number is from five to six); and between these lirations there are very fine spiral striæ.

35. Purpura buccinea, *Deshayes, Anim. sans Vert.* ed. 2, vol. x. p. 92; *Reeve, Conch. Icon.* iii. f. 16, *a, b.*—Purpura striata, *Quoy & Gaimard, Voy. Astrolabe,* pl. 37. f. 12, 13; *Kiener, Coq. Viv.* pl. 38. f. 88.

Hab. Makeira Harbour, San Christoval, Solomon Islands (*Brazier*); "New Guinea" (*Quoy*).

36. Vexilla fusco-nigra, *Pease, Proc. Zool. Soc.* 1860, p. 141.

Hab. San Christoval, Solomon Islands (*Brazier*); "Sandwich Islands" (*Pease*).

The colour of this species differs somewhat from Pease's decription, the tubercles of the spiral ribs being yellowish edged with black, and the interstices between them bluish ash-colour.

37. Sistrum anaxares, *Duclos.*—Purpura anaxares, *Duclos, Kiener, Coq. Viv.* p. 26, pl. 7. f. 17; *Reeve, Conch. Icon.* iii. pl. 12. f. 61.

Hab. San Christoval, Solomon Islands (*Brazier*); Lord Hood's Island (*Cuming*).

38. Latirus ustulatus, *Reeve.*—Turbinel laustulata, *Reeve, Conch. Icon.* iv. f. 62.

Hab. San Christoval, Solomon Islands (*Brazier*).

The locality of this species has not, I believe, been hitherto recorded.

39. Mitra cærulea, *Reeve, Conch. Icon.* ii. f. 113.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

This species is described and figured by Reeve as being encircled by "a broad blue band" around the last whorl. In the specimen from the Solomon Islands this band is of a brown colour.

40. MITRA FLAMMEA, *Quoy & Gaimard, Voy. Astrolabe*, pl. 45 bis. f. 23–25; *Reeve, Conch. Icon.* ii. f. 120.
Hab. San Christoval, Solomon Islands (*Brazier*); Philippines (*Cuming*).

41. M. QUOYI, *Deshayes*.—M. nigra, *Q. Voy. Astrolabe*, pl. 45. f. 16–18; *Reeve, Conch. Icon.* ii. f. 109; *Kiener, Coq. Viv.* pl. 12. f. 37.
Hab. San Christoval, Solomon Islands.

I am by no means confident that the species figured above are identical. Quoy describes his shell with three plaits on the columella, and Reeve four. The species of the latter author, when in a good state of preservation, is clothed with a very thin dirty olive epidermis, and is encircled with rather distant spiral series of shallow punctures. The specimen from the Solomon Islands agrees with the latter variety.

42. M. (ZIERLIANA) ANTHRACINA, *Reeve, Conch. Icon.* ii. f. 137.
Hab. San Christoval, Solomon Islands (*Brazier*); "Philippine Islands" (*Cuming*).

The liræ within the labrum are very fine, thread-like, and about fifteen in number.

43. M. (ZIERLIANA) CRENIPLICATA, *A. Adams, Proc. Zool. Soc.* 1851, p. 139.
Hab. San Christoval, Solomon Islands (*Brazier*).

The locality of this species is not quoted by its describer. The specimen sent by Mr. Brazier is 17 millim. long and 6½ in width; and the lirations within the aperture are twelve in number, some of them extending much further inwards than others.

44. M. (TURRICULA) RUFOFILOSA, sp. nov. Pl. XXX. fig. 10.
Testa ovato-fusiformis, turrita, saturate olivaceo-fusca, circa partem inferiorem anfract. superiorum et paululum supra medium anfr. ultimi zona alba medio linea rufa bipartita ornata; anfractus 11 sutura profunda discreti, subplani, costis parum obliquis 14 instructi, et sulcis profundis 5–6 præcipue inter costas, spiraliter sculpti; anfr. ultimus sulcis transversis circiter 21, paucis ad basim profundissimis ornatus et costis longitudinalibus inferne attenuantibus et granosis; apertura subangusta, longitudinis testæ quam ½ paulo minor, nigro-fusca albo fasciata, intus tenuiter lirata; columella obliqua, plicis albis 4 munita, superne tuberculum parvum gerens; canalis angustiusculus leviter recurvus. Long. 18½ mill., diam. 7.
Hab. San Christoval, Solomon Islands.

This is a very pretty species and easily recognizable by its style of coloration. The white band, which is bisected exactly in the middle by the red thread-like line, occupies about the lower half of the whorls. The ribs are sharpish at their edge, and of a lighter colour there than the interspaces, and contiguous to one another at the base; those of the last whorl are somewhat attenuated inferiorly, and nodulous where they are traversed by the six or seven broad deep sulci, the nodules being of a pale horny colour. The very fine lirations within the aperture are about twelve in number.

45. MITRA (TURRICULA) ANTONELLII, *Dohrn, Proc. Zool. Soc.* 1860, p. 367.

Hab. San Christoval, Solomon Islands (*Brazier*); "Philippine Islands" (*Dohrn*).

46. M. (TURRICULA) LIGATA, *A. Adams, Proc. Zool. Soc.* 1851, p. 134.

Hab. San Christoval, Solomon Islands (*Brazier*); "Philippine Islands" (*Adams*).

This species is 17 millim. long and 5⅓ broad.

47. M. (TURRICULA) OBELISCUS, *Reeve, Conch. Icon.* ii. f. 107.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

48. M. (TURRICULA) CRUENTATA, *Chemnitz, Reeve, Conch. Icon.* ii. f. 126.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

49. M. (TURRICULA) SEMIFASCIATA, *Lamarck, Reeve, Conch. Icon.* ii. f. 131, *a*, *b*.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

50. M. (TURRICULA) DISCOLORIA, *Reeve, Conch. Icon.* ii. f. 230.

Hab. San Christoval, Solomon Islands (*Brazier*).

The habitat of this very pretty species has not hitherto been recorded.

51. M. (TURRICULA) DESHAYESII, *Reeve, Conch. Icon.* ii. f. 170.

Hab. San Christoval, Solomon Islands (*Brazier*); "—— ?" (*Reeve*).

The shell from the above islands differs somewhat in coloration from the typical form. It is broadly black-banded beneath the orange tips of the ribs in the upper whorls; and the last is entirely blackish brown interrupted by three yellowish zones, the uppermost one adjoining the suture, the median one near that region of the whorl, and the lowest a little below it. Reeve describes the whorls as being smooth beneath the orange nodules. The shell before me is longitudinally broadly ribbed, the upper extremities being somewhat thickened, but scarcely nodulous. They do not extend quite to the base of the body-whorl.

52. Mitra (Turricula) lubens, *Reeve, Conch. Icon.* ii. f. 331.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

53. M. (Turricula) nodulifera, *A. Adams, Proc. Zool. Soc.* 1851, p. 141.

Hab. San Christoval, Solomon Islands (*Brazier*); "—— ?" (*Adams*).

The length of the specimen from the above locality is 11½ mill., and its diameter 4. Its ground-colour is pale pinkish; and the ribs are white, especially at the nodulous ends, and the interior of the aperture orange.

54. M. (Turricula) ficulina, var. Pl. XXX. fig. 12.

Mitra ficulina, *Lamk. Anim. sans vert.* ed. 2, vol. x. p. 336; *Kiener*, pl. 27. f. 86; *Reeve*, f. 141.

Testa ovata, turrita, brevis, lata, saturate chocolato-fusca; anfractus 9? (apice fracto), sutura profunda sejuncti, costis obliquis crassiusculis (in anfr. ultimo 13 versus basim fere obsoletis) instructi, et sulcis spiralibus circiter 6 distantibus (in anfr. ult. 15–16, quorum 2–3 paululum ante basim latissimi et profundi) sculpti; apertura pallide lilacea, longitudinis testæ ½ paulo superans, longe intus liris filiformibus circiter 12 armata; columella tenuiter callosa superne tuberculata, plicis obliquis 4 munita; canalis mediocris, leviter recurvus. Long. 15½ mill., diam. 7⅔.

Hab. San Christoval, Solomon Islands.

This specimen is remarkable for its short ovate form and uniform dark chocolate-brown colour. The ribs on the body-whorl are much attenuated at the base, and are made nodulous by being traversed by the few deep and broad sulcations which exist around that portion of the whorl.

55. M. (Pusia) Cumingii, *Reeve, Conch. Icon.* ii. f. 67.

Hab. San Christoval, Solomon Islands (*Brazier*); "Philippine Islands" (*Cuming*).

The interstices between the transverse ridges are described by Reeve as "deeply impressed;" but in the specimen sent by Brazier they are deeply elongately punctured between the longitudinal costations, especially on the spire and the upper half of the body-whorl; on the lower portion they are less deep. The short cauda of this whorl is bright orange; and the aperture is pale buff.

56. Mitra (Pusia) Græffei, *Crosse, Journal de Conch.* xv. p. 297.
Hab. San Christoval, Solomon Islands.

57. Tritonium (Epidromus) digitale, *Reeve.*—Tritonium digitale, *Reeve, Conch. Icon.* ii. f. 86.
Hab. Strong Island, Caroline Group (*Brazier*); Philippine Islands (*Cuming*); Marquesas Islands (*Pease*).

"The close-set obtuse granules" with which the whorls are described by Reeve as being covered, are situated upon somewhat oblique ribs, which are 24 on the body-whorl. The columella is straight in the middle and oblique in the region of the canal; it is smooth and coated with a callosity which is very well defined. The canal is narrow, deep, and recurved; and the labrum is thickened and furnished with about 7 teeth within. The length is 13 millim., width $4\frac{1}{2}$.

58. Tritonium (Epidromus) truncatum, *Hinds, Voy. Sulphur*, pl. 4. f. 9, 10; *Reeve, Conch. Icon.* ii. f. 83.
Hab. San Christoval, Solomon Islands (*Brazier*) · "New Ireland" (*Hinds*); "Philippine Islands" (*Cuming*).

59. Tritonium (Epidromus) bracteatum, *Hinds, Voy. Sulphur*, pl. 4. f. 5, 6; *Reeve, Conch. Icon.* ii. f. 84.
Hab. San Christoval, Solomon Islands (*Brazier*); "Marquesas Islands" (*Hinds*); "Philippine Islands" (*Cuming*).

60. Recluzia? globosa, sp. nov. Pl. XXX. fig. 8.
Testa globosa, tenuis, imperforata, albida, pallide fusco strigata; anfractus 5 convexi, sutura simplici discreti, incrementi lineis ubique arcuatis superne ad suturam leviter squamose elevatis ornati, et spiraliter levissime striati; anfr. ultimus magnus, ventricosus, ad regionem umbilicalem albus; apertura lunato-circularis, magna, longitudinis totius circiter $\frac{2}{3}$ æquans; columella perarcuata, leviter incrassata, alba, callo tenui labro juncta. Long. $11\frac{1}{2}$ mill., diam. anfr. ultimi supra aperturam 7; aperturæ long. 8, diam. 6.
Hab. Tarawa, Gilbert Group.

I am very doubtful with regard to the correct position of this species. It seems to have some relationship to *Natica* as well as to *Recluzia*. From the former it differs in the absence of an umbilicus and in its light construction, and from the latter in the arcuate columella. The spiral striæ are very close together, very faint and wavy. The lines of growth beneath the suture, especially in the last whorl, are elevated in a scale-like manner. Probably this shell has been invested by a thin epidermis which has been worn off by being rolled on the beach, where two specimens were picked up by Mr. Brazier.

61. Littorina melanacme, sp. nov. Pl. XXX. fig. 21.

Testa ovata, ventricosa, ad apicem acuta et nigrescens, albida vel cæruleo-albida lineis tenuibus fuscis radiantibus numerosis irregulariter picta; anfractus 6 convexi, striis spiralibus paucis sculpti; anfr. ultimus infra suturam et præcipue versus labrum aliquanto depressus, ad peripheriam inconspicue obtuse angulatus, striis transversis circiter 20 (paucis ad basim quam cæteræ majoribus) ornatus; apertura subsemicircularis, intus saturate fusca, fascia lutea basali ornata; labrum margine luteo fusco lineato; columella obliqua, fere rectilinearis, leviter excavata, fusca. Long. $9\frac{1}{2}$ mill., diam. 5.

Hab. San Christoval, Solomon Islands.

This species is allied to *L. Novæ-Zealandiæ* of Reeve, and differs only in the following particulars: it is smaller, not quite so globose in form, of a bluish-white tinge, and with a dark apex; the longitudinal lines are cut across by the spiral striæ, and thus have a dotted appearance. In *L. Novæ-Zealandiæ* the apex is pale, the ground-colour is opaque white, and the reddish lineations are very faint, and the spiral striæ are rather finer than in the present species. The aperture of the latter is much darker in colour, the edge of the outer lip is pale and dotted with short brown lines, and the columella is brown and not so broadly excavated as that of Reeve's shell.

62. Risellea tantilla, *Gould*.—Trochus tantillus, *Gould, Proc. Boston Soc. Nat. Hist*, 1849, vol. iii. p. 118; *Otia Conchol.* p. 59.

Hab. Bonham Island, Marshall group (*Brazier*); Sandwich Islands (*Gould*).

This species appears to vary very much in height. It was originally described as possessing a depressed spire; but usually it is shortly conical. The angulation of the whorls is very faint in some examples and situated about the middle of the whorls. The shells from the Marshall Islands are small, with the spire much elevated, the radiating flexuous brown lines being wanting, and the base is furnished with five instead of two spiral lirations as described by Gould. The interior of the aperture is not pearly as in the Trochidæ; and yet the operculum truly appertains to that family, being concentric and multispiral; and although therefore differing from that of *Risella*, the shell itself appears to suggest the propriety of its being located with that genus rather than with the Trochidæ.

63. Planaxis virgatus, *Smith, Annals & Mag. Nat. Hist.* 1872, vol. ix. p. 44.

Hab. San Christoval, Solomon Islands (*Brazier*).

Other specimens in the British Museum are from the Fiji Islands and New Caledonia.

64. Rissoina clathrata, *A. Adams, Proc. Zool. Soc.* 1851, p. 265; *Schwartz von Mohrenstern's Monograph, Denkschrift. Akad. Wissenschaft. Wien*, 1861, vol. xix. pt. 2, p. 154, pl. vi. f. 49.

Hab. Strong Island, Caroline group (*Brazier*); Philippine Islands (*Cuming*); New Holland (*Paris Museum, teste Schwartz*).

The spiral liræ in the upper whorls are three in number, and twice as many in the body-whorl, the lowest one being very thick, indeed double as thick as the others; the longitudinal costations or lirations are about eighteen, somewhat obliquely arcuate and minutely nodulous at the points of junction with the transverse liræ. The length of the largest Philippine specimen is 12 millim., diameter $3\frac{1}{2}$. The shells from the Caroline Islands are much smaller, being only 7 mill. long and $2\frac{1}{3}$ broad.

65. R. canaliculata, *Schwartz von Mohrenstern's Monograph, Denkschrift. Akad. Wissenschaft. Wien*, 1861, vol. xix. pt. 2, p. 123, pl. ii. f. 18.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Schwartz*).

This species is very closely related to the *R. scalariana* of A. Adams, from which it chiefly differs in its larger size and more numerous ribs.

66. R. myosoroides, *Récluz*, var., *Schwartz von Mohrenstern, Densch. Akad. Wissenschaft. Wien*, 1861, vol. xix. pt. 2, p. 134, pl. iv. f. 30.

Testa cylindraceo-ovata superne acuminata, alba (interdum circa medium anfractuum obscure roseo tincta); anfractus $8\frac{1}{2}$, apicales $2\frac{1}{2}$ læves convexi vitrei, cæteri convexiusculi, sutura parum obliqua sejuncti, costis aliquanto arcuatis et obliquis circiter 17, et spiraliter minutissime striati; anfr. ultimus costis flexuosis ad basim continuis et dimidio infero liris spiralibus tenuibus inter costas cincto; apertura obliqua, mediocris; labrum extra late incrassatum et costulis tenuibus ornatum; columella medio paululum arcuata tenuiter callosa; canalis mediocriter profundus, obliquus. Long. $5\frac{1}{2}$ mill., diam. 2.

Hab. San Christoval, Solomon Islands (*Brazier*); Mauritius (*Schwartz*).

The ribs on the body-whorl are rather more numerous than on the upper whorls, and gradually more slender as the labrum is approached, three or four being situated on the thickening without it. I have given the above description, as the specimens from the Pacific offer a few slight differences from the examples found at the Mauritius. In the former only two or three of the apical whorls are smooth, whilst in the latter six are sculptureless. The ribs of the Solomon-Islands examples are rather fewer, and the whole shell is a trifle larger.

67. Rissoina terebroides, sp. nov. Pl. XXX. fig. 19.

Testa breviter subulata, solidiuscula, albida, circa medium anfractuum fusco zonata et supra partem inframedianam fusco tincta; anfractus 10? apicales abrupti, reliqui 7 convexiusculi, costis obliquis 11–12 mediocriter crassis, leviter arcuatis instructi, ubique minutissime spiraliter striati; anfr. ultimus infra medium longe crassius striatus, costas haud ad basim productas gerens; apertura parva obliqua alba; labrum extra fortiter et late varicosum; columella obliqua, leviter arcuata, callo tenui induta; canalis haud profundus sed distinctus. Long. $8\frac{1}{2}$ mill., diam. $2\frac{2}{3}$.

Hab. San Christoval, Solomon Islands.

The shortly subulate form, the stoutish oblique ribs, the most minute spiral striation and the much coarser striæ around the base of the last whorl, and the style of colouring are the chief characteristics of this species.

68. Cerithium columna, *Sowerby, 'Genera of shells'* No. 42, f. 7; *Thesaurus Conch.* ii. pl. 178. f. 56–58; *Reeve, Conch. Icon.* xv. f. 2, *a, b.*

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

69. C. armatum, *Philippi, Abbild. u. Beschr. Conchylien,* vol. iii. pl. i. f. 9; *Sowerby, Thesaurus,* ii. pl. 179. f. 68; *Reeve, Conch. Icon.* xv. f. 14, *a, b.*

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

70. C. planum, *Anton, Philippi, Abbild. und Beschreib. Conchyl.* iii. p. 19, pl. i. f. 18; *Sowerby, Thesaurus Conch.* ii. pl. 181. f. 111–113; *Reeve, Conch. Ic.* xv. f. 79.—Var. = C. balteatum (*Philippi*?), *Sowerby, l. c.* f. 116, 117; *Reeve,* f. 72, *a, b.*

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

The chief difference between this species and the variety *balteatum* is, that it is rather smoother, and rather more deeply pitted between the longitudinal costations. Both forms have the black apex and the orange or brown base, *balteatum* having a band at the base of the upper whorls, which passes round the last one a little above the middle. This zone is not present in the typical *planum*; but there are three specimens of a variety of it in the

Museum which have it exactly similar to that of *balteatum*. There is some doubt with regard to the identity of the shell described and figured by Philippi with that of Sowerby & Reeve. Philippi does not mention the dark apex, nor does he describe his shell as being coloured at the base.

71. CERITHIUM CORONATUM, *Sowerby, Thesaurus Conch.* ii. pl. 181. f. 118; *Reeve, Conch. Icon.* xv. f. 48, *a*, *b*.
Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands, (*Cuming*).

72. C. ROSTRATUM, *Sowerby, Thesaurus Conch.* ii. pl. 180. f. 104; *Reeve, Conch. Icon.* xv. f. 95, *a*, *b*.
Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands & Lord Hood's Island (*Cuming*); Sandwich Islands (*Pease*); Red Sea (*MacAndrew*).

The Solomon-Islands specimen differs from the type of this species in the absence of the spiral lines between the ribs, which are prominent and agree in this respect with some examples from the Gulf of Suez, collected by and presented to the Museum by the late Robert MacAndrew.

73. C. RUGOSUM, *Wood, Sowerby, Thesaurus Conch.* ii. pl. 183. f. 195, 197; *Reeve, Conch. Icon.* xv. f. 45, *a*, *b*.
Hab. Bonham Island, Marshall group (*Brazier*); Philippine Islands (*Cuming*); Red Sea.

The shells from the Marshall Islands are dwarfs in comparison with the Philippine and Red-Sea specimens; in all other respects they are identical. Length 12 mill., diam. 5.

74. C. NASSOIDES, *Sowerby, Thesaurus Conch.* ii. pl. 183. f. 200, 201; *Reeve, Conch. Icon.* xv. f. 83, *a*, *b*.
Hab. San Christoval, Solomon Islands (*Brazier*); Sandwich Islands (*Newcombe*).

Not only between the plications at the suture and on the labrum is this species painted; for in specimens in fine condition nearly the whole surface is dotted minutely with brown.

75. C. LACTEUM, *Kiener, Coq. Viv.* pl. 7. f. 3; *Sowerby, Thesaurus*, ii. pl. 184. f. 213, 214; *Reeve, Conch. Icon.* xv. f. 85, *a*, *b*.
Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

76. C. EGENUM, *Gould, Proc. Boston Soc. Nat. Hist.* vol. iii. 1849; *Atlas United-States Explor. Exped.* (Wilkes), pl. x. f. 171; *Otia, Conchol.* p. 62.

Hab. San Christoval, Solomon Islands (*Brazier*); Wilson's Island (*Gould*).

The little shell which I associate with this species, agrees very well with Gould's description, with the exception that the spiral liration which is situated a little above the middle of the whorls, and is larger than the others, is decidedly nodulous; and that at the suture is also nodulous, the nodules of the latter being smaller than those of the former. The figure given by Gould is not good, as it does not show the little dark-brown spots which exist around the lower portion of the body-whorl.

77. VANIKORO ACUTA, *Récluz*, var.—Narica acuta, *Récluz, Mag. de Zoologie*, 1845, p. 60, pl. 133. f. 1, 2.

Hab. San Christoval, Solomon Islands (*Brazier*); "Lord-Hood Island, Moluccas, and Cape Natal" (*Cuming*).

The single example from the Solomon Islands differs somewhat from the types of this species. The umbilicus is narrower, and the spiral sculpture rather coarser, and the striæ more deeply incised.

78. NERITINA SIDEREA, *Gould, Proc. Boston Soc. Nat. Hist.* 1847, vol. ii.; *Otia Conchol.* p. 48; *Reeve, Conch. Icon.* ix. f. 171, *a, b.*—Neritina dispar, *Pease, American Journ. Conchol.* vol. iii. p. 285, pl. xxiv. f. 3.

Hab. San Christoval, Solomon Islands (*Brazier*); Feejees (*Gould*).

The two specimens from San Christoval are very large, measuring eleven millims. in length, and are much paler in colour than the typical form. The fine longitudinal wavy lines (not mentioned by Gould) are somewhat distant; the white triangular spots, which are shaded on the left with purple black, are rather large; and the last whorl is encircled near the middle with two indistinct bands of the same colour. From the series of this species in the Museum collection, it would appear that the smaller the specimen the blacker it is and the white spots fewer.

79. LIOTIA CIDARIS, *Reeve.*—Delphinula cidaris, *Reeve, Conch. Icon.* i. f. 27.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

80. L. DISCOIDEA, *Reeve.*—Delphinula discoidea, *Reeve, Conch. Icon.* i. f. 15, *a, b.*

Hab. San Christoval; Philippine Islands (*Cuming*).

81. Liotia crenata, *Kiener*.—Delphinula crenata, *Kiener*, pl. 4. f. 8; *Reeve*, *Conch. Icon.* i. f. 19, *a*, *b*.
Hab. San Christoval (*Brazier*); Philippine Islands (*Cuming*).

82. Adeorbis tenuilirata, sp. nov. Pl. XXX. fig. 18.
Testa minuta, orbicularis, depressa, tenuis, umbilicata, flavescens, lineis interruptis olivaceo-nigris et maculis radiantibus ejusdem coloris infra suturam ornata, versus apicem purpurascens, et circa umbilicum sordide alba; anfractus 4 convexi, rapide accrescentes, sutura subprofunda sejuncti, liris spiralibus tenuibus cincti, incrementi lineis oblique striati; apertura magna, subcircularis, ad basim recedens, albida lineis exterioribus variegata; columella aliquanto expansa et reflexa; peristoma interruptum, marginibus callo brevissimo junctis. Alt. $2\frac{1}{3}$ mill., diam. max. 3, min. $2\frac{1}{2}$. Operculum tenuissimum, pallide corneum, extra concavum.
Hab. San Christoval, Solomon Islands.

The spiral liræ which encircle the body-whorl around the middle, are stouter than the rest; and those beneath are very fine indeed. As these lirations are rather close together and interruptedly of a dark olive-colour, the shell displays more of this tint than of the yellowish ground-colour.

83. Trochus (Clanculus) bathyrhaphe, sp. nov. Pl. XXX. fig. 17.
Testa depresse conica, basi complanata, olivaceo-viridis, ad apicem viridis, granulis saturate fuscis ornata, sublate umbilicata; anfractus $5\frac{1}{2}$ convexi, sutura anguste canaliculata sejuncti, liris granosis (in anfr. penult. 7, suprema longe maxima) ubique cincti; anfr. ultimus ad peripheriam rotunde angulatus, granulorum seriebus circiter 14 cinctus; umbilicus albus, lira alba granulifera circumdatus, intus lira simplici ornatus; apertura obliqua, pulcherrime margaritacea, intus lirata; labrum exterius margine crenulato, ad basim fortiter liratum; columella superne anfractui juncta, obliqua, inferne dentata. Alt. $6\frac{1}{2}$ mill., diam. maxima $8\frac{1}{2}$, min. $7\frac{1}{2}$.
Hab. San Christoval, Solomon Islands.

Perhaps the nearest ally of this species is *Cl. atropurpurea* of Gould. From that species, however, it may easily be distinguished by its difference of colour, channelled suture, more rounded spire and the peculiarity of the umbilicus. The main colour of *C. bathyrhaphe* is a very dark olive-green, the apex being bright green; the granules of the infrasutural series, which are considerably larger than the rest, are dark brown at intervals, two or three together being of this colour, and those between them of the same hue as the shell. The granules on the base are subalternately reddish brown and greenish.

84. T. (Clanculus) atropurpureus, *Gould.*—Trochus (Monodonta) atropurpureus, *Gould, Boston Soc. Nat. Hist. Proc.* 1849; *Otia Conchol.* p. 59; *Atlas to Wilkes United-States Explor. Exped.* pl. xiii. f. 224, *a–e*.

Hab. San Christoval, Solomon Islands (*Brazier*); Tutuila, Navigators' Islands (*Gould*).

The dentate margin of the umbilicus is very characteristic in this species; it is white, and the large tooth on the upper side is very constant. The interstices between the series of granules are generally of a darker colour than the granules themselves; and sometimes the apex is of a rose-colour.

85. Trochus (Gibbula) supragranosus, sp. nov. Pl. XXX. fig. 15.

Testa solida, depresse globosa, anguste sed profunde perforata, pallida, strigis latis radiantibus aliquanto interruptis fuscis vel rosaceo-fuscis ornata; anfractus 5 convexiusculi, sutura profundiuscula sejuncti, liris spiralibus versus apicem granosis (in anfr. penult. 4–5) cincti; anfr. ultimus medio rotundatus inferne convexiusculus, liris circiter 20, irregulariter præsertim prope medium in paribus, ornatus, paululum pone labrum macula magna fusca vel roseo-fusca notatus; apertura parva, circularis, intus argenteo-margaritacea, prope marginem labri alba, et (in exemplis adultis), tenuiter lirata; labrum crassum margine acuto; columella arcuata, superne levissime reflexa. Alt. 5 mill., diam. maxima 5, minima $4\frac{1}{3}$.

Hab. San Christoval, Solomon Islands.

One of the chief peculiarities of this species is that the spiral liræ on the last whorl near the middle run in pairs. The lirations on the spire become granulous as the apex is approached. The brown or pinkish-brown stripes which flow downwards from the suture are interrupted somewhat by the transverse sulci, and thus appear as oblong dots on the liræ. On the back of the body-whorl, not far from the labrum, is a large brown or pinkish-brown stain.

86. T. (Canthiridus) Huttonii, sp. nov. Pl. XXX. fig. 20.

Testa breviter conica, obtecte perforata, cæruleo-nigra vel purpureo-nigra, ad apicem detritum albida; anfractus 5–6, convexiusculi, striis spiralibus circiter 7–8 incrementique lineis sculpti; anfr. ultimus ad peripheriam obtuse angulatus, inferne convexiusculus, in regione umbilicali levissime impressus; apertura subcirculari-quadrata, intus iridescens, tenuiter sulcata; labrum intus paululum incrassatum, albescens, anguste nigro limbatum; columella parum arcuata, incrassata, perforationem tegens. Alt. $14\frac{1}{2}$ mill., diam. $10\frac{1}{2}$. Exempli minoris alt. 9 mill., diam. 7.

Hab. New Zealand.

Care must be taken not to confound this species with one or two others which are found from the same locality. *C. tenebrosus*, described by A. Adams in the Proc. Zool. Soc. 1851, p. 170, is a narrower and more coarsely sulcated species than the present; and a second species (at present undescribed) is closely allied; it is umbilicated more broadly, spirally sulcated, and not so dark in colour, being of a pale purplish tint with the spiral liræ between the sulcations of a darker tint. Neither *Canthiridus tenebrosus*, A. Adams, nor *C. rufozona* (also from New Zealand, and of the same author) appear in Hutton's Catalogue of the Marine Mollusca of that country, probably owing to their being published without localities. I feel much pleasure in dedicating this species to the author of the above very useful Catalogue.

87. Trochus (Euchelus) alveolatus, *A. Adams*.—Monodonta alveolata, *A. Ad. Proc. Zool. Soc.* 1851, p. 176.

Hab. San Christoval (*Brazier*); Philippine Islands (*Cuming*).

This is a very pretty species, and of the following dimensions —length, 12½ millims., diam. 9. The spiral granular liræ are six on the penultimate, and about twelve on the last whorl. The whorls are seven in number, somewhat convex, and divided by a deeply but narrowly channelled suture. They have no longitudinal liræ between the three upper series of transverse nodules (which is not stated in Adams's very loose description), but are only obliquely striated in this region. Only the lower half of the whorls has a cancellated aspect. The longitudinal brown markings are broadest at the suture, and not interrupted by the transverse sulci on the upper part of the whorls; but beneath they appear on the granose lirations in small spots.

88. Stomatia angulata, *A. Adams, Proc. Zool. Soc.* 1850, p. 34; *Sowerby's Thesaurus Conchyl.* ii. pl. 175. f. 57; *Reeve, Conch. Icon.* vol. xix.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

As might be supposed from Mr. Adams's description, this species is not uniformly "green." It is generally of a grey- or sage-green; and on the lower half of the body-whorl there are some narrow radiating undulating pale stripes. The specimen from the Solomon Islands is of a luteous colour above, and tinged with greenish ash beneath, with the slender pale stripes, and everywhere it is most minutely dotted with black upon the spiral lirations.

89. Stomatella haliotoidea, *Sowerby, A. Adams in Sowerby's Thesaurus Conchyl.* ii. p. 837, pl. 154. f. 10, 11.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*).

The shell sent by Mr. Brazier is of a uniform olive-green, and dirty white in the umbilical region, and dotted with white upon the spiral liræ. These are subequidistant and very fine; and between them the shell is very finely spirally striated.

90. Emarginula variegata, *A. Adams, Proc. Zool. Soc.* 1851, p. 84; *Sowerby, Thesaurus Conchyliorum,* iii. pl. 245. f. 9, 10; *Reeve, Conchol. Icon.* vol. xix.

Hab. San Christoval, Solomon Islands (*Brazier*); Philippine Islands (*Cuming*); Australia (*Sowerby*).

The species is described by Adams as "albida, rufo-fusco variegata," and by Sowerby as "alba griseo variegata;" and the figure in the 'Thesaurus' represents it as white, variegated with pinkish purple, with darker spots on the ribs. The latter coloration agrees best with certain specimens in the Museum; and others are almost entirely of an obscure purplish tint, with scarcely any white markings. The specimens from the Solomon Islands are dirty white, with most of the radiating ridges of a blackish colour, and very finely granose.

91. Tellina christovalis, sp. nov. Pl. XXX. fig. 22.

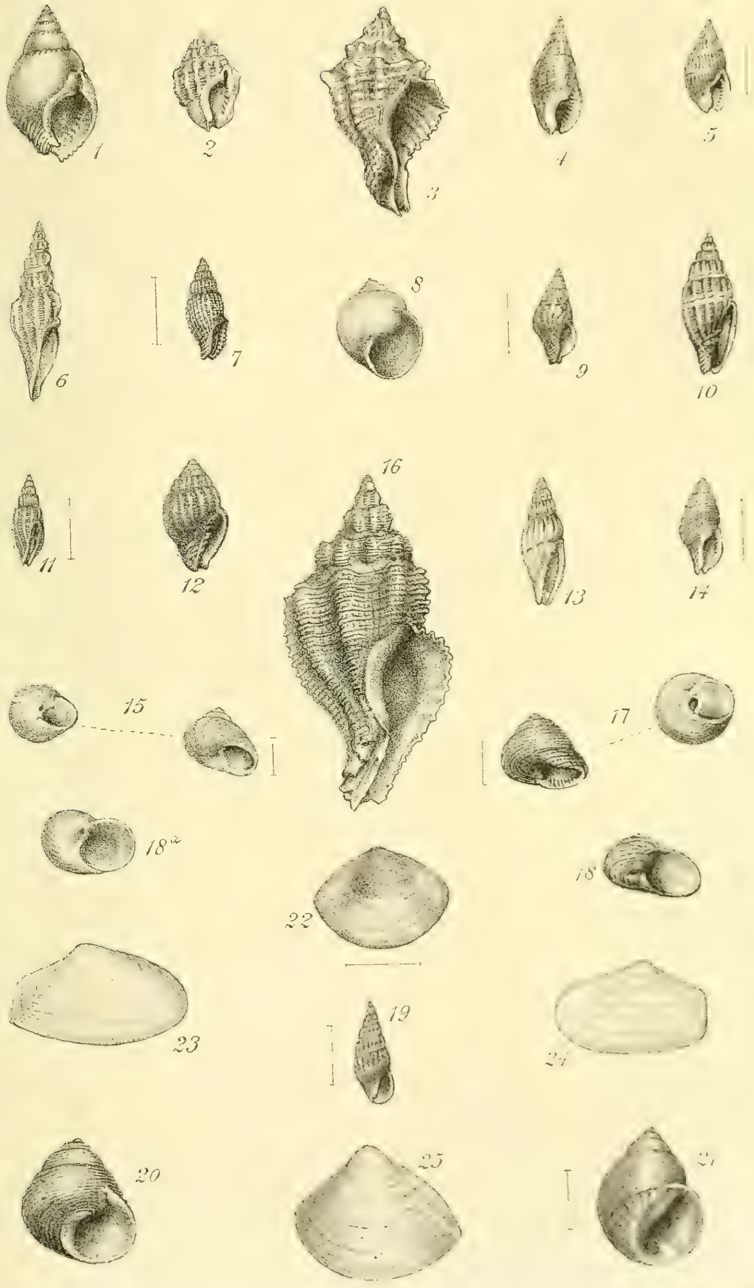
Testa æquilateralis, æquivalvis, rotunde subtriangularis, aliquanto tumida, alba, macula rufescente magna subtriangulari versus umbones picta, polita, concentrice tenuiter striata; margo dorsalis utrinque valde declivis, et paululum arcuatus, ventralis arcuatissimus, postice levissime sinuatus. Long. $7\frac{1}{3}$ mill., lat. 9, crass. $4\frac{1}{2}$.

Hab. San Christoval, Solomon Islands.

There is a single specimen of this little species in the Cumingian collection from Upolu, which is a trifle larger than the above dimensions, but agreeing in all other respects with that from San Christoval. The reddish spot, which is somewhat triangular in form, and stains the valves towards the umbones, is also seen within them. The shining surface is slightly prismatic in certain lights.

92. Thracia Angasiana, sp. nov. Pl. XXX. fig. 23.

Testa alba, tenuis, inæquivalvis, ovato-oblonga, postice angustata et rotunde truncata, mediocriter inæquilateralis, concentrice tenuiter striata, obscure et minutissime granosa; margo dorsalis antice arcuatus, postice decliviter rectiusculus, ventralis antice arcuatus,



C.Berjeau lith

NEW MARINE SHELLS

postice rectiusculus; latus anticum rotundatum, latum. Lat. 23 mill., long. 14, crass. 6½

Hab. Sow-and-Pigs Reef, Port Jackson.

The granulation of the surface is so minute as scarcely to be noticeable with the aid of a simple lens; and consequently the valves appear to be but concentrically striated. The posterior end of this species is narrower than the anterior, whilst in *Jacksoniana* it is broader.

93. THRACIA JACKSONIANA, sp. nov. Pl. XXX. fig. 24.

Testa alba, ovato-oblonga, postice biangulata, rotunde truncata, antice aliquanto angustata et rotundata, subæquivalvis, paululum inæquilateralis, concentrice leviter plicata, ubique minute granose striata; margo dorsalis utrinque valde declivis leviter convexiusculus, ventralis parum arcuatus; valvæ intus tenuiter radiatim striatæ; impressio pallii lata, haud maxime profunda. Lat. 21 mill., long. 12½, crass. 8.

Hab. Sow-and-Pigs Reef, Port Jackson.

This species is almost equilateral, but a trifle longer anteriorly. The surface of the valves is irregularly and rather distantly concentrically plicated, and also most minutely granosely striated in the same direction. Down the posterior portion of the valves from the umbo to the obtuse angle at the conjunction of the lateral and ventral margins there radiates a slightly raised elevation or keel; and a second one is observed near the dorsal slope.

94. CARDITA BIMACULATA, *Deshayes, Proc. Zool. Soc.* 1852, p. 102, pl. xvii. f. 4, 5.

Hab. Tasmania (*Brazier*); New Zealand (*Deshayes*).

The shells from Tasmania are white beneath the dirty brown epidermis, and spotted irregularly with red upon the granose ribs. Besides the two brown spots on the muscular scars in each valve, there are two elongate marks of the same colour, one on each side of the umbo, in the region of the lunule and dorsal ligament.

95. CARDIUM (FRAGUM) MUNDUM, *Reeve, Conchologia Iconica,* ii. f. 125.

Hab. Arrowsmith Island, Marshall Group (*Brazier*); Lord Hood's Island (*Cuming*).

The specimens of this beautiful species from Arrowsmith Island have a few sanguineous spots on the angles of the valves, and are also stained with the same colour between the lovely imbricated ribs on the posterior slope. The ground-colour of these shells is yellow; and they are dotted with opaque white.

EXPLANATION OF PLATE XXX.

Fig. 1. *Nassa bicallosa.*
2. *N. trinodosa.*
3. *Fusus imbricatus.*
4. *Nassa Marratii.*
5. *N. interlirata.*
6. *Pleurotoma* (——?) *solomonensis.*
7. *Clathurella immaculata.*
8. *Recluzia* (?) *globosa.*
9. *Columbella Carolinæ.*
10. *Mitra* (*Turricula*) *rufofilosa.*
11. *Cythara interstriata.*
12. *Mitra* (*Turricula*), var. *ficulina.*
13. *Cythara unilineata.*

Fig. 14. *Pisania solomonensis.*
15. *Trochus* (*Gibbula*) *supragranosus.*
16. *Fusus Brazieri.*
17. *Trochus* (*Clanculus*) *bathyrhaphe.*
18, 18 *a.* *Adeorbis tenuilirata.*
19. *Rissoina terebroides.*
20. *Trochus* (*Cantharidus*) *Huttonii.*
21. *Littorina melanacme.*
22. *Tellina christovalis.*
23. *Thracia Angasiana.*
24. *T. Jacksoniana.*
25. *Mactra pinguis*, var.

On the Introduction of Trout and Tench into India.

By Francis Day, Esq., Surgeon-Major, F.L.S.

[Read April 6, 1876.]

During the last few years three attempts have been made to introduce European fish into the rivers and tanks on the Neilgherry Hills in the Presidency of Madras. It may now be assumed that at any rate the Trout (*Salmo levenensis*) and the Tench (*Tinca vulgaris*) have bred there, and may prove an eventual success.

The first trial was made by Mr. Thomas, of the Madras Civil Service, who took out a few hundred trout-ova in the 'Ripon' in 1863. From various causes they died prior to reaching India.

In 1866 I made the second attempt. The eggs were obtained for me by Mr. Frank Buckland, and were in an excellent state when packed. This process was performed by myself, as I had previously been instructed by Mr. Youl; and six small boxes of ova were placed, February 2nd, in the ice-room of the P. & O. steamer 'Mongolia' at Southampton. On March 12th, they were landed at Madras. On the 14th they reached the Government Gardens at Ootacamund, where the Superintendent, Mr. M'Ivor, had prepared a very suitable house for their reception. Through it flowed a stream of clear water. Things went on pretty well for a few days; but on April 1st a great mortality occurred amongst the ova, and by the 10th the majority were dead.

Fearing the waters of the hills were too warm for the eventual success of European fish, I obtained leave to introduce suitable species from the low country, which was done with considerable trouble.

Mr. M'Ivor was greatly interested in these experiments; and subsequently, when proceeding to Europe, he determined to try and introduce Trout in another way. Distrusting the ova, he proposed to bring them over in the form of young fish; and it must be remembered that in those days, as vessels could not go through the Suez Canal, the fish would have to be landed at Alexandria and conveyed in the crowded and inferior railway carriages across Egypt to Suez. He informed me that every one considered failure to be inevitable; but he adhered to his own views, and I am glad to add that his enterprise, intelligence, and patience have been rewarded by success.

He first had young fish captured and placed in a receptacle through which water ran; the stream was diminished by degrees and finally cut off, and thus the trout became accustomed to confinement. On board ship the water was constantly oxygenated by being poured from a height, or passed through the rose of a watering-pot or large syringe; and some of the Trout, Tench, and other Carp reached Ootacamund in safety.

I regret that I have no account of this interesting experiment to offer, especially as I believe it has been published; but if I ever had a copy, it has been mislaid.

Whilst on the Neilgherry hills for a short time in 1873, I obtained several specimens of Tench (*Tinca vulgaris*, Cuvier) from different localities around Ootacamund; they were doubtless bred from those Mr. M'Ivor took out to the hills. I did not see any Trout; and although Mr. M'Ivor promised to send me some from the Koondah streams, he was unable to do so.

"No doubt," observed Mr. M'Ivor, (Feb. 5th, 1873), "all our fish are breeding rapidly, with the exception of the Trout; and the waters of the Hills will soon be alive with them. The Trout also have produced young; and we caught some, but not nearly in the number of the other kinds. They, however, seem to be doing well in the Pyjcara and Macoorty streams, although I have not been able to catch any of them there. They should do well in the Koondahs and west side of the Hills. The great quantity of mud washed in heavy rains from the cultivated land on the east side of the Hills will, I fear, render the streams unfit for Trout. We caught several Tench weighing about 1½ pound, and Rudd* still heavier."

Mr. H. S. Thomas, of the Madras Civil Service, wrote to me (Jan. 8th, 1876) saying he was despatching a Neilgherry Trout. "It was sent by Mr. M'Ivor in spirit to Mr. Ballard, by whom it was immediately forwarded to me, and overtook me at Coonoor, just as I was going down the Ghât. I took a hurried look for the adipose fin, wrapped him in muslin, and replaced him again in the spirit. The red spots were then bright; a week later they had almost disappeared. I mention this to show that he was clearly fresh when he came to me, and to draw your attention to the spots being *red*,—this latter point, because Mr. M'Ivor told me that, with one solitary exception, the Trout he put into the rivers were all Loch-Leven Trout; in Loch Leven, according to Mr. C. Pennell, the Trout have not *red* spots. Still the spots may have been due to their having been bred in a river, not a lake, for a series of years.

The specimen weighed, out of spirit, 1¼ ounce. Length, from nose to bifurcation of tail, 6 inches, to end of tail 6½ inches.

SALMO LEVENENSIS, *Walker, Yarrell.*—Loch-Leven Trout, *Richardson.*—Salmo cæcifer, *Parnell.*

D. 13; A. 11; L. l. 120; L. tr. 26/30.

Length of head 4½, of caudal 6⅔; height of body 5¾ in the total length. *Eyes*, diameter ¼ of length of head, 1 diameter from end of snout, and 1¼ apart. The width of the head equals its length behind the eyes; its height equals its length, excluding the snout. Thirteen rows of scales between the lateral line and the base of the adipose dorsal fin.

This fish having been well described, it is useless to enter fully on that subject. Respecting its colour, it shows twelve short, vertical, light bars along the middle of the side, or the finger-marks of a young fish. The spots alluded to are now black, whilst Mr. Thomas observes that they were originally red. This is probably due to the fish having been bred in a clear mountain-stream; for the Loch-Leven Trout are said to have no red spots. The colour of the water and the soil through which streams flow exercise great influence on the colours of fishes; but the result in this instance is most interesting.

* I think these were Gold Carp. The single specimen I saw was *Carassius auratus*.

Whether Trout will permanently succeed in Hindoostan, has yet to be ascertained. None of the Salmonidæ have been discovered south of the Hindoo Koosh, whence Griffith brought specimens.

I may here mention that, having received the collection of fish made by the late Dr. Stoliczka in the recent expedition to Yarkand, I do not find a single specimen of Salmonidæ contained therein; one Siluroid, and the rest Cyprinidæ, comprise the whole.

On some of the Fishes of the Deccan.

By Francis Day, Surgeon-Major, F.L.S.

[Read April 6, 1876.]

Having received from Dr. A. F. Dobson, of the Madras Medical Service, about 170 fishes collected from the Kistna and its tributaries near the Nizam's station of Hingolie, in the Deccan, as well as a few others from a tank near Bellary, I have thought it might be worth while to offer a few remarks under the above heading.

It is now nearly forty years since Colonel Sykes's paper* on "the Fishes of the Dukhun" appeared in the 'Transactions of the Zoological Society,' in which the author alluded to forty-six species, remarking that no less than forty-two were new to science.

Dr. Bleeker, in his paper "Beng. en Hind.," gives a list of these fishes, and places them in the genera to which he then considered they belonged. Jerdon (M. J. L. & Sc.) also remarked on a few, expressing his regret that Valenciennes, in the grand 'Histoire Naturelle des Poissons,' had omitted all reference to Col. Sykes's paper.

Dr. Günther, in the 'Catalogue of Fishes in the British Museum,' thus disposes of Sykes's forty-two new species:—six new, eleven previously known, twenty doubtful or omitted, five the genus doubtful.

The only record which I have yet discovered at the India Office respecting Sykes's collection is the following note of presentation: —"July 15th, 1831. Fish, insects, and reptiles in spirit 117;" also "drawings of fish twenty-nine," which being one more than

* Paper read Nov. 27, 1838.

were published, is probably due to the *Cyprinus nukta* having been omitted. No notice of the gift of skins of fish can be discovered That they may have existed appears probable from the following passage in his paper under the head of *Cyprinus nukta*:—"Both Mr. Rüppell and Mr. Yarrell, who have done me the favour to look over my fishes, express their belief that the present fish is only a monstrosity of *C. auratus*" (p. 355).

The next officer who examined some of the fishes of these parts was Dr. Wyllie (see Proc. Zool. Soc. 1840, p. 34), who was struck with the accessory branchial sacs of the *Saccobranchus singio*, which he considered were "perhaps intended for reservoirs of water to enable the animal during its migrations from tank to tank to maintain the gills in a constantly moist condition. They may also perhaps serve, in ordinary circumstances, as an extension of the respiratory surface; and the numerous blood-vessels that are seen in their coats would tend to give a probability to such a conjecture. . . . . . . They are of loose cellular texture, of a whitish grey colour, speckled with numerous minute black points; they are traversed from one extremity to the other by a blood-vessel of considerable size, into which numerous small branches open at right angles."

I believe Dr. Wyllie to have been correct in the last part of his observation, that this sac or sacs (which extend backwards from the gill-cavity, amongst the muscles on either side of the neural spines) are receptacles for air, that air is taken in by a constricted orifice existing between the superior and the next branchia, and that the single blood-vessel is employed in returning arterial blood to the general circulation, it having been oxygenated in the air-sac*. It appears to pass to the lowest branchial arch; but I must leave this subject for a future paper. Irrespective of this air-sac, an air-vessel or air-bladder enclosed in bone exists, and is connected by a tube with the pharynx, as is usual in the *Physostomi*.

Since then Col. Playfair has received some specimens from Poona, which have been deposited in the British Museum. Personally I have collected in the Kistna and its affluents at Kurnool, Bezwada, and Masulipatam, also in the Godavery from Rajahmundy to its mouth. I have also obtained a few species from the Nerbudda at Jubbulpore, from the tanks at Hurdah, and had a collection made for me at Poonah and in its vicinity.

* These fishes take in and blow out globules of air.

1. Ambassis ranga = Chanda ranga, *H. B.*; C. lala (young), *H. B.*; Ambassis Barlovi, *Sykes, Bleeker, Jerdon*; A. alta, *C. V.*; Chanda (Ambassis) ruconius, *M'Clelland.*

Sykes, as can be seen on his original drawing, referred this fish to Hamilton Buchanan's species.

2. Gobius giuris, *Ham. Buch.*

This species may be thus subdivided:—(1) *G. giuris*, H. B., Bleeker, = *G. catebus*, C. V.; *G. spectabilis*, Günther. (2) *G. koramottah*, Russell, = *G. kora*, C. V. (3) *G. bullee-kokah*, Russell, = *G. kurpah*, Sykes; *G. Russellii*, C. V.; *G. platycephalus*, Peters. "*Oolooway*, Tamil; *Ooskia denta*, Telugu; *Balloo seekdah*, Hind."

3. Ophiocephalus marulius, *Ham. Buch.*

This is not Sykes's fish, of which, however, I have specimens from the Malabar coast and Canara. The *O. marulius* appears to invariably possess an ocellus on the base of the caudal fin, which is absent in the second species.

4. O. leucopunctatus, *Sykes, Bleeker,* = O. grandinosus, *C. V.*

The original drawing of Valencienne's species was brought from China; and the further remark occurs, "là retrouvée dans le Maissour," whence Dussumier brought a fine specimen. Sir John Richardson (Ich. China, p. 252) observes of Cuvier & Valenciennes' species, "described from a painting executed in China;" whereas it is most distinctly stated that the description was drawn up from Dussumier's specimen, not from the drawing. Dr. Günther locates the species, "Fresh waters of China; river Maissour."

Not long since I visited the unrivalled and beautifully kept ichthyological collection in the Jardin des Plantes at Paris, which is freely opened to those who wish to study its treasures. Dr. Sauvage was good enough to show me the type specimen of *O. grandinosus*, C. V., labelled as having been obtained *in Malabar* by Dussumier. The Maissour is probably the Maisur or Mysore country, from which some of the rivers on the western coast of India were believed to have their origin. I also saw in the fine collection at Berlin a specimen received from the Paris Museum with the locality given as Malabar. The Madras Museum has also received it from the Coromandel coast; and it is probably the *Ophiocephalus* termed *sowarah* by Russell (Fish. Viz. pl. 163). Of course, because it is found in India, such is no reason against its also being in China, as seen in *O. gachua*, H. B.

5. OPHIOCEPHALUS GACHUA, *Ham. Buch.*

One of the specimens is tinged with orange. When in Assam I obtained some of these fishes from near Goalpara, where the *O. aurantiacus*, H. B., came from. All were more or less spotted and marked with yellow about the head. I have received this widely distributed species from Major Miles, who captured it in the river Kej, near Gwadur, in Beloochistan. It is also found in Afghanistan.

6. MASTACEMBELUS ARMATUS, *Lácep.*

Is the same as Sykes's species. I obtained the *M. pancalus*, H. B., at Jubbulpore, and also as high up the Brahmapootra in Assam as Debrooghur. The variations which this spined eel undergo are very remarkable: the fin-rays are usually D. 25–26/30–40, A. 3/31–38; in Upper Assam I found the fin-rays D. 26/42, A. 3/46, and a few vertical bands on the body. In Burmah the banded *M. zebrinus*, Blyth, appears to supersede it; still it is worthy of inquiry whether such is not only a local form: it has D. 28–29/50–52, A. 3/51–56. There are twenty rows of scales between the lateral line and the commencement of the soft dorsal fin instead of eighteen, as seen in the *M. pancalus*. To illustrate how widely the number of fin-rays differs in fish of this genus, I have received a *M. unicolor* from the Berlin Museum with D. 33/94, A. 3/98, the formula usually given being D. 33–34/80–84, A. 3/75–81. In the *M. armatus* the variations in the number of the fin-rays are likewise considerable. It is termed at Hingolie "*Aral*, Tamil; *Panpura*, Telugu; *Baum*, Hindostanee; *Wām*, Mahratta."

7. MACRONES AOR = Pimelodus aor, *H. B.*; Platystoma seenghala, *Sykes*; Bagrus seenghala, *Bleeker & Jerdon.*

"*Karlee kellettee*, Tam.; *Waldee*, Hind."

8. M. CAVASIUS = Pimelodus cavasius, *Ham. Buch.*; Pimelodus seengtee, *Sykes*; Bagrus seengtee, *Bleeker.*

"*Topa kellettee*, Tam.; *Chinnah jellah*, Tel.; *Chota katerna*, Hind."

9. RITA KUTURNEE = Phractocephalus kuturnee, *Sykes*; Pimelodus? kuturnee, *Bleeker*; Bagrus kuturnee, *Jerdon.*

This species of *Rita* has no posterior prolongation of its air-vessel. "*Hathoo kellettee*, Tam.; *Code jellah*, Tel.; *Burah kuturnee*, Hind."

10. RITA GOGRA = Phractocephalus gogra, *Sykes*; Pimelodus? gogra, *Bleeker*; ? Arius pavimentatus, *Val.* *; Pangasia? gogra, *Jerdon*; Gogrius Sykesii, *Day*.

I have taken this fish in the Kistna at Kurnool, and also received it from Poona.

11. PSEUDEUTROPIUS GOONGWAREE = Hypophthalmus goongwaree, *Sykes*; Bagrus exodon, *Val.*; B. goongwaree, *Bleeker & Jerdon*.

Although this species is not in Dr. Dobson's collection, I have obtained it in the Deccan.

12. Ps. TAAKREE = Hypophthalmus taakree, *Sykes*; Bagrus taakree, *Bleeker & Jerdon*; Pseudeutropius longimanus, *Günther*.

13. CALLICHROUS BIMACULATUS = Silurus bimaculatus, *Bloch*.

This may be *Schilbe pabo*, Sykes, = *Wallago pabo*, Bleeker; *Silurus pabo*, Jerdon. The *C. bimaculatus* is the common Deccan form, but it has rarely above 66 anal rays; whilst Sykes states A. 68–70, and may refer to *C. checkra*, Ham. Buch., also found in the Deccan. "*Chowallay*, Tam.; *Tedwah*, Tel.; *Poptah*, Hind.; *Goomgulah*, Mahr."

14. WALLAGO ATTU = Silurus athu, *Bl.*; Schilbe boalis, *Sykes*; Wallago Russellii, *Bleeker*; Silurus boalis, *Jerdon*.

"*Wallay*, Tam.; *Walgoo*, Tel.; *Podom*, Hind."

15. SILUNDIA SYKESII, n. s.? = ? Ageneiosus Childreni, *Sykes, Bleeker, & Jerdon*.

B. xii., D. $\frac{1}{7}$/0, P. $\frac{1}{12}$, V. 6, A. $\frac{2}{42\text{–}48}$, C. 17.

Length of head $5\frac{1}{4}$, of caudal $4\frac{2}{3}$; height of body $5\frac{3}{4}$ in the total length. *Eyes* with a narrow, free, adipose lid, diameter $3\frac{1}{2}$ in length of head, 1 diameter from end of snout and $1\frac{1}{3}$ apart. Anterior nostril on front edge of snout, the posterior oval and patent, more in the mesial line of the head. Lower jaw slightly the longer, curved upwards in the middle; snout rather broad. *Barbels*—the maxillary ones extend nearly, or quite, to the base of the pectoral fin; the mandibular ones are thin and as long as the diameter of the eye. *Teeth* cardiform in the jaws; in a crescentic band on the palate. *Fins*—dorsal spine weak, rugose anteriorly, finely serrated posteriorly, and as long as the

* Valenciennes does not mention the dark fins so well marked in this species; but as his specimen was upwards of a foot long, it cannot be the young of *Pimelodus rita*, H. B.

head excluding the snout; pectoral spine stronger, as long as the head behind the angle of the mouth, and reaching to above the ventral; ventral arises behind the vertical from the posterior dorsal rays, and reaches the anal; caudal lobed, the lower lobe somewhat the longer. *Air-vessel* transverse, not enclosed in bone. *Colours*—bluish superiorly, becoming white beneath, the fins stained externally with grey. Two specimens up to 6½ inches in length.

I have one from Kurnool nearly 9 inches long.

Sykes states that this fish is termed *Purree* (Mahr.) and *Sillun* in the Deccan, that it is *without cirri*, and also that the first bony ray is "serrated on the anterior edge," such being also shown in the figure. This last observation leads me to believe that he described from the drawing, which seems to have maxillary barbels indistinctly marked.

The long maxillary barbels of this species at once serve to distinguish it from the *S. gangetica* *, C. V.

I am unable to admit that the existence of mandibular barbels in this species is a valid reason for instituting a new genus for its reception:—*Silundia Sykesii* has long maxillary and also mandibular barbels; *S. gangetica*, maxillary but no mandibular barbels. If these *Silundiæ* are considered generically distinct, so must the *Hemipimelodus itchkeea*, Sykes, from the genus in which I have placed it, as it possesses eight instead of six barbels. Likewise another Deccan fish, *Nemacheilus Evezardi*, Day, which has eight instead of the normal six barbels, would require a genus to itself. This opens too wide a question to enter upon in this place; but if the foregoing views are correct, it follows that the genus *Lepidocephalichthys*, Bleeker (divided from *Cobitis* on account of its having eight instead of six barbels), must be suppressed. In *Barbus* it is generally admitted that those with four, two, or without barbels, belong to one genus. I have also found two species of *Rohtee* with barbels, a genus considered to be without any.

* 15 *a*. SILUNDIA GANGETICA, n. s.

B. xii., D. $\frac{1}{7}$/0, P. $\frac{1}{13}$, V. 6, A. $\frac{4}{36}$, C. 19.

Length of head 5¼, of caudal 6; height of body 5¼ in the total length. *Eyes*—diameter 4½ in length of head, 1¼ diameter from end of snout, and 2 apart. Width of head equals its length, excluding the snout, whilst its height is rather less. A pair of maxillary barbels about as long as the eye, no mandibular ones. *Fins*—dorsal spine as long as the head, excluding the snout, almost smooth anteriorly, serrated posteriorly. This species so closely resembles the other two, that a further description appears unnecessary.

Habitat. The rivers of Bengal and Burma. It attains a large size.

16. Hemipimelodus itchkeea = Phractocephalus itchkeea, *Sykes*; Bagrus itchkeea, *Bleeker*; Pimelodus itchkeea, *Jerdon*; Macrones itchkeea, *Günther*.

D. $\frac{1}{7}$/0, P. $\frac{1}{8}$, V. 6, A. $\frac{3}{10}$, C. 17.

Length of head 5, of pectoral 5; height of body 6 in the total length. *Eyes*—diameter $\frac{1}{3}$ of length of head, 1 diameter from end of snout, and also apart. Snout overhanging the mouth, upper jaw the longer. Upper surface of head rugose. Occipital process four times as long as wide at its base; the lateral occipital process curves rather outwards and downwards. Humeral process pointed and as long as the head, excluding the snout. The superior longitudinal groove extends to the base of the occipital process. *Barbels* eight, the maxillary pair longer than the head. *Teeth* villiform in both jaws, none on the palate. *Fins*—dorsal spine smooth, its length equal to the distance between the anterior nostril and the posterior end of the head; pectoral spine serrated internally; ventrals commence behind the vertical from the last dorsal ray; caudal deeply forked. *Air-vessel* in two lobes, rather large, and visible on the sides of the shoulder below the skin. *Colours*—yellowish-bronze, becoming silvery on the abdomen; three dark blotches over the head, and four more over the back, descending as low as the lateral line; a black edging to the caudal, and a black blotch on either lobe; a dark mark on the dorsal fin.

This species and *H. cenia*, H. B., are very similar; but the *itchkeea* has eight instead of six barbels, whilst its air-vessel is only partially surrounded by bone.

I have specimens from Poonah; but it is not included amongst Dr. Dobson's fish.

17. Bagarius Yarrellii = Pimelodus bagarius, *H. B.*; Bagrus Yarrellii, *Sykes, Bleeker*; Bagarius Buchanani, *Bleeker*; Pimelodus Yarrellii, *Jerdon*.

18. Glyptosternum lonah = Bagrus lonah, *Sykes*; B. lona, *Bleeker*; Pimelodus lonah, *Jerdon*; Glyptosternum dekkanense, *Günther*.

"*Korah muttah*, Tel."

19. Belone cancila = Esox cancila, *H. B.*; Belone Graii, *Sykes, Bleeker, & Jerdon*.

This species I have obtained in the Deccan.

20. Discognathus lamta = Cyprinus lamta, *H. B.*; Chondrostomus mullya, *Sykes, Bleeker*.

This is by no means a rare fish in the Deccan; Dr. Dobson has sent seven specimens; I have taken it in numbers from the Kistna. Sykes's figure gives a far better idea of this fish than does his description. The transverse process on the upper lip, which he mentions, is better seen in specimens from the neighbourhood of hilly districts than in those confined to the plains. *Chondrostoma wattanah*, Sykes, is stated to belong to Hamilton Buchanan's *Garra* division of the genus *Cyprinus*; but the figure does not give one that impression. It may possibly be intended for the young of *D. lamta.*

21. Catla Buchanani, *C. V.*, = Cyprinus catla, *H. B.*; Cyprinus abramioides, *Sykes, Jerdon*; Leuciscus abramioides, *Bleeker.*

This fish is by no means uncommon in the Kistna, where it attains a considerable size *. Sykes remarks that its flesh is firm, sweet, and agreeable, that the fish is highly esteemed, and appeared to him to be the most valuable of the carps of India; M'Clelland, that there is no species of more importance than this in an economic point of view, and wonders why it has been so long overlooked by our epicures; and he observed that it extends to Upper Assam. I found it in Burma, and when last in Paris saw a beautiful large stuffed specimen from Siam.

22. Labeo fimbriatus, *Bloch*, = Varicorrhinus bobree, *Sykes*; Leuciscus? bobree, *Bleeker.*

There are six specimens of this widely spread species.

23. L. rohita = Cyprinus rohita, *H. B.*

24. L. potail = ? Cyprinus potail, *Sykes, Jerdon*; Leuciscus potail, *Bleeker.*

D. 3/10, P. 17, V. 9, A. 2/6, C. 19, L. l. 40, L. tr. 8/11.

Length of head 5, of caudal 4; height of body $3\frac{1}{2}$ in the total length. *Eyes*—diameter $\frac{1}{6}$ of length of head, 3 diameters from the end of snout. Dorsal profile much elevated, the abdominal nearly horizontal; snout overhanging the mouth, which is inferior and has a slight lateral lobe; lower labial fold distinct. Fine pores on the upper surface of the head, snout, and along the cheeks, being most developed on the snout. A pair of maxillary barbels of medium length. *Fins*—dorsal commences midway between the snout and the posterior extremity of the base of the anal fin, its upper edge concave, the height of the fin two thirds of that of the body; pectoral nearly as long as the head, its length equalling that of the ventral; anal much highest ante-

* In 'Nature,' December 9, 1875, is a note from Mr. Mitchell, showing the rapidity with which this fish grows. Having had a tank dug near Calcutta (65 × 58 feet and 13 deep), he placed in it some fry from $\frac{1}{2}$ to 1 inch in length (this occurred in May); after four months it was netted, one of the largest weighed 14 oz., and was 11 inches long; the others were only 1 or 2 oz. lighter.

riorly; caudal deeply forked, the upper lobe the longer. *Lateral line*, $5\frac{1}{2}$ rows between it and the base of the ventral. *Colours*—greyish, each scale with a red lunule; fins stained grey along their edges, and dorsal also along its centre.

I have a specimen 10 inches long from Poonah.

25. L. BOGGUT = Chondrostoma boggut, *Sykes, Bleeker*; Tylognathus striolatus, *Günther*.

One specimen. I have also obtained it from Poonah, Jubbulpore, and other places.

26. L. NUKTA = Cyprinus nukta, *Sykes, Jerdon*; Carassius auratus? (monstrosity), *Bleeker*.

This species I have already described (J. A. S. of Bengal, 1872, p. 319), when I showed that it was not the *Carassius auratus*, but a true *Labeo*. Dr. Dobson has sent one small specimen from the Kistna. I obtained some larger ones from Poonah through the assistance of Col. Everard. The *C. auratus* is only found in the domesticated form in India and Burma; but Dr. Anderson brought back a number from the first expedition to Yunnan, all of a dull green colour.

27. CIRRHINA KAWRUS = Chondrostoma kawrus, *Sykes, Bleeker, Jerdon*.

D. 3/9–10, P. 19, V. 9, A. 2/5, C. 19, L. l. 36–38, L. tr. $6\frac{1}{2}$/7.

Length of head 6, of caudal $4\frac{3}{4}$; height of body 5 in the total length. *Eyes*—diameter $3\frac{1}{2}$–$3\frac{3}{4}$ in length of head, $1\frac{1}{2}$ diameter from end of snout, and $1\frac{2}{3}$–2 apart. Dorsal and anal profiles equally curved and low. The width of the head equals its length without the snout, whilst its height is slightly more. Upper jaw the longer; lips not fringed, a tubercle above the symphysis of the lower jaw. A few pores on snout, or else absent. *Barbels* absent, or a rudimentary maxillary one. *Fins*—dorsal commences midway between the snout and the posterior end of the base of the anal fin, it is nearly as high as the body; pectoral almost as long as the head; ventral commencing on a vertical line below the hind branched ray of the dorsal fin, it reaches rather above halfway to the vent; anal does not reach the caudal when laid back; caudal deeply lobed. *Scales*, 14 or 15 rows before the dorsal fin; $4\frac{1}{2}$ rows between the lateral line and the base of the ventral fin. *Lateral line* with a very slight curve. *Colours*—silvery, with some dark spots near the shoulder; dorsal and caudal fins edged with grey; pectoral, ventral, and anal reddish.

Sykes's figure, if intended for this species (which appears to be otherwise undescribed and common in the Deccan), shows the eye too small. He observes on its having no lateral line, but qualifies this assertion by saying "lateral line very rare, and, when occurring, obscure."

28. C. FULUNGEE = ? Chondrostoma fulungee, *Sykes, Bleeker.*

This species I have received fram Poonah, and described in the 'Journal of the Asiatic Society of Bengal, 1872, p. 321.

29. MOLA SANDKHOL = Leuciscus sandkhol, *Sykes, Bleeker, Jerdon*; Leuciscus harengula, *Cuv. & Val.*

This fish, of the genus *Thynnichthys*, Bleeker, is found in both the Kistna and Godavery rivers almost to their terminations. I have not taken it in Burma.

30. M. BUCHANANI, *or* Cyprinus mola, *H. B.*

Is found throughout the Decan, and may be identical with *Leuciscus chitul*, Sykes, Bleeker, Jerdon; but if so, the number of fin-rays has been given incorrectly.[a]

31. BARBUS SARANA, *H. B.*, = B. khudree, pt., *Sykes, Bleeker, Jerdon.*

32. B. (BARBODES) DOBSONI, sp. nov.

D. 4/9, A. 8, L. l. 32, L. tr. $5\frac{1}{2}/5\frac{1}{2}$.

Length of head 6, of caudal $4\frac{1}{2}$, height of body $3\frac{1}{2}$ in the total length. *Eyes*—diameter $3\frac{1}{3}$ in length of head, nearly one diameter from end of snout, and $1\frac{1}{2}$ apart. Dorsal profile rather elevated; snout a little obtuse. The greatest width of the head equals its length behind the middle of the eye. Mouth horseshoe-shaped, the lower labial fold interrupted in the middle. Upper jaw overlaps the lower; the maxilla reaches to below the front edge of the eye. *Barbels* thin; the maxillary ones as long as the eye; the rostral ones somewhat shorter. *Fins*—dorsal commences midway between the snout and the base of the caudal, its last undivided ray articulated and $\frac{2}{3}$ as high as the body; pectoral nearly as long as the head, not reaching the ventral, which latter extends $\frac{2}{3}$ of the way to the base of the anal; anal does not quite reach the base of the caudal, which latter is deeply forked. *Scales*, $2\frac{1}{2}$ rows between the lateral line and the base of the ventral fin. *Lateral line* complete. *Colours*—bluish above, lighter below; the fins edged with grey.

Sykes has *B. khudree*, composed, I believe, of two species—one with "blood-stained fins" (*B. sarana*), and his variety with "the fins tipped with bluish instead of red" (or the fish now described). Both species exist in this collection; but Sykes observes of the undivided dorsal rays, "the whole four compact" or unserrated, which would be correct for *B. Dobsoni*, but not for *B. sarana*;

whilst the remainder of his description agrees with this latter species. *B. sarana* is termed "*Kunnum*, Tel.; *Rhhoo*, Hind.; *Wadis*, Mahr."

33. Barbus tor, *H. B.*,=? B. mussulah, pt. *Sykes, Bleeker, Jerdon.*

Sykes's specimen of this fish in the British Museum has been referred by Dr. Günther to *B. tor*; but he gives *B. khudree*, Sykes, as a synonym, but not *B. mussulah*, Sykes. However, in P. Z. S. 1872, p. 877, Dr. Günther further observes, "Although not the true names (if any) were attached to the bottles when they were transferred to the Museum, the name of Colonel Sykes was written on the labels; and I still believe the specimens to be typical."

B. khudree, however, is a species which, Sykes observes, only attains to 1½ foot in length. He also states having seen the *B. mussulah*, 3 feet 4 inches in length, and weighing nearly 42 lb., and that the papillæ on the cheeks are not constant. The *B. tor* appears to be found all through the Deccan. There are nine specimens in this collection; they are named "*Sanu candee*, Tam.; *Tella purka*, Tel.; *Sufeed khowl*, Hind.; *Bhud gall*, Mahr."

34. B. kolus, *Sykes*,=Capoeta kolus, *Bleeker*; B. Guentheri, *Day.*

There are ten specimens of this fish in the collection; it appears to extend its range to the mouth of the Kistna river. "*Challa candee*, Tam.; *Pinedoo*, Tel.; *Koodwah*, Hind.; *Aurool*, Mahr."

35. B. stigma, *H. B.*

36. B. ticto, *H. B.*,=Rohtee ticto, *Sykes*; Systomus ticto, *Bleeker, Jerdon.*

37. B. cosuatis, *H. B.*,=Rohtee pangut, *Sykes*; Systomus pangut, *Bleeker.*

I have taken this species at Hurda and in Bombay, but only up to 3 inches in length. Sykes observes his fish attains to 5 inches.

38. Rasbora daniconius, *H. B.*

39. Aspidoparia morar, *Ham. Buch.*,=Leuciscus morar, *Sykes, Bleeker.*

40. Rohtee alfrediana, *Cuv. et Val.*

41. R. Vigorsii, *Sykes*,=Systomus Vigorsii, *Blkr.*; Abramis Vigorsii, *Jerdon*; Osteobrama rapax, *Günther.*

Five specimens. This fish is taken as low as the mouth of the Kistna.

42. R. Ogilbii, *Sykes*, = Systomus Ogilbii, *Blkr.*; Abramis Ogilbii, *Jerdon.*

I have this species from the Kistna.

43. Barilius cocsa, *H. B.*

44. Danio osteographus, *M'Clelland.*

There are two specimens of this fish in the collection; they are of the variety which has the maxillary barbels deficient. I have seen similar ones from Seebsagor, presented to the Calcutta Museum by S. E. Peal, Esq. In this genus but little stress can be laid on the existence or absence of barbels.

45. Chela bacaila, *Ham. Buch.*, = ? C. teekanee, *Sykes*; Leuciscus teekanee, *Blkr.*; Perilampus teekanee, *Jerdon.*

Thirteen specimens in the collection.

46. C. phulo, *H. B.*, = ? C. Oweni, *Sykes*; Leuciscus Oweni, *Blkr.*; Pelecus Oweni, *Jerd.*

Several specimens. I have also taken it in the Kistna.

47. C. clupeoides, *Bl.*, = ? C. balookee, *Sykes*; Leuciscus balookee, *Blkr.*; Pelecus balookee, *Jerdon.*

This species is found in the Deccan.

48. Cobitis guntea, *H. B.*, = C. maya, *Sykes, Bleeker, Jerdon.*

This species is found throughout the Deccan.

49. Nemacheilus Ruppelli = Cobitis Ruppelli, *Sykes, Bleeker, Jerdon.*

I have received what I believe to be this species from Poonah (see J. A. S. of Bengal, 1872, pt. 2, p. 184).

50. N. botia = Cobitis botia, *H. B.*

One specimen, having the preorbital projection well developed.

51. Notopterus kapirat, *Bonn.*, = Mystus badgee, *Sykes*; Notopterus bontianus (*C. V.*), *Bleeker.*

Of this there are seven specimens in the collection. "*Chota wallay*, Tam.; *Chuppul mutche*, Hind.; *Chumbaree*, Mahr."

52. Anguilla bengalensis, *Gray & Hardwicke*, = A. Elphinstonei, *Sykes, Bleeker, Jerdon.*

This species I have taken in the Deccan.

It now remains to briefly enumerate such species of Sykes as have not yet been alluded to.

53. CHELA JORAH, *Sykes*,=Leuciscus jora, *Bleeker*, *Jerdon*. D. 10, A. 11.

This is perhaps *Chela gora*, H. B.

54. C. ALKOOTEE, *Sykes*, =Leuciscus alkootee, *Bleeker*, *Jerdon*.

Appears to be a young fish, and is one which I am unable to recognize.

55. NEMACHEILUS MOREH=Cobitis moreh, *Sykes*, *Bleeker*, *Jerdon*. D. 12, A. 7.

I have not as yet obtained a Loach from the Deccan that corresponds to this description.

The following sixteen species* I consider were unknown when Sykes described them:—*Ophiocephalus leucopunctatus*, **Rita kuturnee*, *R. gogra*, *Pseudeutropius goongwaree*, **P. taakree*, **Hemipimelodus itchkeea*, **Glyptosternum lonah*, *Labeo potail*, *L. boggut*, *L. nukta*, *Cirrhina kawrus*, *C. fulungee*, *Mola sandkhol*, **Barbus kolus*, *Rohtee Vigorsii*, **R. Ogilbii*.

Irrespective of the foregoing is the question whether the *Silundia* I have described as new may not be Sykes's species; I have therefore named it after him.

Before concluding this paper, I wish to draw the especial attention of pisciculturists in this country to one of the species I have mentioned—*Barbus tor*, or the Mahseer of India. This fish is well known not only for the sport it affords the angler, but also for the excellence of the flavour of its flesh. It attains to a size equalling, or even surpassing, that of the Salmon, but, unlike the latter fish, never enters salt water. It deposits its ova, which are small, as far as it can force its way up hill-streams, and consequently would not run the risks to which Salmon are exposed when entering fresh water or returning to the sea.

The Mahseer is a Barbel as easy to convey from place to place as the Chinese Gold Carp; but it can only be ascertained by actual experiment whether it will thrive in this country. It is found in most of the large rivers of India and Sind, attaining its greatest size when living in those which have alpine sources.

I may mention that in an ichthyological point of view the Indian rivers may be divided into those of the plains as distinguished from such as have their origin in the hills. The hill-rivers consist (1) of those which have alpine sources, and (2) those which do not possess them. The Mahseer evidently thrives best in those

* The six with an asterisk before them are those which are recognized in the B.M. Catalogue as unnamed previous to Sykes's paper.

streams which have alpine sources. No doubt fine fish of this species are captured in the Nerbudda, Kistna, Godavery, and other rivers of the plains; but the largest supply exists in the Ganges and Jumna, or those descending from the Himalayas. The rivers which have their origin in the Himalayas have, exclusive of springs, two great sources of replenishment:—first (during the hot months), from the melting of the ice and snow near their sources; secondly, by the rains which during the monsoon-time assist in and increase this melting.

The breeding-season is during the moonsoon-months, when the rains occasion sudden floods in the hill-streams, at which period their subsidence is often as rapid as their rise; consequently fishes ascending to breed have to complete that operation as quickly as practicable, or a sudden subsidence of the river may cut off their return to the plains. Whether due to some deleterious action of snow-water, or more probably to the force of these snow-fed currents, Indian Carps, as a rule, do not deposit their ova in the main stream, but in the side affluents. Having effected this, the parent fish rapidly descends to the main river, and that of course before the appearance of the fry. The young fish are rarely hatched out in sufficient time to be able to descend to the rivers of the plains, and are consequently detained until the next floods, when they are stronger and more able to avoid their persecutors than they would be if they entered the main stream immediately they were hatched. Their growth is at first slow, probably from want of sufficient nourishment; but on the return of the rains they rapidly increase in size, and then descend to the main rivers.

Remarks on the Insects of Kerguelen's Land *.

By H. N. Moseley, M.A., Naturalist to H.M.S. 'Challenger.'

"The insects we found at Kerguelen were two apterous flies, one as large as a house-fly, the other almost as big as a blow-fly, an apterous gnat (*Culex*) and a winged gnat, a small apterous (or rather very short-winged) moth, two or three beetles (*Curculio* and *Staphylinidæ*), and three or four spiders (*Saltici* and a *Trombidium*).

"The moth I found crawling upon the beds of the little *Juncus*. The gnats are to be found about the dead seaweed &c. on the sea-shore. The larger fly nestles at the base of the leaves of *Pringlea*,

* This communication is an extract from a letter addressed to Dr. Hooker, chiefly concerning the Plants of Kerguelen, and already published by the Society in their Journal, Botany, No. 82, vol. xv. p. 53. Its zoological bearings, however, may there be lost sight of; hence its present reproduction.—Ed.

and lays its eggs in the fluid which is caught there. I never found it elsewhere; but there it is extraordinarily abundant, and every cabbage yielded ten or a dozen specimens. The fly creeps in a slow, lazy manner. I am very sorry I did not observe whether it climbs to the inflorescence in sunshiny weather; perhaps this may be the case. This is an instance of one of those "neglected opportunities" to which you refer (in the 'Flora Antarctica') as so galling in the retrospect. Even at Heard [Yong] Island I found the same apterous fly nestling on *Pringlea* in abundance. Perhaps the two forms have some relation of mutual benefit."

Note on *Arctomys dichrous*. By JOHN ANDERSON, M.D., F.L.S., &c.

[Read May 4, 1876.]

(PLATE XXXI.)

IN a preliminary notice on some new Asiatic Mammals and Chelonia, published by me last year*, I very briefly referred to a few specimens of Marmot obtained in the mountainous country to the north of Kabul, and which appeared to me to offer peculiarities entitling them to specific distinction. Since then my attention has been called to a paper by Mr. Blanford † on the Marmots of the Himalayan range. I am induced, therefore, to lay before the Linnean Society some additional memoranda on my species *Arctomys dichrous*, and place at the disposal of the Council a figure illustrating the animal in question.

Mr. Blanford (*l. c.*) gives a succinct epitome of the history of the nomenclature and synonymy of the Himalayan and Tibetan Marmots, and expounds and criticises all the published data concerning the supposed species from the above regions. A study of skins and skulls in the Indian Museum, Calcutta, and some comparisons of other material incline him to consider that there are four species, possibly a fifth (with that mentioned by myself). Those best characterized he gives as under-mentioned, and he suggests my *A. dichrous* as probably the form indicated by Burns and Griffith, while *A. robustus*, M.-Edw., he sinks in *A. himalayanus*, Hodg.

Sect. I. Short-tailed Marmots, having the tail less than one third the length of the head and body. 1. *A. himalayanus*, Hodgson.

Sect. II. Marmots with tails one third or more than one third the length of the head and body. 2. *A. hemachalanus*, Hodgson. 3. *A. caudatus*, Jacqemont. 4. *A. aureus*, Blanford.

My intention here, however, is not to discuss the conclusions arrived at by Mr. Blanford, but, in giving a more detailed description of *A. dichrous*, to enable comparison to be made between it and his *A. aureus*.

With regard to the size of the Kabul Marmot (*A. dichrous*), I had formerly incidentally mentioned the body as being 17 inches, and tail 6½ inches long. These were measurements taken roughly in a straight line. I now, in the subjoined tabular form adapted from Mr. Blanford's paper, give more exact data, in inches and decimals, from the specimen in the British Museum, and corresponding to those of *A. aureus* given by him (*l. c.* p. 123).

* Ann. & Mag. Nat. Hist. 1875, (ser. 4) vol. xvi. p. 282.

† "On the Species of Marmot inhabiting the Himalaya, Tibet, and the adjoining Regions," by W. T. Blanford, F.R.S., F.Z.S. (Journ. Asiat. Soc. Beng. 1875, pt. 2, no. 3, vol. xliv. pp. 113–127).

	A. dichrous.	*A. aureus.*
Length taken on the dried skins.		
Nose to insertion of tail	18·5	16·5 to 18·75
Tail, without hairs at the end	7·5	5·0 to 6·5
Hairs at end of tail	1·0	1·5 to 1·75
Fore foot (palma) to end of toe, without claws	2·2	2·05
Mid toe, without claw, measured below	0·5	0·8
Claw, measured above	0·4	0·6
Hind foot (planta) to end of toe, without claws	2·9	2·9
Mid toe, without claw	0·6	0·8
Claw of mid toe, measured above	0·5	0·52

As far as one can make out from the above, it would seem that the two species in question bear considerable resemblance to each other in size. This is equally manifested in the dimensions of the skull as shown below. Mr. Blanford (*l. c.* p. 124) has ranged together a series of cranial measurements (in parts of a metre) of several species; and taking his points to start from, the relative sizes of the skulls of the animals from Yarkand and Kabul are below seen at a glance. The greatest difference appears in the width at the zygomatic arches; but injury to those of *A. dichrous* renders the diameter a doubtful one. The dimensions are in millmetres.

	A. dichrous.	*A. aureus.*
Length from occipital plane to anterior end of nasal	90	94
Breadth across widest part of zygomatic arches	48 ?	57
,, ,, behind postorbital processes	20	17
Length of nasal bones	33	38
Breadth of nasal bones behind	11	10
,, ,, in front	15	16
Length of row of upper molars	20	20
,, lower jaw from angle to alveolar margin	45	66
Height of lower jaw at coronoid process	32	35

Circumstances have caused my comparisons with the Marmot skulls in the British Museum to be meagre; and moot points suggested by Mr. Blanford I shall not here enter into. The skull marked *A. bobac* (*A. gigantea*, Brandt, from Kamtschatka) agrees in most respects with that of *A. dichrous*, but is considerably larger, the mandibular angle of the former, however, being more produced and stronger than in the latter. Of two other skulls, also labelled *A. bobac* (?=*A. himalayanus*, Hodg.), one appears young, the other fully adult. *A. dichrous* much resembles the younger specimen, but it differs from the more aged one in its postpalatines being narrower and deeper, in less emargination of the bone above the hinder angle of the lower jaw, and in the mandibular body being less arched. A skull marked *A. thibetanus* (Tibet, Hodgson) (?=*A. hemachalanus*, Hodg.) is evidently young, inasmuch as the processes and occipito-parietal crests are undeveloped, with other signs of immaturity. Its post-palatine region is comparatively shallow and wide, and the posterior free border of the mandible is relatively straighter than that of *A. dichrous*.

In my former notice I described the colour of the skin of *A. dichrous*, which, as the trivial name implies, is of two shades—a rusty yellow above, and a dark rich brown on all the underparts, tail included. The hair, moreover, is long and remarkably *harsh in texture*, although there is an under-fur, so to speak, which is shorter, weaker, and dark-coloured.

It still appears that there is good ground for the specific distinction of *A. dichrous*, although the *A. aureus* of Blanford agrees in several respects. Whether the animal incidentally referred to by Dr. Griffith as having been obtained at an altitude of 11,000 feet in Afghanistan, but heretofore undescribed, is identical with my *A. dichrous*, as Mr. Blanford seems inclined to believe, is a matter still *sub judice*. On my return to Calcutta, I hope to be able to elucidate certain of the doubtful points raised but requiring further investigation.


J. Smit

INDEX.

END OF THE TWELFTH VOLUME.