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EXPLANATION OF THE PLATES.

ERRATA.

Page
111, footnote at bottom, read † Ludwig, Zeitschr. f. wiss. Zool., Bd. liv. (1892) pp. 350-363, pl. 16. figs. 1-9.
231, line 15 from bottom, for *Chilophorus* read *Chilophoxus*, Stebbing.
259, lines 3 and 12 from top, for *Synemosyna* read *Synesmosyna*.
259, line 14 from bottom, for *Cremastogaster contenta* read *C. contemta*, Mayr.
260, line 10 from bottom, for *Cerodida* read *Cerocida*, Simon.
262, line 5 from top, for *Corinomma* read *Corinnomma*, Karsch.
262, line 21 from top, for *Castaneira* read *Castianeira tenuiformis*.
264, top line, for *Synemosyna* read *Synesmosyna*.
264, line 5 from top, for *Zuninga* read *Zuniga*, Peckham.
293, lines 3 and 5 from top, for *Tubocellaria* read *Tubucellaria*.

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THE JOURNAL

OF

THE LINNEAN SOCIETY.

(ZOOLOGY.)

A Contribution to the Physiology of the Museum Beetle, *Anthrenus museorum* (Linn.). By Alfred J. Ewart, D.Sc., Ph.D., F.L.S., Professor of Botany in the University of Melbourne and Government Botanist.

[Read 6th December, 1906.]

The larvæ of this small beetle have worked terrible havoc in the National Herbarium at Melbourne, and its ravages are only kept in check by placing the portfolios of plants in a chamber impregnated with the vapour of carbon bisulphide for two or three days at regular intervals. This work is continually in progress, so that each plant is subjected to the vapour once a year. Permanent poisoning by mercurial or arsenical poisons is inadvisable on account of the danger to health when large bulks of the dried plants are frequently handled in a dry dust-forming atmosphere.

Naphthalin, though it may aid in keeping away the adult beetles, has no effect upon the larvæ, which were found to be still alive, after remaining for a week in a closed tin box containing a ball of naphthalin. The most remarkable feature about the larvæ is of course their power of feeding on dry materials without any apparent supplies of water. It is true that imperfectly dried specimens are most liable to attack, but nevertheless I have found the grubs in an active condition on plants containing slightly less than 9 per cent. (8·8 per cent.) of water.

The larvæ themselves contain about the same percentage of water as do those of allied insects, the percentages being found to vary between 68·5 per cent. and 71·8 per cent.

The lowest limits were found in quite young larvæ, and in those approaching the beetle stage, the percentage being highest when they are actively feeding and nearly full grown. The plant specimens from which the above grubs were taken contained 9·4 to 11 per cent. of water, whereas the excrement collected in as fresh a condition as possible contained from 15·8 to 19·4 per cent. of water. Within the parcels of plants stored in close cupboards or tin cases in which these larvæ were found, it is hardly possible to conceive of there being a sufficient condensation of water to explain this gain in moisture. It is worthy of note that the larvæ seem to have a minimum rate of transpiring water, for of a number placed in a desiccator, the majority were still living after a week at 12° C., without any supplies of water or food.

When feeding on dried plants only two direct sources of water are available for the larvæ. These are the imbibed water retained in the dried material, and that condensed on the surface by fall of temperature. The former averages 7 to 20 per cent. in herbarium specimens, although naturally higher in fresh imperfectly dried ones, and those which have been exposed to moist air.

As regards the latter source of water, careful microscopical examination of feeding larvæ on plants previously moistened by steam failed to reveal any attempt by the larvæ to squeeze out water from the material and swallow it. The damper parts of the material, which are the central portions in the case of freshly dried fruits, stems, and flowers, are more attacked by the larvæ, but these seem merely to take in the imbibed water along with the material containing it. Some other supply of water appears therefore to be needed to explain the high percentage in the animal's body, and the increased percentage in the excrement as compared with the food.

A possibility worthy of consideration is whether this water may not be chemical in origin, being derived from the carbohydrate food and set free in the animal's body by the oxidation of the carbon in respiration.

If this were the case we should expect to find the larvæ having an unusually high production of CO_2 and increasing in weight in a desiccator if provided with dry carbohydrate food.

Experiments in Desiccator.

(1) 25 grubs, two of which were very small, weighed 0·06 gramme. After being for 12 days in a sulphuric-acid desiccator at 10 to 12° C. with leaves and stems previously dried for several days in a desiccator at 15° C., 17 grubs were living, the two very small ones appearing distinctly larger, and weighed

0·038 gramme; eight grubs were dead and dried hard; the total weight of the whole 25 being 0·05 gramme, a loss of weight of 0·01 gramme.

Assuming that the dead and living grubs averaged the same weight at first, the living grubs have gained 0·0016 gramme in weight ($0·038 - \frac{17}{25} \times 0·06 = 0·0016$). The dead grubs showed no signs of external injury, but nevertheless the possibility remains that the moisture exhaled from them may have been condensed and absorbed in some way by the living grubs.

(2) The 17 living grubs weighing 0·038 gramme were returned to the desiccator with the plant material, and after 14 days at 8 to 10° C., 12 remained living and capable of moving. They weighed when brushed clean 0·028 gramme. This equals an apparent gain in weight on the above assumption of 0·0016 gramme ($0·028 \times \frac{17}{12} - 0·038$), the two smaller grubs being still living. As before, however, this moisture may have been gained from the dead grubs, for the twelve living and five dead and shrivelled ones weighed altogether 0·033 gramme, a loss of weight of 0·005 gramme. On the other hand, the loss by respiration has to be considered, for judging from the amount of excrement the grubs fed little or not at all upon the desiccator dried material, and seemed rather to devote their energies to protecting themselves against transpiration.

(3) *Respiration.*—The remaining 0·028 of a gramme of living grubs were placed in 2·5 c.c. of air for 18 hours at 8 to 10° C., and the residual gas analysed in a Bonnier and Mangin gas apparatus. No measurable quantity of carbon dioxide was present, probably as the result of the poisonous action of the mercury, the grubs being dead at the end of the experiment.

(4) 25 medium-sized active grubs weighing 0·083 gramme were placed, with 1·044 gram of plant material dried, in a desiccator at 10° C. until a constant weight was reached. A similar amount of plant material tested in the same way still contained 4·8 per cent. of moisture, or at least lost that weight when heated to 100° C. for 8 hours, so that the 1·044 gramme may be taken to still contain 0·05 gramme of water.

After 14 days in a desiccator at 8° to 10° C., the total loss of weight was 0·092 gramme. 22 living grubs weighed 0·063 gramme, and with the three dried and shrivelled ones, 0·072 gramme. The living grubs apparently therefore lost 0·012 gramme in weight ($0·083 - 0·063 \times \frac{25}{22}$), while the apparent loss converted into CO_2 would be 0·0084 gramme.

The 0·063 gramme of living grubs were sealed in a tube with 1·6 c.c. of air, and after 24 hours were found to have produced at 8° to 10° C., 0·000525 gramme of carbon dioxide, which in 14 days gives a total production of 0·0024 gramme, which is less than one-third the apparent loss. The difference of 0·006 of a gramme is partly due to the loss of water by dead grubs, and partly to respiration being more active at the commencement of the experiment. The relative activity of respiration may be seen from the following table:—

Organism.	CO_2 in mg. per gr.	Temperature.	Time.
Grubs after 14 days in desiccator	2·7	10° C.	24 hours.
			24 ,,
Potatoes	0·08 to 1·44	15°	24 ,,
Man	7·2 to 12	37–38°	24 ,,
Dog	13·4	37–39°	24 ,,
Horse	9·9	38·3°	24 ,,
Fresh actively feeding grubs	5·4 to 8·8 *	10–15°	24 ,,
			24 ,,
Frog	0·912	13°	24 ,,
,,	8·52	19–20°	24 ,,
Tench	1·73	14°	24 ,,
Cray-fish	1·54	12·5°	24 ,,
Cockroach	6·24	15–20°	24 ,,
Earthworm	2·59	,,	24 ,,†

* These values are probably too high, the larvæ being heated to 100° C. at the close of the experiment so that all the CO_2 contained in their bodies was driven out.

† Some of the numbers are from values supplied by Prof. Osborne.

When actively feeding, the respiratory activity of the grubs is even at low temperatures nearly as high as that of a warm-blooded animal, but a part of the CO_2 produced may be due to bacterial action in the alimentary canal.

Bacteria are present in abundance in the alimentary canals of actively feeding grubs, and since these bacteria feed on the carbohydrate food and oxidize its carbon under conditions where no transpiration of water as vapour is possible, a certain increase in the percentage of free water in the alimentary canal must be produced in this way. This may be the explanation of the slight rise observed in the percentage of moisture contained in fresh excreta as compared with the food, but it is uncertain whether the larvæ absorb internally any of the moisture set free in this way.

It follows from the above data that under unfavourable conditions as regards temperature or the supply of moisture and food, the respiratory activity of the grubs is reduced considerably. At the same time the loss of moisture is largely controlled by the living animal, for in a desiccator, dead grubs dry rapidly, whereas living ones retain their moisture for a long time even when no apparent external supply of moisture is available and when not actively feeding. They cannot live for more than a limited space of time in dry air on material containing less than 10 per cent. of water, and may lose more than 10 per cent. of their moisture within a fortnight in a desiccator.

When actively feeding and respiring, the oxidation of the carbon in their carbohydrate food sets free a certain amount of water which, aided by the imbibed water retained in the plant-tissues, suffices, if the latter is over 10 per cent. in amount, for their aqueous requirements. The grubs do not seem to have any power of condensing water vapour from the air, although naturally any moisture condensed on the surface of a plant by a fall of temperature may be taken in by them with their food. Grubs observed under the microscope do not seem to swallow any of the moisture film condensed on glass, although such moisture may be taken in through the general surface of the body. A point worthy of mention is that the percentage of moisture in a dried plant specimen is rarely uniform throughout, and that the grubs may be feeding and thriving on the moister parts of a specimen which seems as a whole prohibitively dry. Nevertheless the experiments show that reduced as are the moisture requirements of the larvæ, thoroughly dried specimens kept in dry air in which no condensation of moisture occurs at any time are practically immune from attack. In this connection the absence of anything capable of aiding in the condensation of water is of importance, such as sugary gum and certain kinds of glazed paper.

Note on the Origin of the Name *Chermes* or *Kermes*.

By E. R. Burdon, M.A., F.L.S.

[Read 6th December, 1906.]

Great confusion has arisen from the fact that there are two genera of insects, both belonging to the Hemiptera, which bear the same name under different spellings. One of these is the genus *Chermes* included in the family Aphidæ, while the other belongs to the Coccidæ and is spelt *Kermes*. According to Kirkaldy (1) there is yet a third genus of the Hemiptera which bears this name, viz. that usually known as *Psylla* belonging to the family Psyllidæ. Kirkaldy, enforcing the rules of priority in nomenclature, states that *Psylla* should be called *Chermes*, and that the name of the family ought to be Chermidæ instead of Psyllidæ.

I leave it for others to decide whether this statement is correct or not, but even supposing that the correct name of *Psylla* is *Chermes*, it would, I consider, be a great mistake to insist upon the observance of the laws of priority in the present instance. The confusion between the Aphid *Chermes* and the Coccid *Kermes* is already so great, that it is no easy work to disentangle the literature relating to either genus. This difficulty has to some extent been overcome by a sort of tacit agreement to accept the difference in spelling as sufficient indication of the particular genus referred to. *Chermes* is used by most authorities for the Aphid genus, and an extensive literature is to be found not only in English but also in French, German, and Russian scientific records describing the insects under this name. The Coccid genus is, I believe, quite as widely known under the name of *Kermes*. The genus *Psylla*, on the other hand, is certainly better known under that name than under *Chermes*, and even though this latter name may be the correct one according to the rules of priority, I would protest strongly against its adoption in view of the hopeless confusion which would infallibly result from such a step.

It is not my purpose to enter into the question as to which genus—Aphid, Coccid, or Psyllid—should rightly be called *Chermes*. My object is merely to explain how the confusion between the Aphid *Chermes* and the Coccid *Kermes* appears to have originated.

To do this it is necessary to hark back to ancient history, where frequent references are found to an important trade which was carried on in certain "berries" collected from a species of Oak, and valued on account of the brilliant scarlet dye they produced. Thus in Dioscorides (**2** *a*) a short account of the trade is given under the heading "*περὶ κόκκου βαφικῆς*," and Pliny (**2** *b*) also mentions the "berry" several times in his Natural History, using the same name in a Latinized form, viz. "coccum." The "berries" were procured from Asia, Africa, and various countries bordering the Mediterranean, Spain being specially mentioned on account of her having at one time paid tribute in them to Rome. Numerous references to similar passages in other Greek and Latin authors might be added, but the above are sufficient to show that the "berry" was well known in ancient times as the "coccum" of the Oak, and that it was widely distributed all over the South of Europe.

The Greeks and Romans were not acquainted with the real nature of the "berry," which they imagined was a natural production of the Oak itself, and Pliny specially mentions one kind which was valueless because it turned to maggots! The Persians, however, were probably aware of its animal nature, for they called it by the name "kermes" or "kirmis," a word derived from the Sanskrit "krimi" which means a worm.

The Persians apparently introduced both the insect (for the "berry" was of course the insect now known as *Coccus ilicis*, L.) and the name into Arabia. The Arabs in their turn carried the name into Spain, where, as we have seen, the insect was found in abundance.

The trade in Kermes lasted right on through the Middle Ages, and into comparatively recent times, when the dye obtained from the Cochineal insect (*Coccus Cacti*) supplanted the Kermes dye, and was in its turn supplanted through the discovery of aniline dyes.

The name Kermes, therefore, was commonly used in Spain for the insect, and it spread thence into all the countries bordering the Mediterranean, where the trade existed and the insect was consequently well known (**3**).

The name was introduced into scientific nomenclature by Linnæus (**4**). In 1740 he published the second edition of his 'Systema Naturæ,' and we here find "*Kermes*" adopted as a generic name for certain insects which Linnæus at that time included under the order Aptera :—

> "174. *Kermes*—Pedes 6. Corpus ovale, depressum testudinis instar. Os inter primos pedes. Pediculus Hesperidum."

This insect is undoubtedly the orange louse now known as *Lecanium hesperidum*, and we thus see that Linnæus first applied the name *Kermes* to one of the Coccid family.

After publication of the second edition Linnæus very probably referred to Pliny's Natural History, and finding the Kermes dye insect there described under the name of "coccum," he may have decided to adopt this name for the genus instead of *Kermes*. Be that as it may, Linnæus gave up the name *Kermes*, and in the later editions of the 'Systema Naturæ' (**5**) and also in his 'Fauna Suecica' (**6**), the genus *Coccus* appears in its place. His former *Kermes Hesperidum* is now entered as *Coccus citri*, and in the same genus he also includes the Kermes dye insect as *Coccus querci-ilicis.*

Being, however, in want of a name for another group of Hemipterous insects which resembled his genus *Coccus* in many points, but differed in possessing four wings instead of two, he evidently thought the name now set at liberty suitable for them, and accordingly the genus *Chermes* was established to receive them.

As regards the spelling Linnæus appears to have used either "Ch" or "K" indiscriminately, for although he more often spelt the word *Chermes*, the other spelling, *Kermes*, is found both in his Itinerary though Öland and Gothland (**7**), and in the second edition of the 'Systema Naturæ' already mentioned (**4**).

Living in Sweden, Linnæus naturally was not very familiar with the Kermes dye insect (*i. e.* his *Coccus ilicis*), and was unaware how firmly the name Kermes was established in the South of Europe, or he would never have made such a regrettable blunder as to adopt it as the generic name for another group of hemipterous insects.

In France, where of course the dye insect was well known, this new application of the name *Chermes* was unintelligible to naturalists. In 1764 Geoffroy (**8**) pointed out that the insects which Linnæus called *Chermes* had nothing to do with "le Kermés," and he therefore gave them the name *Psylla*, and he adopted the name *Chermes* for the Coccid genus, originally called *Kermes* (S. N. 2nd ed.), but subsequently *Coccus* by Linnæus. In this Geoffroy was followed by Müller (**9**) and several other writers of Southern Europe. In popular parlance the name was spelt with a "K," and only with "Ch" when used as a generic name. In 1828, however, Boitard (**10**) who, like Geoffroy, applied the name to certain insects of the Linnæan genus *Coccus*, spelt it with a "K," and we here find the dye insect under the name *Kermes ilicis* (= *Chermes ilicis*, Geoffroy = *Coccus ilicis*, L.).

With regard to this last writer, Cockerell (**11**) in 1899 wrote as follows:—
"The name Kermes had been used in a popular sense from early time, but Boitard is the first author I find using it as a genus in scientific nomenclature."

Newstead repeats this statement in his recent work on Coccidæ (**12**).

In view of the facts mentioned above this hardly seems correct, unless Cockerell intended to restrict his meaning to the word when spelt with a "K," and even then both spellings were used by Linnæus. But to return to the genus *Chermes*, established by Linnæus for the group of four-winged insects referred to above, the diagnosis of the genus was very broad, and allowed the inclusion of all Hemipterous insects with "Rostrum pectorale, antennæ thorace longiores, alæ 4 deflexæ, thorax gibbus, pedes saltatorii." As time went on it was seen that this diagnosis resulted in many insects being placed in the genus, which in reality belonged not only to separate genera but even to separate families. Most of the Linnæan species of *Chermes* have accordingly been redistributed amongst other genera such as *Psylla*, *Schizoneura*, *Vacuna*, &c., but the Spruce gall-insect has been left in as *Chermes abietis*.

In 1837 Hartig (**13**) revised the diagnosis of the genus but retained the Linnæan name *Chermes*, and from this time onwards this name has been accepted by the majority of observers, such authorities as Ratzeburg, Kaltenbach, Blochmann, Eckstein, Dreyfus, and, last but not least, Cholodkovsky, having been content to take *Chermes* as the generic name for these Spruce gall-insects.

Numerous attempts have been made at different times to christen the genus afresh—*Adelges*, *Cnaphalodes*, *Elatiptus*, *Sacchiphantes*, being a few of the names under which this unfortunate genus has been described. But none of these names has been generally accepted, and the attempts to change the name have only resulted in adding to the confusion.

It will thus be seen from the foregoing that the existence of the same generic name in two families of the Hemiptera is due to the following causes:—

1. That the dye insect of the Oak had been known since the Arab conquest of Spain by the popular name of Kermes all over the South of Europe.
2. That Linnæus, apparently unaware of this fact, put the Kermes dye insect into the genus *Coccus*, and employed *Chermes* as the generic name for another group of insects, amongst which he placed the Spruce gall-insect.
3. That Geoffroy, objecting to this misapplication of a well-known popular name, used *Chermes* as the generic name for the dye insect which Linnæus called *Coccus*.
4. That Boitard used the name for the same insects as Geoffroy but spelt it *Kermes*.

5. That the majority of workers at the Spruce gall-insects have retained the Linnæan name of *Chermes*, and at the same time Coccid authorities have naturally continued to use the name *Kermes* for the insect which had popularly been so called from early times.

It would certainly have saved infinite trouble had one of the earlier names given to the Spruce gall-insects been generally accepted, but in view of the wide acceptance which both *Chermes* and *Kermes* have now obtained, any alteration in the name of either genus at this hour of the day would only make "confusion worse confounded."

References.

(1) Kirkaldy, G. W., "Bibliographical and Nomenclatorial Notes on the Hemiptera." Entomologist, vol. xxxvii. No. 497, p. 255.

(2*a*) Dioscorides, Pedanios, Opera, interpretatione J. A. Saraceni, Lib. IV. 48, p. 260.

(2*b*) Pliny, C., Hist. Nat., Lib. 9, cap. 41; Lib. 16, cap. 8; Lib. 22, cap. 2; Lib. 24, cap. 4.

(3) Encyc. Brit. vol. xiv. p. 49. See also Beckmann's Hist. of Inventions, &c., translated by Johnston, 4th ed. vol. i. pp. 385–404.

(4) Linnæus, C., Syst. Nat. 2nd ed., 1740 (Stockholmiæ).

(5) —— Syst. Nat. 7th ed., 1748 (Lipsiæ). 9th ed., 1756. 10th ed., 1758.

(6) —— Fauna Suecica, 1st ed., 1746, pp. 214–220. Ed. altera, 1761, pp. 262–266.

(7) —— Ölandska och Gothlandska Resa. Stockholm, 1745, p. 180. (For help in translating the passage I am indebted to Mr. L. A. Boodle, F.L.S.)

(8) Geoffroy, Hist. Abrégée des Insectes, T. i. pp. 482–509. Paris, 1764.

(9) Müller, O. F., Zool. Dan. Prod. pp. 109–10. Havniæ, 1776.

(10) Boitard, P., Manuel d'Entomol. vol. ii. pp. 171–2.

(11) Cockerell, T. D. A., Proc. Acad. Nat. Sc. Philadelphia, p. 269 (1899).

(12) Newstead, R., Monograph Brit. Coccidæ (Ray Soc.), vol. ii. p. 138.

(13) Hartig, T., Jahresbericht über die Fortschritte der Forst-Wissenschaft und forstlichen Naturkunde in Jahre 1836–7 (Berlin, 1837), pp. 643–8.
—— Germar's Zeitschrift für Entomol. vol. iii. 1841, pp. 359–76.

Tertiary Foraminifera of Victoria, Australia.—The Balcombian Deposits of Port Phillip: Part I. By FREDERICK CHAPMAN, A.L.S., F.R.M.S., Palæontologist, National Museum, Melbourne.

(PLATES 1-4.)

[Read 7th February, 1907.]

Introduction.

MANY of the clays and limestones of the Victorian Tertiary strata are so rich in Foraminifera that they offer a wide field of research to the rhizopodist. In the gigantic size and redundant growth of many of the species we see the result of congenial life-conditions; and in this respect the foraminiferal fauna affords a parallel instance with that of the Tertiaries of the Sub-apennines, the Oligocene and Miocene deposits of the West Indies, and the Miocene of the Vienna Basin.

The Tertiary foraminiferal rocks of Victoria have been by no means neglected, for some valuable descriptive work on the Foraminifera of the Muddy Creek beds has been already published by the Rev. Walter Howchin, F.G.S., of Adelaide *, in which both the lower (Balcombian) and the upper (Kalimnan) series are dealt with. The same author has also contributed a paper on the Foraminifera obtained from the Kent Town Bore, Adelaide †, which passed through somewhat similar Tertiary strata. A complete list of the Tertiary Foraminifera of Muddy Creek (lower and upper beds), including a species of *Fabularia* described by the late M. C. Schlumberger ‡, was given by Mr. Howchin in his census of the fossil Foraminifera of Australia §.

A note with lists of Foraminifera, Tertiary and recent, has also been published by H. Watts ‖, who has recorded 13 species of Foraminifera from "Mt. Martha," which is equivalent to our locality of Balcombe's Bay.

There is yet another paper dealing with the Foraminifera of the Port Phillip area, by G. R. Vine, Jun.¶ Mr. Vine recorded 67 species, and stated that his first lot of material came from Mount Martha (*i. e.* Balcombe's Bay); whilst a second supply, yielding smaller and more numerous Foraminifera, came from a "similar deposit at Yarra Yarra, Victoria." Since there is no locality of that name for Tertiary fossils, it may be assumed that "beyond the

* Trans. R. Soc. S. Australia, vol. xii. 1889, pp. 1–20, pl. i.

† *Ibid.* 1891, pp. 350–354, pl. xiii. figs. 11–13.

‡ The comparatively sudden decease of this most successful and earnest worker in micro-zoology is deplored by all students of Rhizopoda.

§ Report Adelaide Meeting Austr. Assoc. Adv. Sci. (1893).

‖ "Foraminifera of Victoria." Southern Science Record, vol. iii. 1883, No. 3, p. 76.

¶ "On some Miocene Foraminifera from Australia." Trans. & Ann. Rep. Sheffield Microscopical Soc., Session 1897–98, pp. 6–9.

mouth of the Yarra" was intended; and from Vine's description of the material it probably came from Grice's Creek. In this interpretation I am supported by Mr. T. S. Hall, M.A., to whom I am also indebted for a copy of Vine's paper.

Notwithstanding the work which has already been done by the authors just mentioned, there are many other localities in Victoria which require to be worked systematically for their Foraminifera before sufficient data are collected to show adequately their distribution in the Tertiaries both vertically and topographically. I therefore venture to offer a contribution to the study of Victorian species, based on collections made by myself during the past four years from other places in the State besides that of Muddy Creek. The list of species here enumerated is by no means exhaustive, as additional forms are found at each examination of fresh material.

The foraminiferal rocks of Victoria represent, in their lithological structure, deposits laid down under all the varied conditions between clear water and turbid, both deep and shallow, which would result from intermittent or continuous movements of a shore-line. Thus it will be apparent that by a change of environment, along with a varying food-supply, the facies of the foraminiferal fauna would vary.

Sources of the present Collection.

For the Balcombe's Bay deposit I am under great obligations to Mr. T. S. Hall, who has supplied me with a large quantity of the washings from this, as well as many other localities, especially along the coastal areas of Victoria.

The Grice's Creek material was also furnished me by Mr. Hall, and I have supplemented this by collecting samples from both the brown and the blue clays of the same place. There is nothing distinctive in these two layers, however, the brown colour being the result of an alteration of the iron sulphide into the hydrous peroxide, as similarly recorded in the case of the London Clay of Piccadilly *.

The third locality herein dealt with is Kackeraboite Creek (of Selwyn) †, or Dennant Creek (of Kitson) ‡. The clay exposed in this section, although close to Grice's Creek, seems to differ somewhat in its molluscan contents and in the smallness and delicacy of most of the Foraminifera. Samples from this bed were collected by myself.

The fourth locality is situated near Altona Bay, where the blue clay was

* Journ. R. Micro. Soc. ser. 2, vol. vi. 1886, p. 739.

† Report on the Geological Structure of the Basin of the River Yarra. Papers presented to Legislative Council, Victoria, 1856.

‡ Report on the Coast-line and adjacent Country between Frankston, Mornington, and Dromana. Monthly Progr. Rep. Geol. Surv. Vict. 1900, No. 12, p. 3.

thrown out during the boring operations for brown coal. A heap of fossiliferous clay remained until lately at the head of the shaft, and a plentiful harvest of both large and small fossils might have been secured by picking over the clay, or by washing and sifting. My first acquaintance with this rich material was through a sample given me by Mr. E. O. Thiele, who, in conjunction with Mr. F. E. Grant, wrote a short paper on the deposit, giving a list of the fossils, chiefly mollusca *. Since then I have visited the locality several times, and collected and washed a considerable quantity of the clay, thereby securing a fine collection of both Foraminifera and Ostracoda †.

Microscopic Characters of the Washings.

The residues of the clays yielding the Foraminifera treated of in this paper have all the same general character. The majority of the particles point to an organic origin, but there is also present a fair proportion of terrigenous material, consisting mainly of quartz-grains, with an occasional felspar or other mineral fragment. The finer quartz sand is angular, and the coarser grains are usually well-rounded ; whilst here and there a wind-worn grain may be easily detected on account of its highly polished surface. The deposit containing the largest and most numerous quartz-grains is that from the Altona Bay Coal-Shaft ; and one bed in the series passed through by boring is a coarse quartz-grit.

The organisms seen in these washings, and common to all the localities unless otherwise stated, are the following :—

FORAMINIFERA. Generally abundant.

SPONGES. Fragments of hexactinellid skeletal mesh ; 4-rayed and slender, curved needle-shaped spicules, pointed at both ends ; calci-sponge spicules (*Plectroninia Halli*), 4-rayed. Found only at Altona Bay Coal-Shaft and Balcombe's Bay.

GORGONID spicules, two kinds.

Leptoclinum spicules ; stellate, calcareous.

ECHINOID spines ; belonging to Spatangoids and Echinids.

POLYZOA. Numerous.

MOLLUSCA, including *Styliola rangiana* and *Limacina tertiaria* (Pteropods).

OSTRACODA. Fairly common ; valves occasionally united.

FISH ; otoliths. Occasional.

Some fragments of a species of *Corallina* were also found in the washings from the Altona Bay Coal-Shaft.

* "On the Fossil Contents of the Eocene Clays of the Altona Bay Coal-Shaft." Proc. Roy. Soc. Vict. n. s. vol. xiv. pt. 2, 1902, p. 145.

† I have already done a portion of the work on this group, and hope to shortly publish some results.

Description of the Species.

Order FORAMINIFERA.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

Genus BILOCULINA, *d'Orbigny*.

BILOCULINA BULLOIDES, *d'Orbigny*. (Plate **1**. figs. 3, 4.)

Biloculina bulloides, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 297, No. 1, pl. 16. figs. 1–4; Schlumberger, 1887, Bull. Soc. Géol. France, sér. III. vol. xv. p. 120, pl. 15. figs. 10–13, woodcuts figs. 1–5; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 1.

Fairly typical specimens showing the slender **T**-shaped epistoma are not rare. The shells are generally undersized, and have a tendency to become pyriform in a slight degree, thus linking the species with *B. ringens*. Howchin recorded this species from Muddy Creek, but only from the Upper Bed (Kalimnan).

Occurrence.—Grice's Creek, common; Balcombe's Bay, very rare.

BILOCULINA RINGENS, *Lamarck* sp. (Plate **1**. figs. 9, 10.)

Miliolites ringens, Lamarck, 1804, Ann. du Muséum, vol. v. p. 351; vol. ix. pl. 17. fig. 1.

Biloculina ringens, Lam. sp., Schlumberger, 1887, Bull. Soc. Géol. France, sér. III. vol. xv. p. 126, pl. 15. figs. 14–18, woodcuts figs. 6–9; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 1.

The specimens in the present collection are medium-sized. They have a sub-elliptical test, seen from the front, and the face of the penultimate chamber is somewhat pyriform. The epistoma is bifid with the tips more or less recurved. A moderately large specimen (not figured) closely resembles the form common in the English "Coralline" (polyzoan) Crag*. Howchin has noted this species both from the Upper and Lower Beds of Muddy Creek, and Vine from the Port Phillip Tertiaries.

Occurrence.—In the present series *B. ringens* is somewhat frequent; from Grice's Creek, Balcombe's Bay, Kackeraboite Creek, and Altona Bay Coal-Shaft.

BILOCULINA BRADII, *Schlumberger*. (Plate **1**. figs. 7, 8.)

Biloculina ringens, Brady (non Lamarck), 1884, Rep. Chall. vol. ix. p. 142, pl. 2. fig. 7.

B. Bradyi, Schlumberger, 1891, Mém. Soc. Zool. France, vol. iv. p. 557, pl. 10. figs. 63–71, woodcuts figs. 15–19.

The above species has been clearly diagnosed by Schlumberger, who has

* Jones, Parker, and Brady, Mon. Foram. Crag, 1866, pl. 3. figs. 26, 27.

shown its identity with Brady's figure referred to above, by the external form, the shape of the aperture, the thickness of the shell-wall, and especially in the internal arrangement of the chambers so well illustrated by the median slices of the test. Our specimens agree with the above species both in external form and internal plan. Schlumberger's specimens were obtained from the Gulf of Gascony at a depth of 1850 metres.

Occurrence.—Grice's Creek, somewhat rare.

Biloculina Sarsi, *Schlumberger.* (Plate 1. figs. 1, 2.)

Biloculina Sarsi, Schlumberger, 1891, Mém. Soc. Zool. France, vol. iv. p. 553, pl. 9. figs. 55–59, woodcuts figs. 10–12.

At first sight this form might be confused with *B. depressa.* It differs, however, from that species in the relatively thicker test and less salient carina. Internally, the form A in *B. Sarsi* possesses a thick-walled canal-like chamber following the megalosphere or large initial cell ; whilst in form B the quinqueloculine chambers of the initial portion are not so strongly carinate as in *B. depressa.* The specimens examined at present from the Australian localities appear all to belong to form A.

Schlumberger recorded the above species from the *Biloculina*-Clay of the North Sea at 2000 fathoms.

There is very little doubt that d'Orbigny's *B. lunula* from the Vienna Basin is closely related to, if not identical with, the above species.

Occurrence.—This species is fairly common in the present collection. It occurs at Grice's Creek, Balcombe's Bay, and Altona Bay Coal-Shaft.

Biloculina depressa, *d'Orbigny.* (Plate 1. fig. 16.)

Biloculina depressa, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 298, No. 7 ; Brady, 1884, Rep. Chall. vol. ix. p. 145, pl. 2. figs. 12, 16, 17, pl. 3. figs. 1, 2 ; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 1 ; Schlumberger, 1891, Mém. Soc. Zool. France, vol. iv. p. 547, pl. 9. figs. 48, 49, woodcuts figs. 1–5.

The majority of the specimens show a tendency to develop an aboral prolongation of the peripheral flange, as noticed also by Howchin, who recorded this species from both the Lower and Upper beds of Muddy Creek.

Occurrence.—*B. depressa* is not at all common in our samples and is perhaps below the average in point of size. It occurs at Grice's Creek, Kackeraboite Creek, and Altona Bay Coal-Shaft.

Biloculina lævis, *Defrance* sp. (Plate 1. fig. 15.)

Pyrgo lævis, Defrance, 1824, Dict. Sci. Nat. vol. xxxii. p. 273, Atlas, pl. 80. fig. 2.

Biloculina lævis, Defrance sp., Goës, 1894, Kongl. Svenska Vetenskaps-Akad. Handlingar, vol. xxv. p. 119, pl. 24. figs. 914–918.

This species is somewhat similar to *B. depressa* in its general shape, but is distinguished by its bicarinate periphery. It inhabits deep and shallow water alike in the living condition. Defrance's original specimens came from the Paris Tertiaries. Vine records this species from the Port Phillip Tertiaries.

Occurrence.—*B. lævis* seems to be rare in Victorian strata. In this series it was found only in washings from the Altona Bay Coal-Shaft.

Biloculina elongata, *d'Orbigny.* (Plate **1.** fig. 14.)

Biloculina elongata, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 298, No. 4; Brady, 1884, Rep. Chall. vol. ix. p. 144, pl. 2. figs. 9 *a, b*; Howchin, 1899, Trans. R. Soc. S. Australia, vol. xii. p. 1; Schlumberger, 1891, Mém. Soc. Zool. France, vol. iv. p. 571, pls. 11 & 12. figs. 87–89, woodcuts figs. 35, 36.

Our specimens are small but typical. Howchin recorded the species from Muddy Creek, both Lower and Upper Beds; and Vine, from the Port Phillip Tertiaries.

Occurrence.—In the present collection it occurred sparingly at Grice's Creek, Balcombe's Bay, and Kackeraboite Creek.

Biloculina angusta, sp. nov. (Plate **1.** figs. 11–13.)

Specific characters.—Test narrow, elliptical, with a narrow and somewhat concave peripheral flange. Aperture normally closed by a semicircular flange, but sometimes this is absent.

Length ·36 mm.; width ·17 mm.; depth ·13 mm.

This form seems intermediate in character between *B. labiata,* Schlumberger* and *B. elongata,* d'Orbigny, with stronger affinities towards the former.

B. labiata has a much broader test and the oral flange is more pronounced.

Occurrence.—Grice's Creek, frequent; Kackeraboite Creek, frequent.

Biloculina irregularis, *d'Orbigny.* (Plate **1.** figs. 5, 6.)

Biloculina irregularis, d'Orbigny, 1839, Foram. Amér. Mérid. p. 67, pl. 8. figs. 22–24; Brady, 1884, Rep. Chall. vol. ix. p. 140, pl. 1. figs. 17, 18; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 1.

The aperture of this form is sometimes labyrinthic (see figure), as noted also by Howchin in the Muddy Creek specimens. Normally, however, it has a small partition in the aperture. Previously recorded from the Lower Beds of Muddy Creek.

Occurrence.—*B. irregularis* is common at Grice's Creek, Balcombe's Bay, and Kackeraboite Creek.

Biloculina globulus, *Bornemann.* (Plate **1.** figs. 17, 18.)

Biloculina globulus, Bornemann, 1855, Zeitschr. d. deutsch. Geol. Gesellsch. vol. vii. p. 349, pl. 19. fig. 3; Schlumberger, 1891, Mém. Soc. Zool. France, vol. iv. p. 575, pl. 12. figs. 97–100, woodcuts figs. 42–44.

Schlumberger has shown (*loc. cit.*) that this species is distinct from the

* Mém. Soc. Zool. France, 1891, vol. iv. p. 556, pl. 9. figs. 60–62, woodcuts figs. 13, 14.

so-called *Biloculina sphæra* of d'Orbigny, although Brady united the two forms in his synonymy of the latter species, which is in reality a *Planispirina*.

Occurrence.—Grice's Creek, frequent ; Altona Bay Coal-Shaft, rare.

Genus Spiroloculina, *d'Orbigny*.

Spiroloculina acutimargo, *Brady*. (Plate **1**. fig. 19.)

Spiroloculina acutimargo, Brady, 1884, Rep. Chall. vol. ix. p. 154, pl. 10. figs. 12–15.

This species is found, in the living condition, from the littoral zone down to moderately deep water areas. It is distinguished from other *Spiroloculinæ* of the same compressed type by its sharp peripheral margin.

Occurrence.—Grice's Creek, rare ; Kackeraboite Creek, rare.

Spiroloculina affixa, *Terquem*. (Plate **1**. figs. 23–25.)

Spiroloculina affixa, Terquem, 1878, Mém. Soc. Géol. France, sér. III. vol. i. p. 55, pl. 5 (10) figs. 13 *a–c*.

Spiroloculina inæquilateralis, Schlumberger, 1887, Bull. Soc. Zool. France, vol. xii. p. 202, pl. 4. figs. 84–86, woodcut fig. 3.

Spiroloculina affixa, Terq., Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

This delicate and thin-walled foraminifer has one face almost flat whilst the opposite surface rapidly increases in thickness from the centre to the margin, appearing as if deeply incised by a **V**-shaped groove along the median line of the shell. *S. affixa* has been recorded from the Lower Beds of Muddy Creek (Howchin).

Occurrence.—Grice's Creek, rare.

Spiroloculina canaliculata, *d'Orbigny*. (Plate **1**. figs. 20, 21.)

Spiroloculina canaliculata, d'Orbigny, 1846, Foram. Foss. Vienne, p. 269, pl. 16. figs. 10–12; Jones, 1895, Foram. Crag, pt. ii. p. 108, pl. 3. figs. 39, 40, woodcuts figs. 3 *a*, 3 *b*.

Our specimen figured is small but otherwise quite typical. It is readily distinguished by its grooved margin.

Occurrence.—Kackeraboite Creek, very rare.

Spiroloculina asperula, *Karrer*. (Plate **1**. fig. 22.)

Spiroloculina asperula, Karrer, 1868, Sitzungsb. d. K. Ak. Wiss. Wien, vol. lvii. p. 136, pl. 1. fig. 10; Brady, 1884, Rep. Chall. vol. ix. p. 152, pl. 8. figs. 13, 14; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 3.

The majority of our specimens have the suture-lines on the face of the test obscured by the arenaceous covering. Howchin notes the same feature in the specimens from Muddy Creek, where he records it from the Lower Beds. Karrer's original figure is that of a more elongate shell, the sutures being very distinct ; the Balcombian specimens more nearly resemble the recent specimens figured by Brady from comparatively shallow water in the Pacific and elsewhere, in their generally greater breadth.

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, very rare; Kackeraboite Creek, frequent; Altona Bay Coal-Shaft, rare.

Genus MILIOLINA, *Williamson.*

MILIOLINA OBLONGA, *Montagu* sp. (Plate 2. fig. 26.)

Vermiculum oblongum, Montagu, 1803, Test. Brit. p. 522, pl. 14. fig. 9.

Miliolina oblonga, Mont. sp., Brady, 1884, Rep. Chall. vol. ix. p. 160, pl. 5. figs. 4 *a*, *b*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

The specimens in the present series are exceptionally small, but otherwise typical. Howchin found this species in both the Upper and Lower Series at Muddy Creek; Vine records it from the Port Phillip Tertiaries.

Occurrence.—Balcombe's Bay, very rare; Altona Bay Coal-Shaft, frequent.

MILIOLINA CIRCULARIS, *Bornemann* sp. (Plate 2. fig. 27.)

Triloculina circularis, Bornemann, 1855, Zeitschr. d. deutsch. Gesellsch. vol. vii. p. 349, pl. 19. fig. 4.

Miliolina circularis, Born. sp., Brady, 1884, Rep. Chall. vol. ix. p. 169, pl. 5. figs. 13, 14; Sherborn & Chapman, 1886, Journ. R. Micr. Soc. ser. II. vol. vi. p. 742, pl. 14. figs. 2 *a*, *b*; Millett, 1898, Journ. R. Micr. Soc. p. 499, pl. 11. figs. 1–3.

Our figured specimen is typical in outline, but the oral aperture is dentate. Vine records this species from the Port Phillip Tertiaries.

Occurrence.—Balcombe's Bay, very rare.

MILIOLINA SCHREIBERIANA, *d'Orbigny* sp. (Plate 2. fig. 28.)

Triloculina schreiberiana, d'Orbigny, 1839, Foram. Cuba, p. 174, pl. 9. figs. 20–22.

Triloculina austriaca, d'Orbigny, 1846, Foram. Foss. Vienne, p. 275, pl. 16. figs. 25–27.

Triloculina schreiberiana, d'Orbigny, Schlumberger, 1893, Mém. Soc. Géol. France, vol. vi. p. 204, pl. 1. figs. 42–44, woodcuts figs. 5, 6; Fornasini, 1900, Mem. R. Accad. Sci. Ist. Bologna, ser. V. vol. viii. p. 361, fig. 5.

The triloculine forms of *Biloculina lucernula*, Schwager *, are strongly suggestive of affinity with this species; their distinctness, however, is clearly seen on making thin slices of the test. Our specimens agree with the normal triloculine species referred to above, both as to internal arrangement and external form. *M. schreiberiana* may be separated from *B. lucernula*, however, without having recourse to the slicing of the shell, by the form of the oral extremity, which is not prolonged as in the latter species. *M. schreiberiana* is again distinguished from *M. trigonula*, Lam. sp., by the accentuated inflation of the chambers visible on the exterior.

Occurrence.—Grice's Creek, common; Kackeraboite Creek, frequent; Altona Bay Coal-Shaft, frequent.

* Novara-Exped., Geol. Theil (2) 1866, p. 202, pl. 4. figs. 14 *a–c*, 17 *a*, *b*.

Miliolina polygona, *d'Orbigny* sp. (Plate 2. fig. 29.)

Quinqueloculina polygona, d'Orbigny, 1839, Foram. Cuba, p. 198, pl. 12. figs. 21–23.

Miliolina polygona, d'Orbigny sp., Goës, 1896, Bull. Mus. Comp. Zool. Harvard, vol. xxi. No. 1 (xx), p. 83, pl. 8. figs. 11–18.

M. polygona is a neat, short, multicarinate form, which appears to be new to Australian Tertiary lists. In the living condition it is of fairly deep-water habit.

Occurrence.—Grice's Creek, very rare.

Miliolina trigonula, *Lamarck* sp. (Plate 2. fig. 30.)

Miliolites trigonula, Lam., 1804, Ann. du Mus. vol. v. p. 351, No. 3; id., 1822, Anim. s. Vert. vol. vii. p. 612, No. 3.

Miliolina trigonula, Lam. sp., Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

The affinity of this species with the succeeding one, *M. tricarinata*, is somewhat close; *M. trigonula* being distinguished by the less regular carination of the margins, and the comparatively strong inflation of the penultimate and earlier chambers.

Howchin records this species from both series at Muddy Creek; Vine notes it from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, frequent.

Miliolina tricarinata, *d'Orbigny* sp. (Plate 2. fig. 31.)

Triloculina tricarinata, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 299, No. 7; Modèle, No. 94.

Miliolina tricarinata, d'Orbigny sp., Brady, 1884, Rep. Chall. vol. ix. p. 165, pl. 2. figs. 17 *a*, *b*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

The Australian Tertiary examples of the above species are exceedingly large; and although they are generally typical of the species, they have the peripheral margins of the trihedral test less acute than the recent and fossil specimens from the Northern hemisphere.

Howchin records this species from both beds at Muddy Creek. Vine mentions its occurrence in the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, common; Balcombe's Bay, frequent; Kackeraboite Creek, very rare; Altona Bay Coal-Shaft, very common.

Miliolina vulgaris, *d'Orbigny* sp. (Plate 2. fig. 32.)

Quinqueloculina vulgaris, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 302, No. 33.

Q. triangularis, d'Orbigny, 1826, ibid., p. 302, No. 34.

Q. auberiana, d'Orbigny, 1839, Foram. Cuba, p. 193, pl. 12. figs. 1–3.

Q. vulgaris, d'Orbigny, Schlumberger, 1893, Mém. Soc. Géol. France, vol. vi. p. 207, pl. 2. figs. 65, 66, woodcuts figs. 13, 14.

Of the several species grouped around *M. seminulum* as a central type, this is perhaps one of the best defined forms. It is a constant and characteristic species in the present series. The varieties with a sharp peripheral edge agree with the published figures of *M. auberiana*. This form, under the last-mentioned name, was recorded by Vine from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, frequent ; Balcombe's Bay, frequent ; Kackeraboite Creek, common ; Altona Bay Coal-Shaft, very common.

MILIOLINA CUVIERIANA, *d'Orbigny* sp. (Plate **2**. fig. 33.)

Quinqueloculina cuvieriana, d'Orbigny, 1839, Foram. Cuba, p. 190, pl. 11. figs. 19–21.

Miliolina cuvieriana, d'Orbigny sp., Brady, 1884, Rep. Chall. vol. ix. p. 162, pl. 5. figs. 12 *a–c* ; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

This is one of the more ubiquitous Miliolines in these Tertiary beds. It is easily recognized by its prolonged oral extremity, the keeled edge of the test, and sharply ridged median chamber. This form belongs to the *M. vulgaris* type, but differs from that species in the above-mentioned particulars. In the living condition it is found ranging from shallow water down to 95 fathoms. Howchin records it from the Lower Beds of Muddy Creek.

Occurrence.—Grice's Creek, common ; Balcombe's Bay, common ; Kackeraboite Creek, frequent ; Altona Bay Coal-Shaft, common.

MILIOLINA SEMINULUM, *Linné* sp. (Plate **2**. fig. 34.)

Serpula seminulum, Linné, 1767, Syst. Nat. 12th ed. p. 1264, No. 791 ; id., 1788, 13th (Gmelin's) ed. p. 3739, No. 2.

Miliolina seminulum Linné sp., Brady, 1884, Rep. Chall. vol. ix. p. 157, pl. 5. figs. 6 *a–c* Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

Our specimens are somewhat large and solidly built ; otherwise they are quite typical. Howchin records it from both beds at Muddy Creek, and Vine and Watts obtained it from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, very rare ; Kackeraboite Creek, very rare.

MILIOLINA CONTORTA, *d'Orbigny* sp. (Plate **2**. fig. 35.)

Quinqueloculina contorta, d'Orbigny, 1846, Foram. Tert. Vienne, p. 298, pl. 20. figs. 4–6.

Miliolina contorta, d'Orb. sp., Göes, 1894, Arctic and Scand. Foram., Svenska Vetenskaps Akad. Handlingar, vol. xxv. No. 9, p. 111, pl. 20. figs. 851, 852.

This is a species seldom recorded. Our specimens are exactly comparable with d'Orbigny's figured example from the Miocene of the Vienna Basin. It may perhaps be regarded as a weak form of *Miliolina Ferussacii*, d'Orb. sp., and related to *M. nudosa*, Karrer sp.

Vine has already recorded *M. contorta* from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, very rare ; Balcombe's Bay, very rare.

MILIOLINA FERUSSACII, *d'Orbigny* sp. (Plate **2**. fig. 39.)

Quinqueloculina Ferussacii, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 301, No. 18 Modèle, No. 32.

Miliolina Ferussacii, d'Orb. sp., Brady, 1884, Rep. Chall. vol. ix. p. 175, pl. 113. figs. 17 *a, b* ; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

This species, as a fossil, dates from the Cretaceous, and it is found in nearly all foraminiferal deposits of Tertiary age. As a recent form it occurs as far north as Baffin's Bay, and has been also recorded from several places off the coast of Australia.

Howchin records this species from the Lower Bed of Muddy Creek.

Occurrence.—Grice's Creek, frequent.

MILIOLINA AGGLUTINANS, *d'Orbigny* sp. (Plate 2. fig. 36.)

Quinqueloculina agglutinans, d'Orbigny, 1839, Foram. Cuba, p. 168, pl. 12. figs. 11–13.

Miliolina agglutinans, d'Orb. sp., Brady, 1884, Rep. Chall. vol. ix. p. 180, pl. 8. figs. 6, 7; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

This is a variable species in the present series, some of the specimens being more elongate than others; this peculiarity was also remarked upon by Howchin, who recorded it from Muddy Creek, where in the Lower Bed it is very common, and in the Upper Bed rare. Vine also notes this species from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, common; Balcombe's Bay, common; Kackeraboite Creek, frequent; Altona Bay Coal-Shaft, frequent.

MILIOLINA LINNÆANA, *d'Orbigny* sp. (Plate 2. fig. 37.)

Triloculina linnœana, d'Orbigny, 1839, Foram. Cuba, p. 153, pl. 9. figs. 11–13.

Miliolina linnœana, d'Orb. sp., Brady, 1884, Rep. Chall. vol. ix. p. 174, pl. 6. figs. 15–20; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 2.

The present examples are typical in having an elliptical test, sculptured with coarse and fairly deep longitudinal furrows.

The fossils hitherto recorded are from the Tertiaries of the Vienna Basin and the Island of Ischia, and it was also found by Howchin in both Lower and Upper Beds at Muddy Creek. *M. linnœana* is found in the recent condition in fairly shallow-water areas, chiefly within the tropical zone.

Occurrence.—Grice's Creek, frequent.

MILIOLINA VENUSTA, *Karrer* sp. (Plate 2. fig. 38.)

Quinqueloculina venusta, Karrer, 1868, Sitzungsb. d. K. Ak. Wiss. Wien, vol. lviii. Abth. i. p. 147, pl. 2. fig. 6.

Miliolina venusta, Karrer sp., Brady, 1884, Rep. Chall. vol. ix. p. 162, pl. 5. figs. 5, 7.

This species dates from the Cretaceous (Gault of England). Karrer's specimens came from the Miocene of Kostej, Banat. As a living form it is essentially of deep-water habit.

Occurrence.—Grice's Creek, rare.

Genus SIGMOÏLINA, *Schlumberger.*

SIGMOÏLINA SIGMOIDEA, *Brady* sp. (Plate 2. fig. 40.)

Planispirina sigmoidea, Brady, 1884, Rep. Chall. vol. ix. p. 197, pl. 2. figs. 1–3, woodcut fig. 5 *c.*

Sigmoïlina sigmoidea, Brady sp., Schlumberger, 1887, Bull. Soc. Zool. France, vol. xii. p. 118.

Planispirina sigmoidea, Brady, Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 5.

In the recent condition this form has a restricted geographical range. It has been recorded from two localities off S. America out of a total of five. As a fossil form Howchin recorded it from both beds at Muddy Creek, where in the Lower Series it is common.

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, frequent; Altona Bay Coal-Shaft, frequent.

SIGMOÏLINA CELATA, *Costa* sp. (Plate 2. fig. 41.)

Spiroloculina celata, Costa, 1856, Atti Acc. Pontaniana, vol. vii. pt. 1*a*, pl. 26. fig. 5.

Planispirina celata, Costa sp., Fornasini, 1885, Boll. Soc. Geol. Ital. vol. iv. p. 108; Terrigi, 1891, Mem. R. Comit. Geol. Ital. vol. iv. pt. 1*a*, p. 67, pl. 1. figs. 5, 6.

Costa's original specimens differ from the recent form named by Dr. Silvestri *S. Schlumbergeri*, in having an angular contour and conspicuously marked sutures; whilst internally they show in transverse section that the chambers are subcircular or subangular in outline, and these are arranged in a more extended sigmoidal curve than those seen in *S. Schlumbergeri.*

Our specimens are not so broad as the typical examples from the Italian Tertiaries, but they, in all probability, belong to the same species.

Occurrence.—Grice's Creek, frequent; Kackeraboite Creek, rare.

SIGMOÏLINA SCHLUMBERGERI, *Silvestri.* (Plate 2. fig. 42.)

Planispirina celata (non Costa sp.), Brady, 1884, Rep. Chall. vol. ix. p. 197, pl. 8. figs. 1–4; Flint, 1899, Rep. U.S. Nat. Mus. (1897) p. 303, pl. 47. fig. 5.

Sigmoïlina Schlumbergeri, Silvestri, 1904, Mem. dell. Pontif. Acc. Romana d. Nuovi Lincei, vol. xxii. p. 267.

In the last mentioned work Dr. A. Silvestri has pointed out the previous confusion of two forms under the one name, and further shows that the original specimens of Costa are not referable to the species usually found in recent deposits. Silvestri separates this latter form under the name of *S. Schlumbergeri.* The distinguishing characters of this species are the even contour and inconspicuous sutures; whilst internally the differences between this and the preceding species are still more apparent in the rounded form of the chambers and the strong sigmoidal curvature of the series.

Occurrence.—Grice's Creek, frequent.

Subfamily HAUERININÆ.

Genus PLANISPIRINA, *Seguenza.*

PLANISPIRINA EXIGUA, *Brady* sp. (Plate 2. fig. 43.)

Hauerina exigua, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 53.

Planispirina exigua, Brady, 1884, Rep. Chall. vol. ix. p. 196, pl. 12. figs. 1–4, and woodcut fig. 5*b*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 5; Millett, 1898, Journ. R. Micr. Soc. p. 611, pl. 13. fig. 13.

It is interesting to add this record to Howchin's previous one for the

Muddy Creek Lower Beds, since it was from that deposit that this shallow-water tropical species was first recorded as a fossil.

Our figured specimen is most like that depicted by Millett from the Malay Archipelago.

Occurrence.—Grice's Creek, very rare ; Altona Bay Coal-Shaft, very rare.

Genus Articulina, *d'Orbigny.*

Articulina funalis, *Brady.* (Plate 2. fig. 44.)

Articulina funalis, Brady, 1884, Rep. Chall. vol. ix. p. 185, pl. 13. figs. 6–11 ; Egger, 1893, Abhandl. k.-bayer. Ak. Wiss., math.-nat. Cl. II. vol. xviii. p. 242, pl. 3. fig. 1 ; Millett, 1898, Journ. R. Micr. Soc. p. 513.

As in the majority of the recent forms hitherto found, our specimen has lost its initial milioline series of chambers.

This is probably the first occurrence of the species as a fossil. It is found living off Kerguelen Island, the coast of New Guinea and the Malay Archipelago.

Occurrence.—Grice's Creek, very rare.

Subfamily Peneroplidinæ.

Genus Cornuspira, *Schultze.*

Cornuspira crassisepta, *Brady.* (Plate 2. fig. 45.)

Cornuspira crassisepta, Brady, 1882, Proc. Roy. Soc. Edin. vol. xi. p. 714; id., 1884, Rep. Chall. vol. ix. p. 202, pl. 113. fig. 20; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 4.

The geographical distribution of this species is peculiar. It is the most abundant of the *Cornuspiræ* in the Tertiaries of South-eastern Australia, and in the living condition has only been recorded from one locality, namely the Faroe Channel, "warm area," 530 fathoms. Flint* figures two examples of a similar shell in the same group with *C. involvens.* They may possibly belong to this species, but their peripheral aspect is not shown. Flint's specimens came from soundings in the Caribbean Sea, Straits of Yucatan and coast of Georgia, from 276 to 463 fathoms.

C. crassisepta was found by Howchin in the Lower Bed at Muddy Creek.

Occurrence.—Grice's Creek, very common; Balcombe's Bay, very common: Kackeraboite Creek, common; Altona Bay Coal-Shaft, very common.

Cornuspira involvens, *Reuss* sp. (Plate 2. fig. 46.)

Operculina involvens, Reuss, 1850, Denkschr. d. Akad. Wiss. Wien, vol. i. p. 370, pl. 46. fig. 20.

* Rep. U. S. Nat. Mus. for 1897, p. 303, pl. 48. fig. 3.

Cornuspira involvens, Reuss sp., Brady, 1884, Rep. Chall. vol. ix. p. 200, pl. 111. figs. 1–3; Rupert Jones, 1895, Pal. Soc. Mon. Foram. Crag, p. 128, pl. 3. figs. 52–54, woodcuts figs. 11 *a, b*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 4; Millett, 1898, Journ. R. Micr. Soc. p. 612.

Of the two forms of this species usually found associated in the same deposit, that which has the most numerous convolutions is figured here. It probably represents the microspheric stage of this species; whilst the other, with a conspicuous, spherical initial chamber, as Millett remarks respecting the recent examples from the Malay Archipelago, represents the megalospheric form. The microspheric (B) form is twice as abundant as the megalospheric (A) form in the present series.

Howchin records this species from the Lower Bed at Muddy Creek, and Watts from Balcombe's Bay.

Occurrence.—Grice's Creek, very common; Kackeraboite Creek, common.

Cornuspira striolata, *Brady*. (Plate 3. fig. 47.)

Cornuspira striolata, Brady, 1882, Proc. Roy. Soc. Edin. vol. xi. p. 713; id., 1884, Rep. Chall. vol. ix. p. 202, pl. 113. figs. 18, 19.

C. foliacea, Philippi sp. (*pars*), Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii p. 4 [immature examples].

C. striolata, Brady, Goës, 1894, Kongl. Svenska Vetensk. Ak. Handlingar, vol. xxv No. 9, p. 107, pl. 48. fig. 835.

C. involvens, Reuss sp., "striated var.", Vine, 1898, Trans. & Ann. Rep. Sheffield Micr. Soc. p. 9.

The majority of the specimens referred to the above species are not fully developed; that is to say, they do not exhibit the peripheral expansion and reflexure of the last-formed whorl seen in the recent examples. It was only by the fortunate discovery of a few examples out of many hundreds examined that the doubts relating to their specific identification were removed. In his description of *C. foliacea*, Howchin remarked as follows:—"It is worthy of note that all the specimens, which are more or less weathered, show a fine surface ornamentation resembling *C. striolata*, Brady." The mature forms found in the present series show the striated surface to be due not to weathering, but that they are actual markings on the original surface of the test. Other specimens in our series show an initial stage of the peripheral reflexion by the formation of a compressed trumpet-shaped mouth; and in fact, a graduated series might be arranged from one end to the other.

C. striolata is remarkable for its strictly northern distribution in the living condition, as far as its geographical range is at present known; the localities being, Faroe Channel, "cold area," 540 fathoms, and the Siberian Sea, 150 metres. As a fossil this species has been found by Howchin in the Lower beds of Muddy Creek (as *C. foliacea* in part), and by Vine in the Port Phillip Tertiary deposit (as *C. involvens* striated var.).

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, common; Kackeraboite Creek, rare; Altona Bay Coal-Shaft, very common.

CORNUSPIRA FOLIACEA, *Philippi* sp. (Plate **3.** fig. 48.)

Orbis foliaceus, Philippi, 1844, Enum. Moll. Sicil. vol. ii. p. 147, pl. 24. fig. 26.

Cornuspira foliacea, Phil. sp., Brady, 1884, Rep. Chall. vol. ix. p. 199, pl. 11. figs. 5–9; Howchin (*pars*), 1889, Trans. R. Soc. S. Australia, vol. xii. p. 4.

The above is distinguished from *C. involvens* by the stronger compression of the test, and the rapid increase in the diameter of the last whorl. From *C. striolata* it is separated by the much slighter structure and absence of the crowded undulose striæ so conspicuous on the latter species.

C. foliacea has been recorded by Howchin from the Lower Bed of Muddy Creek, and by Vine from the Tertiaries of Port Phillip.

Occurrence.—Grice's Creek, frequent; Kackeraboite Creek, rare; Altona Bay Coal-Shaft, common.

Family ASTRORHIZIDÆ.

Subfamily RHABDAMMININÆ.

Genus JACULELLA, *Brady*.

? JACULELLA OBTUSA, *Brady*. (Plate **3.** fig. 49.)

Jaculella obtusa, Brady, 1882, Proc. Roy. Soc. Edin. vol. xi. p. 714; id., 1884, Rep. Chall. vol. ix. p. 256, pl. 22. figs. 19–22.

There is very little doubt that our specimens belong to the above genus and species. They consist of fairly straight tubes of firmly cemented sand-grains, amongst which are also included minute tests of other, calcareous, foraminifera. The tube is slightly wider at one end than the other. The examples found seem to have lost the bulbous extremity, which is present in the living examples.

This appears to be the first recorded occurrence of the genus in the fossil condition.

As a recent organism *J. obtusa* occurred in the "warm area" of the Faroe Channel at depths of 350 and 542 fathoms.

Occurrence.—Grice's Creek, rare.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

Genus HAPLOPHRAGMIUM, *Reuss*.

HAPLOPHRAGMIUM SPHÆROIDINIFORME, *Brady*. (Plate **3.** figs. 50, 51.)

Haplophragmium sphæroidiniforme, Brady, 1884, Rep. Chall. vol. ix. p. 313.

H. sphæroidiniformis, Brady, Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 6.

Dr. Brady briefly but clearly described this species in the 'Challenger' Report, and stated that his specimens were dredged in the Mediterranean, 70–120 fathoms. Mr. Howchin, in his report on the Muddy Creek foraminifera, referred to this species as a MS. species of Brady's, being unaware of the fact that Brady himself had briefly described the species previously.

The earlier record for this form is the Lower Bed of Muddy Creek.

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, common; Altona Bay Coal-Shaft, frequent.

Genus LITUOLA, *Lamarck.*

LITUOLA SIMPLEX, *Chapman.* (Plate **3.** fig. 52.)

Lituola simplex, Chapman, 1904, Rec. Geol. Survey Vict. vol. i. pt. 3, p. 228, pl. 22. figs. 3, 4.

The Balcombian specimen figured appears to be in every way comparable with the above form, which was found in the Jan Jukian clays of Brown's Creek, Otway Coast, Victoria.

Occurrence.—Altona Bay Coal-Shaft, very rare.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

Genus TEXTULARIA, *Defrance.*

TEXTULARIA GRAMEN, *d'Orbigny.* (Plate **3.** fig. 53.)

Textularia gramen, d'Orbigny, 1846, Foram. Foss. Vienne, p. 248, pl. 15. figs. 4-6; Fornasini, 1887, Boll. Soc. Geol. Ital. vol. vi. p. 399, pl. 11. figs. 4 *a, b*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 7.

This species is well-known as a Tertiary fossil. Besides being of short habit, the test has no spiral commencement as in *Spiroplecta sagittula,*,which in some respects it resembles.

T. gramen was recorded by Howchin from the Lower Bed of Muddy Creek, and it has also been found by Vine in the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, frequent; Balcombe's Bay, frequent; Kackeraboite Creek, rare.

TEXTULARIA GIBBOSA, *d'Orbigny.* (Plate **3.** fig. 54.)

Textularia gibbosa, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 262, No. 6, Modèle No. 28; Fornasini, 1903, Mem. Accad. Sci. Ist. Bologna, ser. V. vol. x. p. 300, pl. O. fig. 1.

This species and the following variety are undoubtedly closely allied. Specimens which belong to the type form *T. gibbosa* are essentially conoidal. They resemble *T. agglutinans* but with a short aborally pointed test, and the chambers are nearly flush with the shell-surface.

T. gibbosa is of frequent occurrence in the Tertiaries (Pliocene), and the shore-sand, of the Adriatic region. It has been recorded by Howchin from the Lower Bed of Muddy Creek, and by Vine from the Port Phillip Tertiaries, *Occurrence.*—Grice's Creek, very rare; Balcombe's Bay, common; Kackeraboite Creek, rare; Altona Bay Coal-Shaft, frequent.

TEXTULARIA GIBBOSA, var. TUBEROSA (*d'Orbigny*). (Plate **4**. fig. 76.)

Textularia tuberosa, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 263, No. 26.

T. aspera, Brady, 1882, Proc. R. Soc. Edin. vol. xi. p. 715; id., 1884, Rep. Chall. vol. ix. p. 367, pl. 44. figs. 9–13; Howchin, 1887, Trans. R. Soc. S. Australia, vol. xii. p. 6.

T. tuberosa, d'Orb., Fornasini, 1889, Boll. Soc. Geol. Ital. vol. vi. p. 161, pl. 2. figs. 2 *a, b.*

T. gibbosa, forma *tuberosa,* d'Orb., Fornasini, 1903, Mem. Acc. Sci. Ist. Bologna, ser. V. vol. x. p. 300, pl. O. fig. 2.

This variety differs from the type form in having an ovoid or sub-cylindrical test. It is essentially a Tertiary species, and is frequent in the Neogene strata of the Italian Sub-apennine area. There is little doubt that Brady's *T. aspera* is referable to this variety, and it is Brady's species to which Howchin referred the Muddy Creek specimens. Since the specific name, *aspera*, drops into synonymy it relieves nomenclature of one preoccupied name, two other forms having been similarly named by Ehrenberg and Terquem respectively *.

Occurrence.—Grice's Creek, very rare; Balcombe's Bay, very rare; Kackeraboite Creek, common; Altona Bay Coal-Shaft, frequent.

TEXTULARIA ABBREVIATA, *d'Orbigny*. (Plate **3**. fig. 55.)

Textularia abbreviata, d'Orbigny, 1846, Foram. Foss. Vienne, p. 249, pl. 15. figs. 7–12; Brady, Parker, & Jones, 1888, Trans. Zool. Soc. Lond., vol. xii. p. 219, pl. 42. figs. 4, 5.

This short and broad form is a characteristic species in the Vienna and Italian Tertiaries, and has been found living on the Abrolhos Bank off the coast of S. America. Vine records it from the Port Phillip Tertiaries. Our specimens are typical in outline, but the chambers are higher and fewer than in d'Orbigny's original specimens.

Occurrence.—Grice's Creek, rare; Balcombe's Bay, frequent; Kackeraboite Creek, rare.

TEXTULARIA SIPHONIFERA, *Brady*. (Plate **3**. fig. 56.)

Textularia siphonifera, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. p. 53; id., 1884, Rep. Chall. vol. ix. p. 362, pl. 42. figs. 25–29.

The localities which have yielded the above species in the recent condition are almost exclusively those of coral-reef areas in the Pacific. It has also occurred in the Gulf of Suez at a depth of 30 fathoms. At Funafuti it occurred at various depths on the outer-reef slope of the atoll down to 150 fathoms, at which depth, at Funamanu, the writer found it to be most abundant.

Occurrence.—Grice's Creek, rare; Balcombe's Bay, very rare.

* See Sherborn's 'Index to the Genera and Species of the Foraminifera,' 1896.

TEXTULARIA RUGOSA, *Reuss* sp. (Plate **3.** fig. 57.)

Plecanium rugosum, Reuss, 1869, Sitzungsb. d. K. Ak. Wiss. Wien, vol. lix. Abth. i. p. 453, pl. 1. figs. 3 *a*, *b*.

Textularia rugosa, Reuss sp., Brady, 1884, Rep. Chall. vol. ix. p. 363, pl. 42. figs. 23, 24; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 7.

This species has also been found at Muddy Creek (Lower Beds). The short varieties bear some resemblance to *T. gramen*, but may be distinguished by the strongly excavated sutures of the chambers.

Occurrence.—Grice's Creek, very rare.

Genus SPIROPLECTA, *Ehrenberg*.

SPIROPLECTA SAGITTULA, *Defrance* sp. (Plate **3.** figs. 58, 59.)

Textularia sagittula, Defrance, 1824, Dict. Sci. Nat. vol. xxxii. p. 177; 1828, vol. liii. p. 344, Atlas Conch. pl. 13. fig. 5; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 7.

Spiroplecta sagittula, Defr. sp., Wright, 1891, Proc. R. Irish Acad. p. 471; id., 1902, Irish Naturalist, p. 211, pl. 3.

The above species was first shown by J. Wright to belong to the genus *Spiroplecta* on account of the spiral arrangement of the initial series of chambers.

S. sagittula has been recorded by Howchin from Muddy Creek (both Lower and Upper Beds), and by Vine and Watts from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, very common; Balcombe's Bay, very common; Kackeraboite Creek, very common; Altona Bay Coal-Shaft, very common.

SPIROPLECTA SAGITTULA, *Defrance* sp., var. FISTULOSA, *Brady*. (Plate **3.** fig. 60.)

Textularia sagittula, Defrance, var. *fistulosa*, Brady, 1884, Rep. Chall. vol. ix. p. 362, pl. 42. figs. 19–22; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 7.

In the Lower Bed at Muddy Creek this variety seems to be comparatively rare. It is, however, nearly as common as the specific form in the present series. Brady regarded the fistulosity as a redundant growth peculiar to examples occurring in tropical or sub-tropical areas.

Occurrence.—Grice's Creek, common; Balcombe's Bay, common; Altona Bay Coal-Shaft, frequent.

SPIROPLECTA CARINATA, *d'Orbigny* sp. (Plate **3.** fig. 61.)

Textularia carinata, d'Orbigny, 1826, Ann. Sci. Nat. p. 263, No. 13; id., 1846, Foram. Foss. Vienne, p. 247, pl. 14. figs. 32–34.

T. carinata, d'Orb., var. *maorica* [var. *antipodum* in text], Stache, 1864, Novara-Exped., Geol. Theil, vol. i. p. 271, pl. 24. figs. 21 *a–c*.

T. carinata, d'Orb., Hantken, 1875 (1881) Mitth. a. d. Jahrb. k.-ungar. geol. Anstalt, vol. iv. p. 66, pl. 7. fig. 8; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 7.

Spiroplecta carinata, d'Orb. sp., Spandel, 1901, Abhandl. Naturhist. Gesellsch. Nürnberg, 1901, pp. 1–12; Fornasini, 1902, Mem. Accad. Sci. Ist. Bologna, ser. V. vol. x. p. 11, woodcut fig. 10.

Although this species is common at one of our localities it is rare to find a thoroughly typical specimen, and this peculiarity was noticed by Howchin, who found it at Muddy Creek (Lower Bed). *S. carinata* and its minor varieties were found by Stache in the late Tertiary marls of Whaingaroa Harbour, Auckland, New Zealand.

Occurrence.—Grice's Creek, common; Balcombe's Bay, rare.

SPIROPLECTA NUSSDORFENSIS, *d'Orbigny* sp. (Plate **3.** fig. 62.)

Textularia nussdorfensis, d'Orbigny, 1846, Foram. Foss. Vienne, p. 243, pl. 14. figs. 17–19.

Our figured specimen agrees very closely with d'Orbigny's original example, with the exception that it has the spiral commencement of a *Spiroplecta.* This feature is not seen in the figure alluded to above, but its general irregularity of build makes it highly probable that d'Orbigny's example was a true *Spiroplecta.*

Occurrence.—Grice's Creek, very rare.

Genus GAUDRYINA, *d'Orbigny.*

GAUDRYINA PUPOIDES, *d'Orbigny.* (Plate **3.** fig. 63.)

Gaudryina pupoides, d'Orbigny, 1840, Mém. Soc. Géol. France, sér. I. vol. iv. p. 44, pl. 4. figs. 22–24.

This rather variable form appears to be extremely rare in the Victorian foraminiferal deposits, so far as I have examined them. The figured specimen is unusually protuberant at the aboral extremity.

Occurrence.—Grice's Creek, very rare.

GAUDRYINA RUGOSA, *d'Orbigny.* (Plate **3.** fig. 64.)

Gaudryina rugosa, d Orbigny, 1840, Mém. Soc. Géol. France, sér. I. vol. iv. p. 44, pl. 4. figs. 20, 21; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 8.

The specimens which are identifiable with the above are exemplified in our series in every stage of their development. The initial portion of the test, with its tricarinate form, is fairly common, and at this stage is closely comparable with *Verneuilina triquetra,* Münster sp. A point of distinction in the young of *G. rugosa,* however, is the brevity of the initial, tricarinate portion; in other words, a typical specimen of *Verneuilina triquetra* has a normally longer test than that of *G. rugosa* in its earlier stage.

Howchin recorded this species from Muddy Creek (Lower Bed); and Vine from the Tertiaries of Port Phillip.

Occurrence.—Grice's Creek, common; Balcombe's Bay, common; Kackeraboite Creek, common; Altona Bay Coal-Shaft, common.

GAUDRYINA SIPHONELLA, *Reuss.* (Plate **3.** fig. 65.)

Gaudryina siphonella, Reuss, 1851, Zeitschr. deutsch. geol. Gesellsch. vol. iii. p. 78, pl. 5. figs. 40–42; Hantken, 1875 (1881), Mitth. d. Jahrb. k.-ungar. geol. Anstalt, vol. iv. p. 14, pl. 1. fig. 3.

This neat little *Gaudryina* is a well distributed Tertiary and recent species.

Its earliest occurrence seems to have been in the Upper Chalk of Rügen. It has been found as a recent form in both the Atlantic and Pacific Oceans, and appears to prefer deep water.

Occurrence.—Grice's Creek, very common.

GAUDRYINA OXYCONA, *Reuss*. (Plate **3**. fig. 67.)

Gaudryina oxycona, Reuss, 1860, Sitzungsb. d. K. Ak. Wiss. Wien, vol. xl. p. 229, pl. 12. figs. 3 *a–c*.

G. Reussi, Hantken, 1875 (1881), [non Stache 1864], Mitth. a. d. Jahrb. k.-ungar. geol. Anstalt, vol. iv. p. 14, pl. 1. fig. 5.

G. oxycona, Reuss, Chapman, 1892, Journ. R. Micr. Soc. p. 753, pl. 12. figs. 1 *a, b*.

It is interesting to meet with the above species in the Tertiary of Grice's Creek, since it is more characteristic of the Cretaceous in other parts of the world. It has, however, been found in the Older Tertiary (Szabói-schichten) of Hungary.

Vine also recorded this form ('*Gaudryina Reussi*') from the Port Phillip Tertiaries.

Occurrence.—Grice's Greek, very rare.

Genus CLAVULINA, *d'Orbigny*.

CLAVULINA COMMUNIS, *d'Orbigny*. (Plate **3**. fig. 66.)

Clavulina communis, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 268, No. 4; Brady, 1884, Rep. Chall. vol. ix. p. 394, pl. 48. figs. 1–13.

The geological range of this species extends through the whole of the Tertiary deposits, and it also occurs in the recent condition. Our specimens are quite typical in every respect, and comparable with those found in the Northern hemisphere.

Howchin found this species in both the Lower and Upper Beds of Muddy Creek, and Vine recorded it from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, very common; Balcombe's Bay, common; Kackeraboite Creek, very common.

CLAVULINA ANGULARIS, *d'Orbigny*. (Plate **4**. figs. 68–73.)

Clavulina angularis, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 268, No. 2, pl. 12. fig. 7; Brady, 1884, Rep. Chall. vol. ix. p. 396, pl. 48. figs. 22–24.

There are two distinct forms of the tricarinate *Clavulinæ* in the present series, one of which is parallel-sided and only bluntly keeled, the other being elongately pyramidal in shape and with sharp salient edges. Upon slicing the tests, the former of these is seen to have a comparatively large initial chamber with only a single group of three chambers in the triserial portion of the test, and this to be followed by an irregularly shaped quasi-textularian series, leading to the uniserial portion, which in the figured specimen shows five superposed chambers.

The larger, pyramidal form, when sliced medially, shows the existence of a comparatively small initial chamber, followed by at least three complete triserial sets of chambers; these are succeeded by three sets of quasi-textularian segments, and terminated by five in the uniserial part of the test.

The former variety, with its large initial chamber and comparatively few segments, may be regarded as the megalospheric condition (form A) of *C. angularis*; and the latter, with its small initial chamber and succeeding, numerous chambers, as the microspheric condition (form B) of the same species.

Hantken figured some specimens almost identical with our form B * from the Older Tertiary of Hungary, which he named *Clavulina Szabói*.

It is noteworthy that the recent specimens hitherto recorded all seem to belong to form A.

Howchin recorded *C. angularis* from the Lower and Upper Beds of Muddy Creek. Vine recorded '*Tritaxia tricarinata*' from the Port Phillip Tertiaries; this is evidently the above species, of form B, which *T. tricarinata* very closely resembles. The distinctive character of the valvuline aperture in *C. angularis* clearly separates it from the genus *Tritaxia*, which has a simple, circular orifice.

Occurrence.—Form A: Grice's Creek, very common; Altona Bay Coal-Shaft, very common. Form B: Grice's Creek, very rare; Altona Bay Coal-Shaft, frequent.

CLAVULINA TEXTULARIOIDEA, *Goës*. (Plate **4**. figs. 74, 75.)

Clavulina parisiensis, d'Orbigny, forma *textularioidea*, Goës, 1892, Arctic and Scand. Rhizop., Svenska Vet.-Akad. Handl. vol. xxv. No. 9, p. 42, pl. 8. figs. 387–399.

Clavulina textularioidea, Goës, 1896, Bull. Mus. Comp. Zool. vol. xxix. No. 1, pt. 20. p. 37, pl. 4. figs. 26–38.

The Australian Tertiary specimens of *Clavulina*, which have a cuneate aboral end and nodosariform chambers in the terminal series, belong to the above species rather than to *C. parisiensis*, which is the only form much resembling it yet recorded from these or similar beds. The chief difference between the two forms lies in the arrangement of the earlier series of chambers, which in *C. textularioidea* are very nearly comparable with those of *Bigenerina nodosaria* d'Orb., but more compressed and carinate (Goës).

The compression of the earlier portion of the test is often so marked as to cause the shell to resemble *Haplophragmium agglutinans*, but that the chambers are arranged as in *Textularia*.

Vine recorded, under the name of *C. parisiensis*, what is probably the above form, from the Port Phillip Tertiaries.

* Mitth. d. Jahrb. k.-ungar. Geol. Anstalt, vol. iv. p. 15, pl. 1. figs. 9 *a–d*.

The recent specimens were obtained by Goës from the Caribbean Sea, 150–300 fathoms.

Occurrence.—Grice's Creek, common; Kackeraboite Creek, common.

Subfamily BULIMININÆ.

Genus BULIMINA, *d'Orbigny.*

BULIMINA ELEGANTISSIMA, *d'Orbigny*, var. APICULATA, *nov.* (Plate **4**. fig. 77.)

The specimens in our series all possess a terminal spine like that often seen in *B. elegans*; the test of this form is comparable with *B. elegantissima* *, although these Victorian fossil examples are remarkably regular in shape. This latter feature and the presence of the aboral spine serves to distinguish the new variety.

The type species dates from the Upper Eocene (Barton Beds) of England, and is found living as far north as the west coast of Novaia Zemlya; and also at the Falkland Islands, the western coast of S. America, S. Pacific, and the east coast of Australia.

Howchin recorded the type species from each of the beds of the Muddy Creek section.

Occurrence.—Grice's Creek, rare; Balcombe's Bay, frequent; Kackeraboite Creek, frequent; Altona Bay Coal-Shaft, rare.

Genus VIRGULINA, *d'Orbigny.*

VIRGULINA SUBDEPRESSA, *Brady.* (Plate **4**. fig. 78.)

Virgulina subdepressa, Brady, 1884, Rep. Chall. vol. ix. p. 416, pl. 52. figs. 14–17.

This species seems to be entirely a Southern hemisphere form, since it occurs in recent deposits only in the South Pacific and South Atlantic.

The specimen now figured is considerably smaller than the recent examples.

Occurrence.—Altona Bay Coal-Shaft, very rare.

Genus BOLIVINA, *d'Orbigny.*

BOLIVINA TEXTULARIOIDES, *Reuss.* (Plate **4**. fig. 79.)

Bolivina textularioides, Reuss, 1862, Sitzungsb. d. K. Ak. Wiss. Wien, vol. xlvi. p. 81, pl. 10. fig. 1.

As a fossil this species dates from the Cretaceous. It is also a well-known Tertiary form, and in recent deposits its geographical distribution is wide.

* d'Orbigny, 1839, Voy. Amér. Mérid. ser. 5, vol. v. 'Foraminifères,' p. 51, pl. 7. figs. 13, 14.

It affects fairly deep-water areas. Recorded by G. R. Vine, Junr., from the Port Phillip Tertiaries.

Occurrence.—Grice's Creek, frequent; Altona Bay Coal-Shaft, frequent.

BOLIVINA PUNCTATA, *d'Orbigny.* (Plate **4.** fig. 80.)

Bolivina punctata, d'Orbigny, 1839, Foram. Amér. Mérid. p. 61, pl. 8. figs. 10–12; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 8.

This well-known Tertiary species is widely distributed, and it occurs in soundings from almost every sea.

It has been recorded from the Lower Bed of Muddy Creek (Howchin).

Occurrence.—Grice's Creek, common; Altona Bay Coal-Shaft, frequent.

BOLIVINA NOBILIS, *Hantken.* (Plate **4.** fig. 81.)

Bolivina nobilis, Hantken, 1875, Mitth. Jahrb. d. k.-ung. Geol. Anstalt, vol. iv. p. 65, pl. 15. figs. 4 *a*, *b*; Chapman, 1892, Quart. Journ. Geol. Soc. vol. xlviii. p. 516, pl. 15. fig. 11; Millett, 1900, Journ. R. Micr. Soc. p. 541, pl. 4. fig. 4.

This elegant species was first found as a fossil in the *Clavulina Szabói* beds of Ofen, Hungary; and the writer found it in the Upper Chalk of Taplow, England. The 'Challenger' dredgings brought it to light as a recent species, apparently restricted to the South Pacific. It has since been found off the West Coast of Africa (Egger), and Millett records it as abundant in the Malay Archipelago.

Occurrence.—Grice's Creek, common; Balcombe's Bay, rare; Kackeraboite Creek, very rare.

BOLIVINA ROBUSTA, *Brady.* (Plate **4.** fig. 82.)

Bolivina robusta, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 57; id., 1884, Rep. Chall. vol. ix. p. 421, pl. 53. figs. 7–9; Millett, 1900, Journ. R. Micr. Soc. p. 543.

As a recent species this form is well distributed. It is occasional in certain Tertiary beds, and is abundant in the L. Pliocene clay of St. Erth, Cornwall, England. Vine records the species from the Port Phillip Tertiaries.

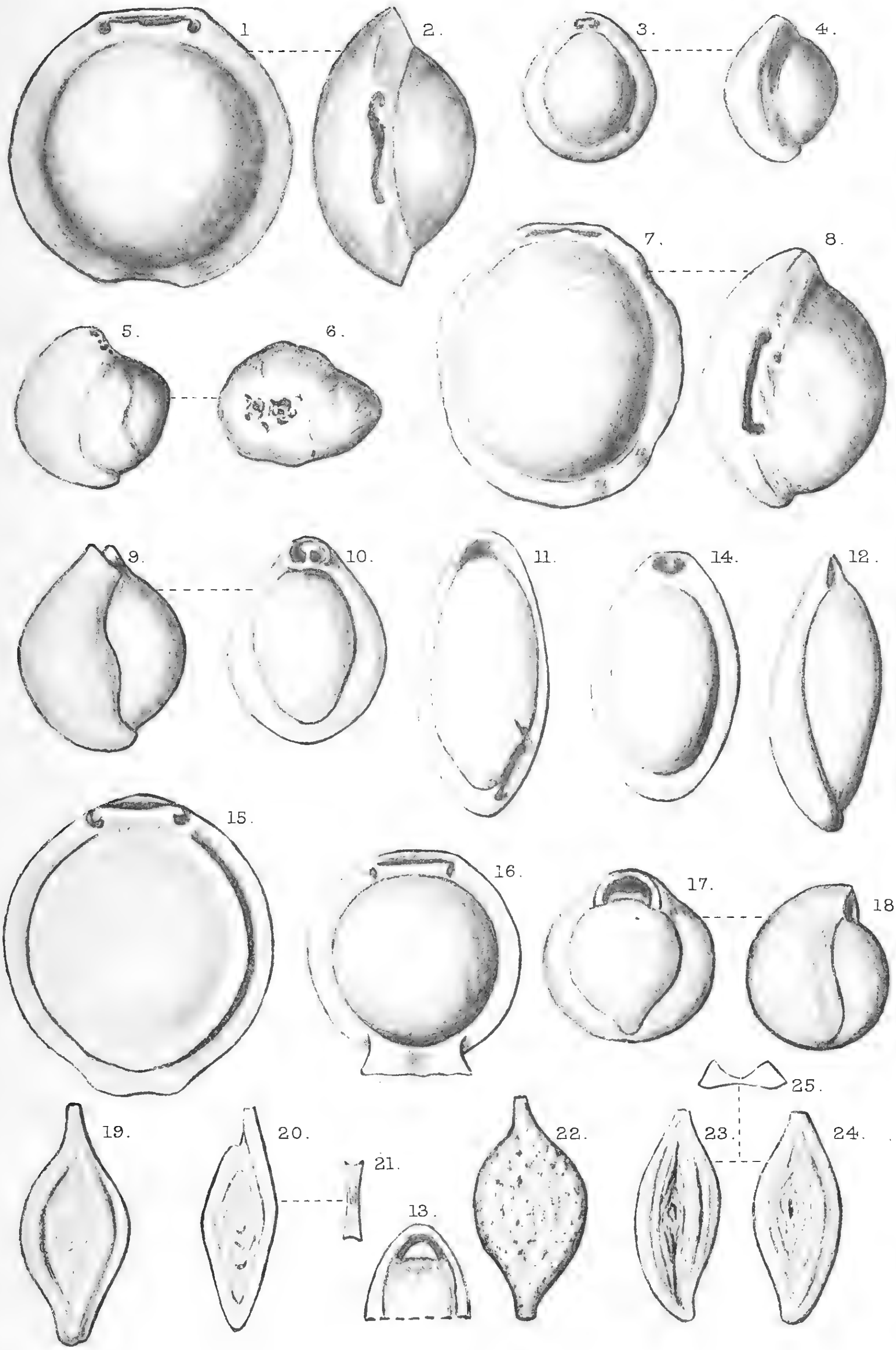
Occurrence.—Altona Bay Coal-Shaft, rare.

BOLIVINA LIMBATA, *Brady.* (Plate **4.** fig. 83.)

Bolivina limbata, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 57; id., 1884, Rep. Chall. vol. ix. p. 419, pl. 52. figs. 26–28; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 8; Egger, 1893, Abhandl. k.-bayer. Akad. Wiss., math.-nat. Cl. II. vol. xviii. p. 300, pl. 8. figs. 10–12.

Our figured specimen is a very minute form. It is referable to the above species, which is commonly found in the neighbourhood of coral reefs at the present day. The bifarine form, with later uniserial chambers, is more often met with in recent dredgings. Howchin records this species from the Lower Bed of Muddy Creek.

Occurrence.—Balcombe's Bay, very rare.



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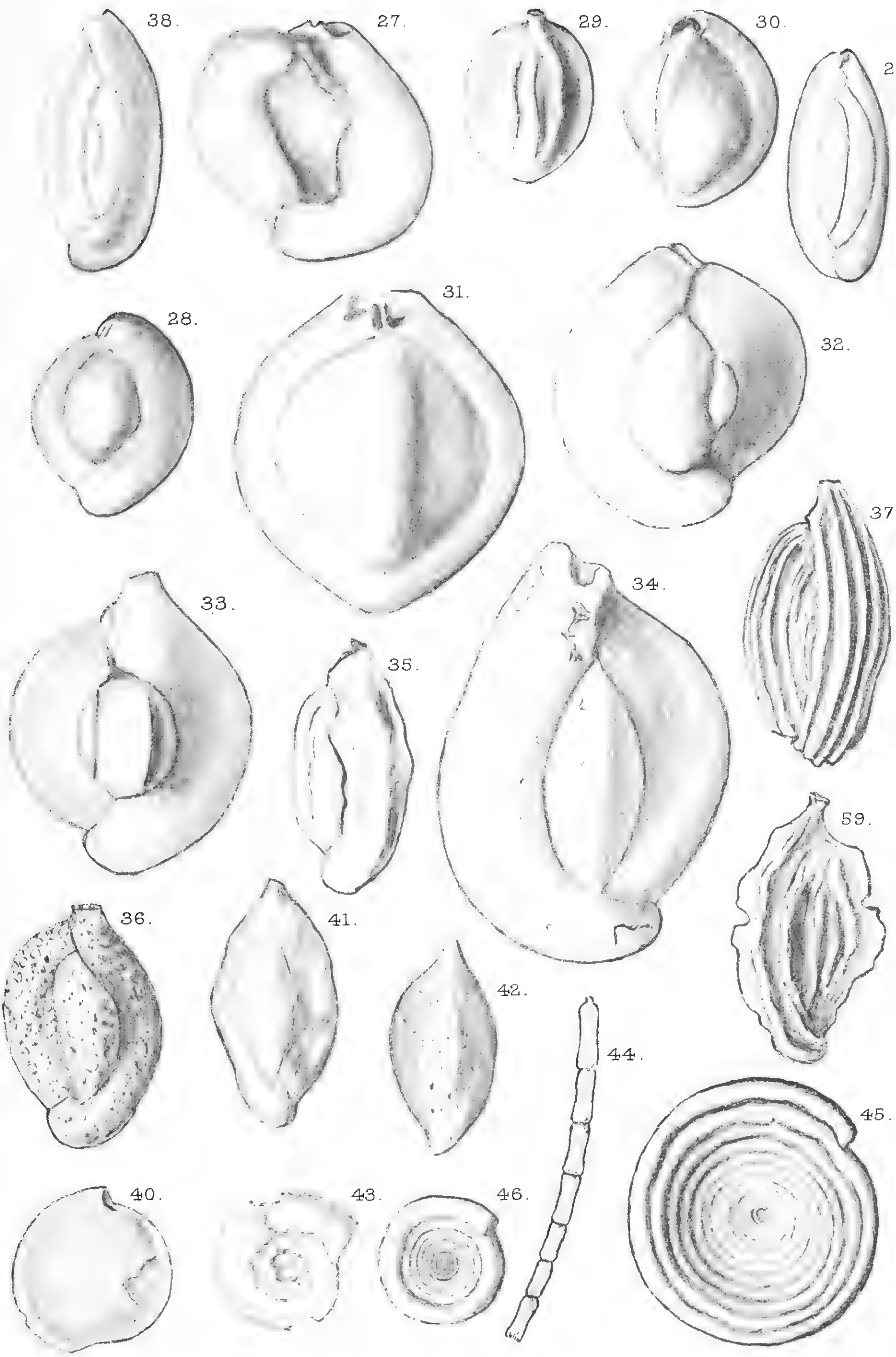
VICTORIAN TERTIARY FORAMINIFERA.



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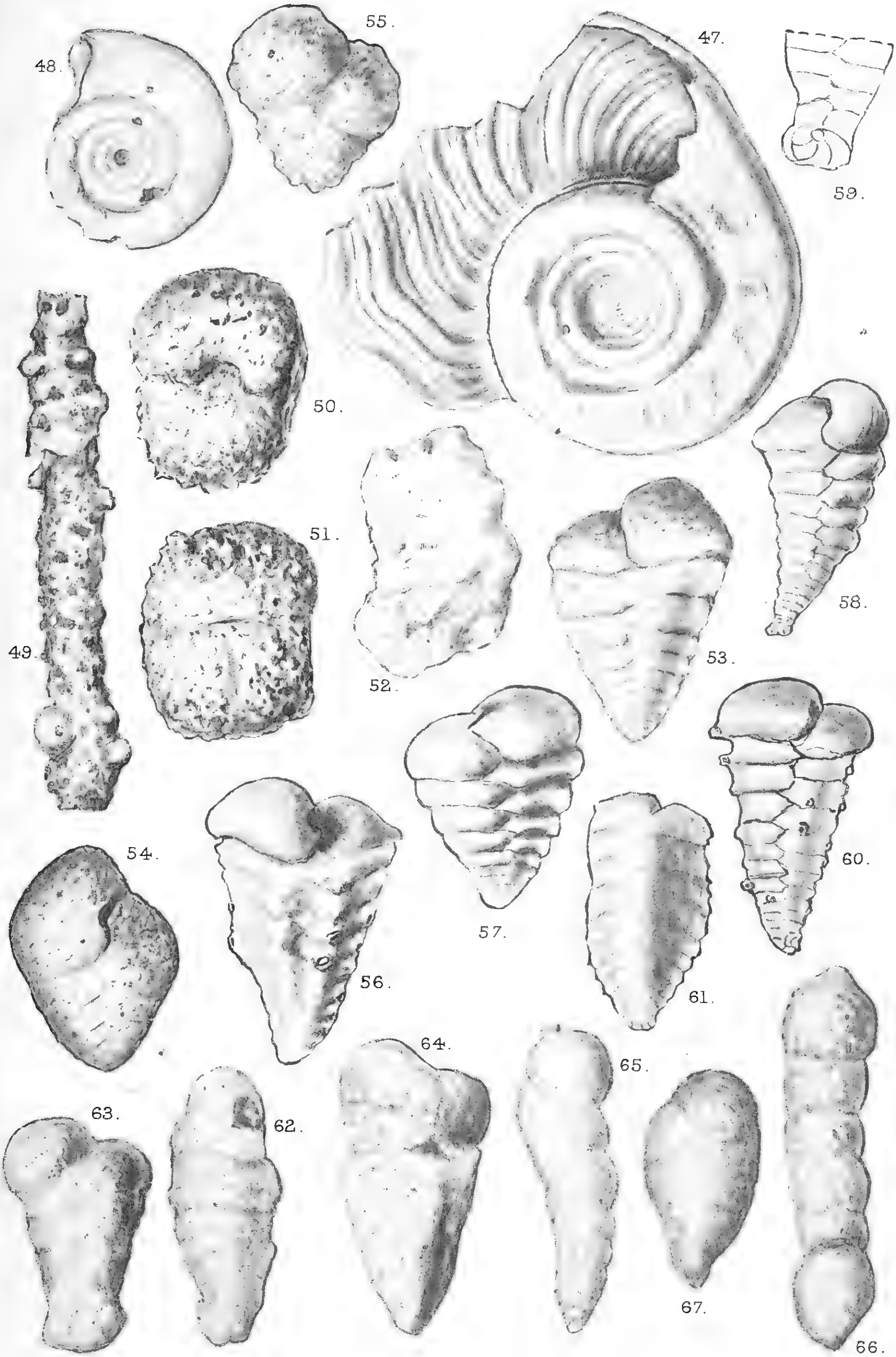

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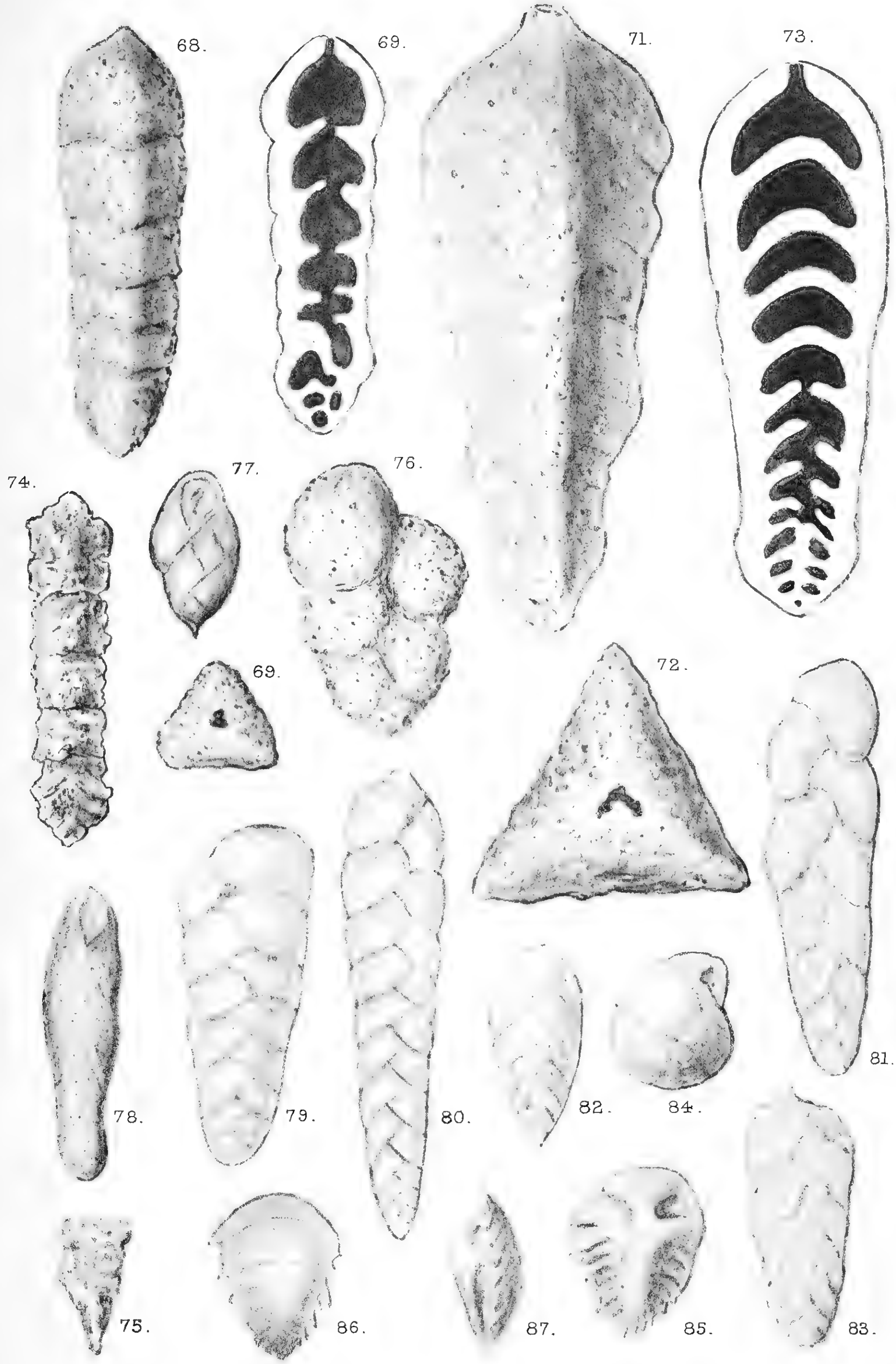
VICTORIAN TERTIARY FORAMINIFERA.



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VICTORIAN TERTIARY FORAMINIFERA.

Subfamily CASSIDULININÆ.

Genus CASSIDULINA, *d'Orbigny.*

CASSIDULINA SUBGLOBOSA, *Brady.* (Plate 4. fig. 84.)

Cassidulina subglobosa, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 60; id., 1884, Rep. Chall. vol. ix. p. 430, pl. 54. figs. 17 *a–c*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 8.

This form appears to be, generally speaking, a deep-water species, and has a wide distribution as a recent form.

It has been recorded by Howchin from the Lower and Upper Beds at Muddy Creek, where, as in common with our examples, the test is very small.

Occurrence.—Altona Bay Coal-Shaft, frequent.

Genus EHRENBERGINA, *Reuss.*

EHRENBERGINA SERRATA, *Reuss.* (Plate 4. figs. 85–87.)

Ehrenbergina serrata, Reuss, 1849, Denkschr. d. k. Ak. Wiss. Wien, vol. i. p. 377, pl. 48. figs. 7 *a–c*; Howchin, 1889, Trans. R. Soc. S. Australia, vol. xii. p. 8.

This ornate little form is well-known as a Miocene fossil (Reuss and Karrer), and it has been found in various West Indian Tertiary deposits, as the *Globigerina*-Marls of Barbados (Chapman).

Howchin records this species from the Lower Bed at Muddy Creek.

Occurrence.—Grice's Creek, frequent; Altona Bay Coal-Shaft, very rare.

EXPLANATION OF THE PLATES.

PLATE 1.

Fig. 1. *Biloculina Sarsi,* Schlumb. Grice's Creek. Front aspect. × 25.
2. *B. Sarsi,* Schlumb. Oral aspect of same. × 25.
3. *B. bulloides,* d'Orb. Grice's Creek. Front aspect. × 50.
4. *B. bulloides,* d'Orb. Lateral aspect of same. × 50.
5. *B. irregularis,* d'Orb. Grice's Creek. Lateral aspect. × 50.
6. *B. irregularis,* d'Orb. Oral aspect of same. × 50.
7. *B. Bradii,* Schlumb. Grice's Creek. Front aspect. × 25.
8. *B. Bradii,* Schlumb. Oral aspect of same. × 25.
9. *B. ringens,* Lam. sp. Grice's Creek. Lateral aspect. × 50.
10. *B. ringens,* Lam. sp. Front aspect of same. × 50.
11. *B. angusta,* sp. nov. Grice's Creek. Front aspect. × 110.
12. *B. angusta,* sp. nov. Lateral aspect of same. × 110.
13. *B. angusta,* sp. nov. Kackeraboite Creek. Oral extremity of test. × 110.
14. *B. elongata,* d'Orb. Grice's Creek. Front aspect. × 110.
15. *B. lævis,* Defr. sp. Altona Bay Coal-Shaft. Front aspect. × 50.
16. *B. depressa,* d'Orb. Grice's Creek. Front aspect. × 50.
17. *B. globulus,* Born. Grice's Creek. Front aspect × 50.
18. *B. globulus,* Born. Lateral aspect of same. × 50.

Fig. 19. *Spiroloculina acutimargo*, Brady. Kackeraboite Creek. Lateral aspect. × 80.
20. *S. canaliculata*, d'Orb. Kackeraboite Creek. Lateral aspect. × 50.
21. *S. canaliculata*, d'Orb. Oral aspect of same. × 50.
22. *S. asperula*, Karrer. Grice's Creek. Lateral aspect. × 25.
23. *S. affixa*, Terquem. Grice's Creek. Lateral aspect. × 50.
24. *S. affixa*, Terquem. Opposite face of same. × 50.
25. *S. affixa*, Terquem. Sectional view. × 50.

Plate 2.

Fig. 26. *Miliolina oblonga*, Montagu sp. Altona Bay Coal-Shaft. × 88.
27. *M. circularis*, Born. sp. Balcombe's Bay. × 50.
28. *M. schreiberiana*, d'Orb. sp. Grice's Creek. × 37.
29. *M. polygona*, d'Orb. sp. Grice's Creek. × 50.
30. *M. trigonula*, Lam. sp. Balcombe's Bay. × 37.
31. *M. tricarinata*, d'Orb. sp. Grice's Creek. × 25.
32. *M. vulgaris*, d'Orb. sp. Altona Bay Coal-Shaft. × 37.
33. *M. cuvieriana*, d'Orb. sp. Altona Bay Coal-Shaft. × 25.
34. *M. seminulum*, Linn. sp. Kackeraboite Creek. × 25.
35. *M. contorta*, d'Orb. sp. Balcombe's Bay. × 50.
36. *M. agglutinans*, d'Orb. sp. Grice's Creek. × 25.
37. *M. linnæana*, d'Orb. sp. Grice's Creek. × 25.
38. *M. venusta*, Karrer sp. Altona Bay Coal-Shaft. × 110.
39. *M. Ferussacii*, d'Orb. sp. Grice's Creek. × 37.
40. *Sigmoïlina sigmoidea*, Brady sp. Balcombe's Bay. × 25.
41. *S. celata*, Costa sp. Kackeraboite Creek. × 50.
42. *S. Schlumbergeri*, Silvestri. Grice's Creek. × 50.
43. *Planispirina exigua*, Brady. Grice's Creek. × 50.
44. *Articulina funalis*, Brady. Grice's Creek. × 25.
45. *Cornuspira crassisepta*, Brady. Grice's Creek. × 37.
46. *C. involvens*, Reuss. Kackeraboite Creek. × 25.

(All figures on this Plate show the lateral aspect of the test.)

Plate 3.

Fig. 47. *Cornuspira striolata*, Brady. Lateral aspect. Kackeraboite Creek. × 25.
48. *C. foliacea*, Philippi sp. Lateral aspect. Kackeraboite Creek. × 25.
49. *? Jaculella obtusa*, Brady. Lateral aspect. Grice's Creek. × 50.
50. *Haplophragmium sphæroidiniforme*, Brady. Oral aspect. Balcombe's Bay. × 37.
51. *H. sphæroidiniforme*, Brady. Lateral aspect. Balcombe's Bay. × 37.
52. *Lituola simplex*, Chapman. Lateral aspect. Altona Bay Coal-Shaft. × 37.
53. *Textularia gramen*, d'Orb. Lateral aspect. Balcombe's Bay. × 37.
54. *T. gibbosa*, d'Orb. Lateral aspect. Kackeraboite Creek. × 25.
55. *T. abbreviata*, d'Orb. Lateral aspect. Grice's Creek. × 25.
56. *T. siphonifera*, Brady. Lateral aspect. Balcombe's Bay. × 37.
57. *T. rugosa*, Reuss sp. Lateral aspect. Grice's Creek. × 37.
58. *Spiroplecta sagittula*, Defr. sp. Lateral aspect. Kackeraboite Creek. × 25.
59. *S. sagittula*, Defr. Spiral, aboral end of test. Kackeraboite Creek. × 100.
60. *S. sagittula*, Defr. sp., var. *fistulosa*, Brady. Lateral aspect. Altona Bay Coal-Shaft. × 37.
61. *S. carinata*, d'Orb. sp. Lateral aspect. Grice's Creek. × 37.
62. *S. nussdorfensis*, d'Orb. sp. Lateral aspect. Grice's Creek. × 50.

Fig. 63. *Gaudryina pupoides*, d'Orb. Lateral aspect. Grice's Creek. × 37.
64. *G. rugosa*, d'Orb. Lateral aspect. Grice's Creek. × 37.
65. *G. siphonella*, Reuss. Lateral aspect. Grice's Creek. × 37.
66. *Clavulina communis*, d'Orb. Lateral aspect. Grice's Creek. × 37.
67. *Gaudryina oxycona*, Reuss. Lateral aspect. Grice's Creek. × 50.

PLATE 4.

Fig. 68. *Clavulina angularis*, d'Orb. Form A, lateral aspect. 69. Oral aspect. Grice's Creek. × 37.
70. *C. angularis*, d'Orb. Form A, vertical half-section. Altona Bay Coal-Shaft. × 37.
71. *C. angularis*, d'Orb. Form B, lateral aspect. 72. Oral aspect. Altona Bay Coal-Shaft. × 25.
73. *C. angularis*, d'Orb. Form B, vertical half-section. Altona Bay Coal-Shaft. × 25.
74. *C. textularioidea*, Goës. Lateral aspect. 75. Edge view of aboral end. Grice's Creek. × 50.
76. *Textularia gibbosa*, var. *tuberosa*, d'Orb. Lateral aspect. Kackeraboite Creek. × 37.
77. *Bulimina elegantissima*, d'Orb., var. *apiculata*, nov. Lateral aspect. Grice's Creek. × 50.
78. *Virgulina subdepressa*, Brady. Lateral aspect. Grice's Creek. × 100.
79. *Bolivina textularioides*, Reuss. Lateral aspect. Grice's Creek. × 80.
80. *B. punctata*, d'Orb. Lateral aspect. Grice's Creek. × 80.
81. *B. nobilis*, Hantken. Lateral aspect. Grice's Creek. × 80.
82. *B. robusta*, Brady. Lateral aspect. Altona Bay Coal-Shaft. × 50.
83. *B. limbata*, Brady. Lateral aspect. Balcombe's Bay. × 100.
84. *Cassidulina subglobosa*, Brady. Lateral aspect. Altona Bay Coal-Shaft. × 100.
85. *Ehrenbergina serrata*, Reuss. Ventral aspect. 86. Dorsal aspect. 87. Edge view. Grice's Creek. × 50.

Note on a new South African Tick, *Rhipicephalus phthirioides*, sp. n.

By W. F. COOPER, B.A., F.L.S., and L. E. ROBINSON, A.R.C.Sc. Lond.

(PLATE 5 and 4 text-figures.)

[Read 20th December, 1906.]

IN the late autumn of last year Dr. S. Williamson, of Berkhamsted, forwarded two dried ticks to us for the purpose of identification. These specimens, a male and a female, had been given to him in Cape Town by Mr. Colin Storey, who had taken them from a horse in Rhodesia, and who remarked at the time that they were unlike any tick which he had previously examined.

Both specimens were much mutilated by a lengthy sojourn in a pocket-book, most of the legs being broken; fortunately these still remained enclosed with the rest, and the specimens were sufficiently serviceable for the purpose of description. A very cursory inspection sufficed to show that the male was quite unlike any tick which we had seen before, or whose description had, to the best of our knowledge, been published hitherto. The female is quite a typical *Rhipicephalus*, but the male is so peculiar that at first sight we considered that it would justify the creation of a new genus to accommodate it. The capitulum conforms to the generic characters, but the modifications of the ventral chitinous plates or adanal shields, the caudal protuberance, and the form of the 4th pair of legs, are remarkable.

RHIPICEPHALUS PHTHIRIOIDES, sp. n.

Specific characteristics.—MALE. Body elongately elliptical, broadest at middle of its length, posterior margin prolonged as a large caudal protuberance. Maximum length 3·5 mm., max. breadth 2·15 mm. Scutum

Fig. 1.

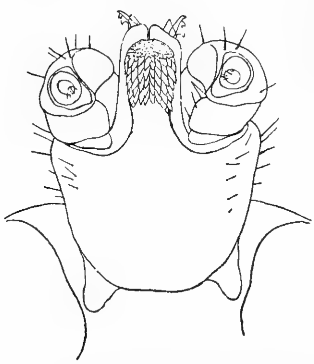
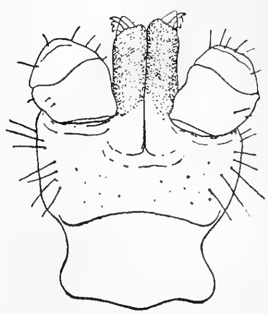


Fig. 2.



Rhipicephalus phthirioides.—Capitulum of Male, × 60.
Fig. 1. Ventral surface. Fig. 2. Dorsal surface.

dark reddish-brown, subrectangular, does not cover entire dorsal surface; anterior margin deeply indented for the reception of the capitulum; cervical furrows shallow, divergent posteriorly; marginal furrows deficient; at the hinder end a short median furrow with shorter accessory furrows on either side; two irregular depressions on the middle of the scutum indicate the site of the punctate areas; eyes small, pale, flat, indistinct in certain aspects, situated on the margin of the scutum, opposite the interspace between the first and second pairs of legs; punctuations small, shallow, irregular, widely scattered; few small hairs, chiefly on those portions of the back not covered by the scutum. Ventral surface with pale scattered hairs; genital pore situated between the coxæ of the second pair of legs; adanal shields fused together in the median line anterior to anus and extending backwards on either side of the latter as two salient spines; stigmal plates almost circular; caudal protuberance bears on its ventral surface a pronounced

FIG. 1.—*Rhipicephalus phthirioides*, ♀.
Dorsal surface. × 13.

FIG. 2.—*Rhipicephalus phthirioides*, ♂.
Dorsal surface. × 13.

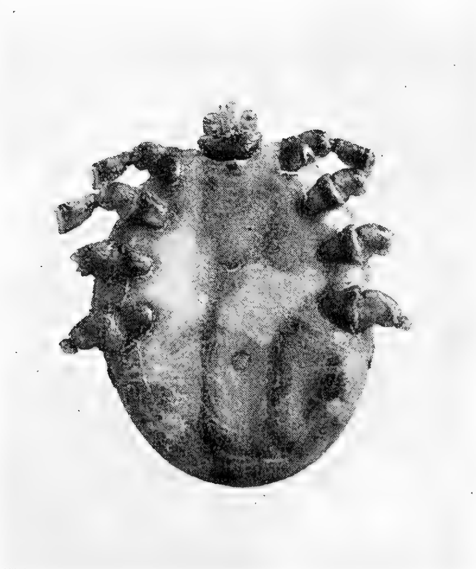


FIG. 3.—*Rhipicephalus phthirioides*, ♀.
Ventral surface. × 13.

FIG. 4.—*Rhipicephalus phthirioides*, ♂.
Ventral surface. × 13.

chitinous tooth-like projection; postero-marginal festoons indicated by tufts of stiff hairs, six tufts on either postero-lateral margin. Capitulum has the usual generic features. External angles of basal portion not prominent; posterior salient margin with blunt, short, backwardly-directed processes at lateral angles. Palpi subconical, very short; hypostome slightly spatulate, 4 longitudinal rows of teeth on each half, terminal portion with numerous minute teeth. Legs strong, reddish-brown with darker markings; segments

Fig. 3.

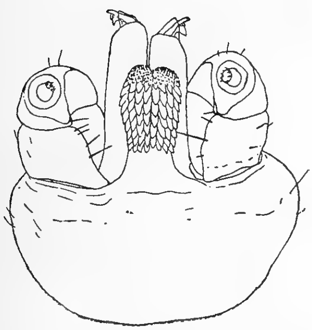
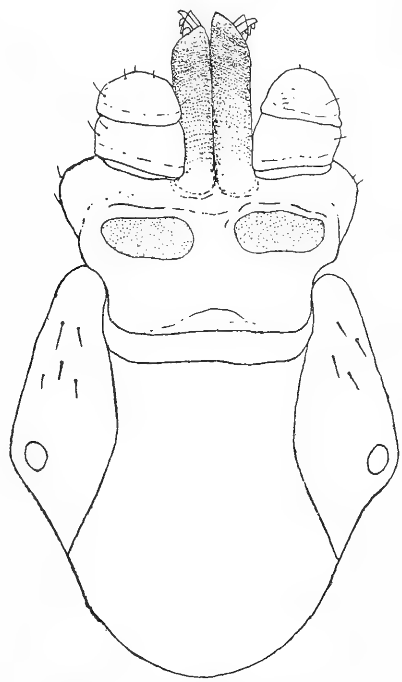


Fig. 4.



Rhipicephalus phthirioides.—Capitulum of Female, × 60.
Fig. 3. Ventral surface. Fig. 4. Dorsal surface.

of 4th pair enormously dilated; coxæ of 1st pair bidentate, spines very short, coxæ of 2nd, 3rd, and 4th pairs slightly unidentate; tarsi bicalcarate, the terminal spurs being so large as to dwarf the relatively small pulvilli; external margins of the 3rd and 4th pairs of legs fringed with numerous stiff hairs.

Female. Body elliptical, widest at middle. Maximum length 4 mm., max. breadth 2·7 mm.; margin entire. General colour grey with yellowish and darker grey irregular markings. Scutum as broad as long, cordiform, with rounded angles at middle of lateral margins, light reddish-brown; cervical furrows shallow, extending to posterior margin of scutum, divergent behind; eyes pale, brilliant, situated opposite lateral angles; few minute hairs on antero-lateral portions of scutum. Marginal furrows and festoons deficient, position of latter slightly indicated by a tendency to grouping of the hairs on the margin of the body. Ventral surface shows few scattered hairs and punctuations; genital opening opposite 1st intercoxal space; genital furrows divergent; median ano-marginal furrow shallow, lateral accessory furrows indistinct. Capitulum with basal portion wider anteriorly, porose areas large, irregularly elliptical, well separated; hypostome as in male; palpi stumpy, external angles slightly salient. Legs pale ochre-yellow with brown markings, segments not dilated as in the male; coxal spines as in the male; tarsi bicalcarate, terminal spurs as in the male.

Although the male of this species is apparently so aberrant, after a careful comparison with other *Rhipicephali*, we have no hesitation in placing it in this genus. In the majority of the male *Rhipicephali* the adanal shields originate some distance in front of the anus, and in certain cases a distinct tendency of the anterior extremities of the shields to approach the middle line of the body is exhibited. In the case of *Rhipicephalus phthirioides* there are signs of a median line of demarcation between the two halves of the shield, and this line of demarcation we consider to be the line of fusion of the separate paired adanal shields present in other representatives of the genus. All the other Rhipicephalan features, more or less modified, are present. The general appearance of the male tick is so remarkably louse-like that it suggested the specific name. The description of the female tick was made from a partially gorged specimen.

EXPLANATION OF PLATE 5.

Fig. 1. *Rhipicephalus phthirioides*, C. & R., ♀. Dorsal surface. × 13.
Fig. 2. *Rhipicephalus phthirioides*, C. & R., ♂. Dorsal surface. × 13.
Fig. 3. *Rhipicephalus phthirioides*, C. & R., ♀. Ventral surface. × 13.
Fig. 4. *Rhipicephalus phthirioides*, C. & R., ♂. Ventral surface. × 13.

A Freshwater Isopod from Calcutta.

By the Rev. T. R. R. Stebbing, M.A., F.R.S., Sec.L.S.

(Plate 6.)

[Read 17th January, 1907.]

The interest of the specimens about to be described lies more in the novelty of their habitat than in any striking features of specific distinction. Dr. Annandale, writing on the 24th October, 1906, says:—"The species is evidently rare, as the three specimens are the only ones I have been able to find in a very large number of sponges examined. The two smaller ones were found last week in the same pond, while the larger one came from a different pond last month. I am working at the freshwater sponges of this district and their inquilines, so that I am very anxious to have the different species found associated with the sponges identified."

It may be noticed that the true limits of the family *Corallanidæ*, to which these specimens belong, have only recently become susceptible of definition through the researches of Mr. Stanley Gardiner in the Maldive and Laccadive Archipelagoes and those of Dr. Willey at Ceylon. The scarcity of a species often disappears when the attention of naturalists has been directed to it, but for the moment we have the singularity of an apparently rare species of an uncommon family presenting itself under conditions which are not very usual for the order of isopods in general.

Family CORALLANIDÆ.

1904. *Corallanidæ,* Stebbing, in Gardiner's Fauna of Maldive and Laccadive Archipelagoes, vol. ii. pt. 3, p. 703.
1904. *Corallanidæ,* Stebbing, Spolia Zeylanica, vol. ii. pt. 5, p. 13.
1905. *Corallanidæ,* H. Richardson, Bull. U. S. Nat. Mus., No. 54, p. 156.

In her monograph on the isopods of North America, referred to above, Miss Richardson has incorporated in this family a new genus *Tridentella,* and the genus *Nalicora* published by H. F. Moore in 1902. Both of these genera have seven-jointed maxillipeds, the palp being distinctly five-jointed.

Genus Tachæa, *Schiödte & Meinert.*

1879. *Tachæa,* Schiödte & Meinert, Naturhist. Tidsskr. ser. 3, vol. xii. p. 284.
1890. *Tachæa,* Hansen, Vid. Selsk. Skr. ser. VI. vol. v. pt. 3, pp. 288, 314, 397.
1904. *Tachæa,* Stebbing, in Gardiner's Fauna of Maldive & Laccadive Arch., vol. ii. p. 703.
1904. *Tachæa,* Stebbing, Spolia Zeylanica, vol. ii. pt. 5, p. 14.

In the species here described the maxillipeds are decidedly only six-jointed, but the terminal joint is longer than any one of the three joints immediately preceding it, an unusual relation which supports the opinion that in this genus the diminished number of joints is due to a coalescence of the sixth and seventh.

TACHÆA SPONGILLICOLA, sp. n. (Plate **6.**)

Front of head bisinuate, with small median process. First segment of peræon with anterior margin not bisinuate; this segment centrally not much longer than any but the seventh. Peræon considerably longer than pleon, of which the first five segments are together shorter than the telsonic segment. This last is as broad as long, apically very broadly rounded in female, partially truncate in male; margins serrate, four setæ and eight spines. Eyes small, dark, widely separated.

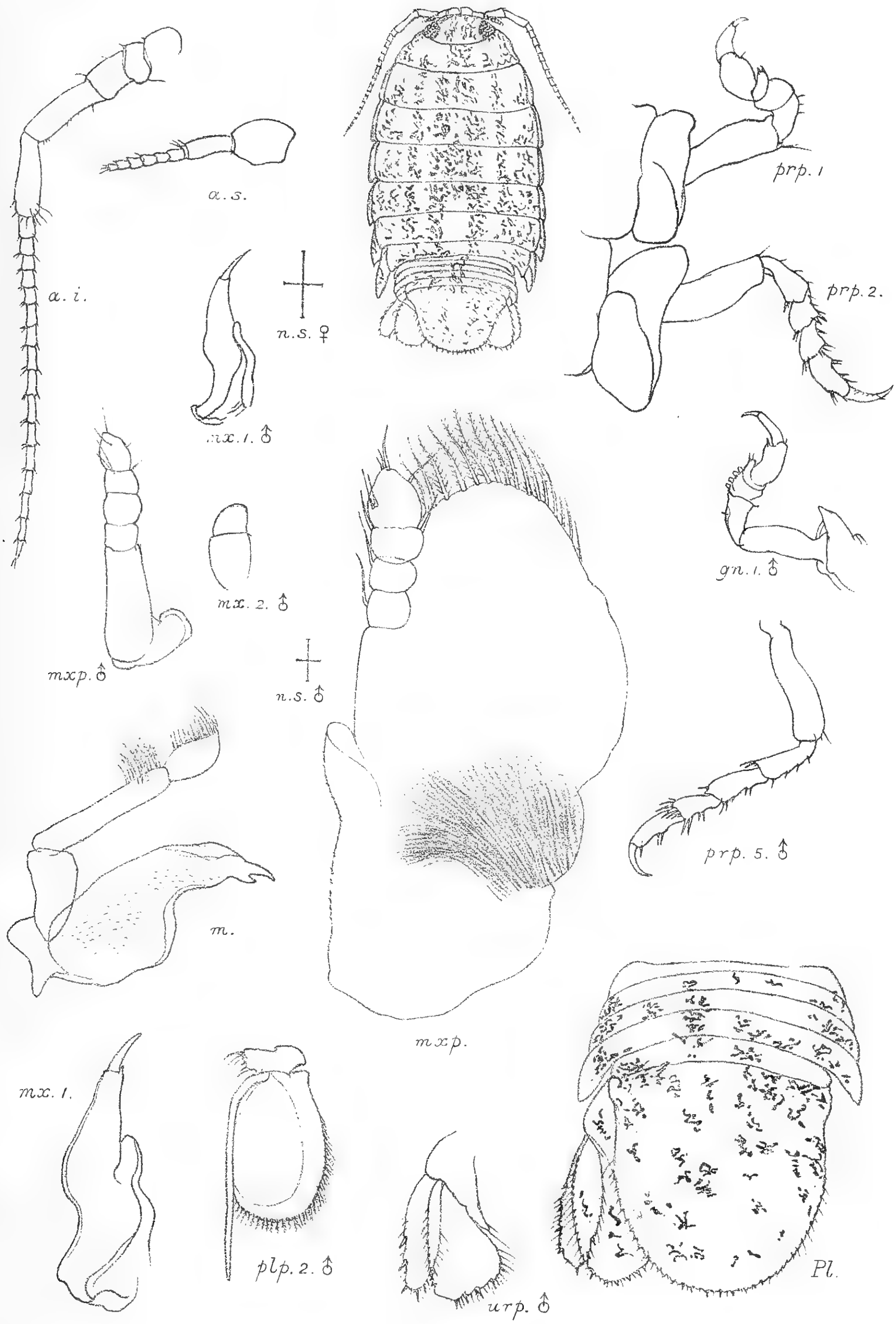
First antennæ having a much dilated first joint, slightly longer than broad, the second (or probably true third) joint being shorter and much narrower; the flagellum of seven short joints overlapping base of fifth joint in the second antennæ. In these the first three joints are short, the fourth a little shorter but stouter than the fifth; the flagellum sixteen-jointed, rather longer than the peduncle.

The mandibles end in a sharp tooth, with another inconspicuous one a little to the rear. The broadest part of the trunk follows the insertion of the palp which is very near the base, the first joint being the broadest, the third the shortest but with the largest number of spines. The surface of the trunk shows fish-scale markings under high magnification.

The first maxillæ have a rounded apex to the inner plate; beyond this the outer plate tapers to its strong single apical tooth. The second maxillæ have an undivided apical plate, as broad as long, broadly rounded distally.

The maxillipeds of the ovigerous female have the vibratory laminæ of the first and second joints largely developed, with strong muscles. The lamina of the second joint is distally fringed with long plumose setæ, and is prolonged nearly to the end of the four-jointed palp. The first three joints of the palp are each broader than long, only the terminal joint being rather longer than broad; this, as above suggested, probably representing a union of two joints. One maxilliped in our specimen has a small mite with its mouth placed on the first joint of the palp and its body reaching half across the anterior vibratory plate. The maxillipeds of the male by the absence of the vibratory laminæ have a very different appearance from those of the female. The palps, however, differ only slightly. In the female the palp's third joint is rather larger than the second; in the male the reverse is true; in both, the terminal joint is the largest in the palp.

The first gnathopods and two succeeding pairs of limbs are closely alike, with the fourth joint short and the fifth still shorter, the sixth robust, more so in the female than in the male, the trunk of the finger considerably longer than its well-defined unguis. The four following pairs of legs are successively



T. R. R. Stebbing del.

J. T. Rennie Reid, Lith. Edinr.

TACHÆA SPONGILLICOLA, n. sp.

longer, the fourth joint especially gaining in length, the fifth distally fringed with numerous spines.

The second pleopods of the male have the masculine appendix produced almost to a point much beyond the smooth inner plate and the broader and longer outer plate, which is fringed nearly all round with short plumose setæ.

The uropods have the inner angle of the peduncle well produced, apically armed with two setæ; the large inner ramus fringed with setæ and spines, distally truncate with oblique corners; the much narrower outer ramus similarly furnished, a little shorter, with apex obliquely truncate.

The specimens as preserved retain dark stellate markings distributed over the back in a roughly symmetrical pattern, the central group broad with occasional bare spaces, the marginal groups very irregular, and between these and the central group two narrow submedian lines.

The female specimen was 9 mm. long by 4·5 mm. broad; the male 5·75 mm. long by 2·75 mm. broad.

Locality.—Freshwater tank, Calcutta. Dr. Annandale found the specimens described, and a third smaller than either, in the canals of a freshwater sponge, *Spongilla carteri*, Bowerbank *, and to this choice of residence the specific name refers.

The hitherto known species of this genus are *Tachæa crassipes*, Schiödte & Meinert, from coral-reefs at Singapore, and *Tachæa incerta*, H. J. Hansen, of unknown locality. The latter author re-examined, and gave fresh figures and description of, *T. crassipes*, which he supposed to be founded on young specimens, probably of the female sex. His own species was founded on a female specimen, a very old and unfortunately a defective one. It was light brown in colour without dark blotches, but Hansen was uncertain whether that might not be due to the bad state of preservation. It appears to be distinguished from *T. crassipes* chiefly by a slenderer sixth joint in the first three thoracic limbs, and by having the telson distally rounded instead of truncate. In the freshwater species here described it is the male that has the slenderer limbs, but in the shape of the telson this sex agrees with *T. crassipes*, while the female in that respect agrees with *T. incerta*. Hence I am disposed to infer that *T. incerta* is not distinct from *T. crassipes*, and that *T. spongillicola* is a very near relation to the same species, distinguished chiefly by the terminal joint of the maxillipeds, but apparently also by having the limbs somewhat less spiny and the pleon shorter in comparison with the peræon. At some future opportunity it would be interesting to test by experiment whether the freshwater form could support life in sea-water.

* According to later information, the sponge may be a local race of *Spongilla lacustris* (Donati).

EXPLANATION OF PLATE 6.

TACHÆA SPONGILLICOLA, sp. n.

n. s. ♀, *n. s.* ♂. Lines indicating natural size of female specimen seen in dorsal view at top of plate, and of male specimen from which some of the appendages are figured.

a. s., *a. i.* First and second antennæ of female.

m., *mx.* 1., *mxp.* Mandible, first maxilla, and maxilliped of female.

*mx.*1 ♂, *mx.* 2 ♂, *mxp.* ♂. First and second maxillæ and maxilliped of male.

prp. 1, *prp.* 2. First and second peræopods of female.

gn. 1 ♂, *prp.* 5 ♂. First gnathopod and fifth peræopod of male.

Pl., *plp.* 2 ♂, *urp.* ♂. Pleon of female, with one uropod omitted: second pleopod and uropod of male.

The mouth-organs are magnified to a higher scale than the other appendages.

On a new British Terrestrial Isopod. By ALEXANDER PATIENCE. (Communicated by the Rev. T. R. R. STEBBING, M.A., F.R.S., Sec.L.S.)

(PLATE 7.)

[Read 17th January, 1907.]

Fam. TRICHONISCIDÆ.

Gen. TRICHONISCUS, *Brandt*, 1833.

TRICHONISCUS STEBBINGI, sp. n. (Plate 7.)

Body oblong oval in form, about two and a half times as long as it is broad. It attains the greatest width about half the total length. Dorsal face convex and very strongly tuberculated, the tubercles being arranged transversely in rows across the segments. Cephalon with the front obtusely rounded; lateral lobes moderately produced, and armed with two small spines on outer edge. Lateral parts of the segments of mesosome edged with very small spicules, which are concealed, however, in a fringe of short hairs; the lateral parts of the three posterior segments prominent, recurved, and acuminate. Metasome with the terminal expansion of last segment broadly and evenly rounded at the tip and armed with four triangular spines, the two central being the largest. Eyes consisting of three visual elements imbedded in dark pigment. Antennulæ with the last joint much longer than the second and having five to seven filaments. Antennæ about one-third the length of body, the flagellum being composed of from four to seven articulations. Left mandible with two, right with one, penicil behind the cutting part. Last pair of legs in both sexes with the last joint densely ciliated on the outside. Inner ramus of first pair of pleopoda in male not very conspicuous, biarticulate; the terminal joint about twice the length of first, slender and needle-shaped, and produced just slightly beyond the first joint of inner ramus of second pair. Inner ramus of second pair biarticulate, proximal joint short; the distal joint greatly produced, reaching almost to tip of last pair of pleopoda, comparatively robust, and gradually tapering to a needle-like point. Uropoda with outer ramus about twice the length of basal part, inner ramus being narrower and shorter. Colour in the living animal dark reddish brown marbled with white. Length of largest males and females about 3·5 mm.

Remarks.—So far as I have been able to ascertain this species has not hitherto been described, and I am indebted to the Rev. Thomas R. R. Stebbing, F.R.S., and Dr. Budde-Lund for their kind assistance in examining the literature on the subject which had not been available to myself. This species is at once distinguished from all the other British species of *Trichoniscus* by the form of the last segment of the metasome, which is broadly and evenly rounded at the tip, instead of being truncate as in the other species. The type of coloration resembles that of *T. pusillus*, Brandt, although the pigment itself appears to be somewhat darker. Two individuals from the second-named locality noted below were, however, uniformly coloured bright orange. The form of the *second* pair of pleopoda in the male bears a close resemblance to that found in *T. pygmæus*, G. O. Sars, the distal joint however being comparatively much more robust in the species under consideration. On the other hand, the *first* pair is not at all obtrusive when the animal is viewed from the side, being unlike *T. pygmæus* in this respect, where the first pair is greatly produced, and is most conspicuous when seen from the same point of view.

Occurrence.—I first met with this species in a field near Alexandra Park, Glasgow, where I obtained two individuals. It was in company with *T. pygmæus* * and *Trichoniscoides albidus* (Budde-Lund). Subsequently I found it in one of the propagating houses in the Botanic Gardens, Glasgow, where I obtained quite a number of specimens. Its movements are quick, and it runs with great agility when alarmed.

* I observe in the December number of the 'Annals and Magazine of Natural History' (vol. xviii. p. 474) a note by Mr. Richard S. Bagnall, F.E.S., on the occurrence of *T. pygmæus*, G. O. Sars, at Winlaton and Newcastle-on-Tyne. This species he regards as new to the British fauna. I may be permitted to observe, however, that I drew attention to the occurrence of this species within the Clyde faunal area in a paper read to the Glasgow Natural History Society on 26th June, 1906, and a report of this paper was published in the 'Glasgow Herald' on the 30th of June. I have found this species, as well as the under-noted which I have lately added to the Scottish records—the last-named being for the West of Scotland—to be widely distributed throughout the Clyde faunal area: *Trichoniscoides albidus* (B.-Lund), *Haplophthalmus danicus*, B.-Lund, *Porcellio dilatatus*, Brandt, *Armadillidium nasatum*, B.-Lund, and *Metoponorthus pruinosus* (Brandt).

EXPLANATION OF PLATE 7.

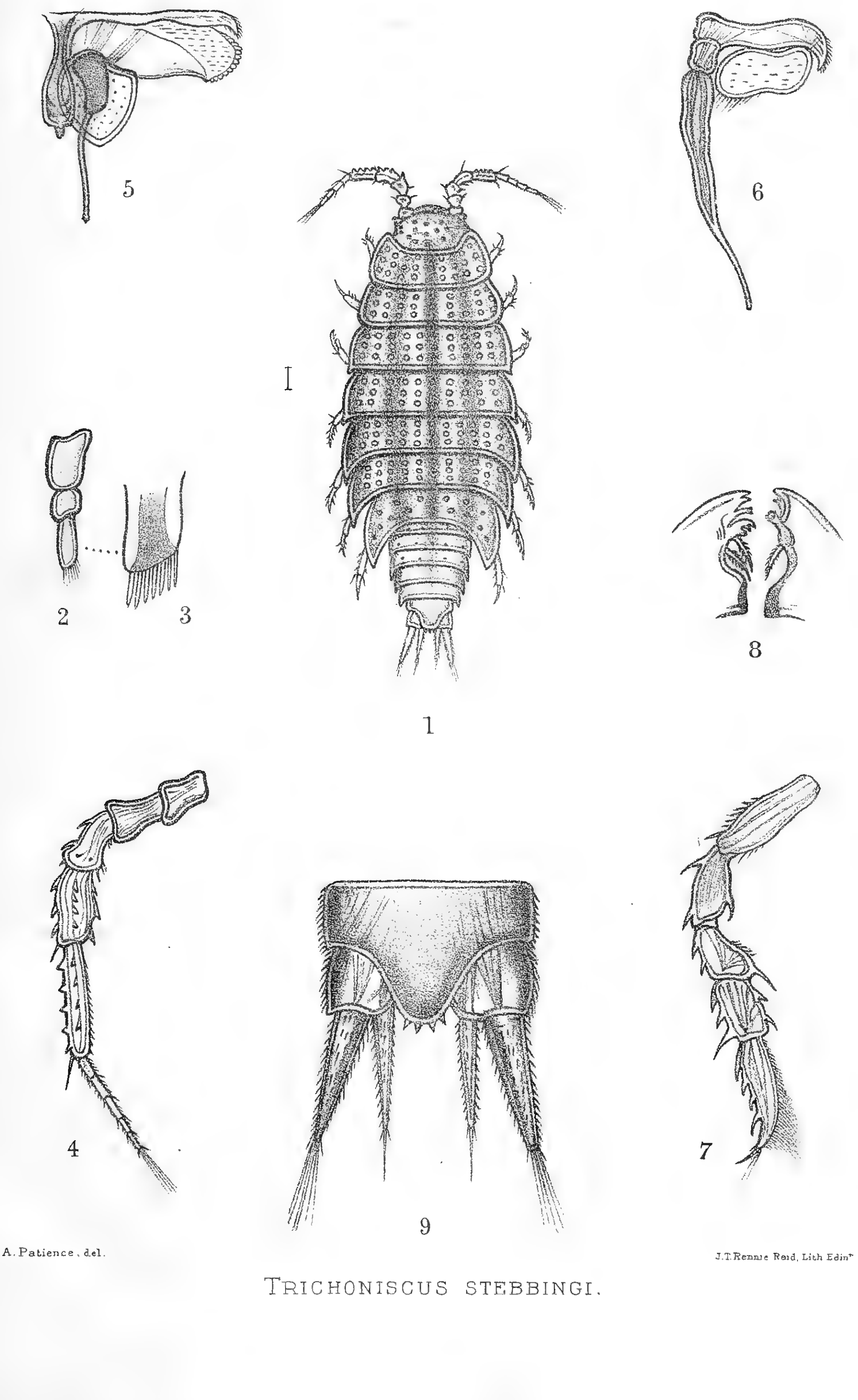
Fig. 1. Female of *Trichoniscus stebbingi.*
Figs. 2, 3. Antennula of male, with portion of last joint more highly magnified.
Fig. 4. Antenna of male.
Fig. 5. One of the first pair of pleopoda of male.
Fig. 6. One of the second pair of pleopoda of male.
Fig. 7. Seventh paræopod of male.
Fig. 8. Mandibles.
Fig. 9. Last segment of metasome with uropods.

Postscript.—Since the above was read before the Society, I have found this species occurring in widely separated parts of the Clyde faunal area, *e.g.*, in several other localities around Glasgow; at Hawkhead in Renfrewshire; at Ayr, and at Uddingston in Lanarkshire. In the last-named place, I found it in considerable numbers in the greenhouse of my friend, Mr. Peter Ewing, F.L.S., who informed me that he has observed the species there for the past twenty years, and suggests that it may have been introduced into his greenhouse along with the roots of *Sphagnum* taken from some of the Scottish hills.

Whilst engaged in investigating the distribution of *T. stebbingi*, I met with another species in a greenhouse in Springburn Park, Glasgow, which offers some points of resemblance to the above-named species, and which I have described in 'The Annals of Scottish Natural History' (April 1907, pp. 85–88, pl. 3) under the name of *Trichoniscus spinosus.* The dorsal face, instead of being tuberculate, is closely covered with small spines directed backwards; the flagellum of each antenna is composed of three articulations, and the last joint of the last pair of legs in both sexes has on the outer edge three or four short but fairly prominent spines. It resembles *T. stebbingi* "in the general form of the body, in the type of coloration, in the structure of the first pair of pleopoda of the male, and in the shape of the last segment of the metasome. The telson, however, in *T. spinosus* is more obtusely rounded at the tip than in the above-named species, and in this respect connects *T. stebbingi* with the other British species of *Trichoniscus*, where the tip of the last segment of the metasome is truncate. Again, the last joint of the inner ramus of the first pair of pleopoda of the male is slightly longer and comparatively more slender than in *T. stebbingi*, while the colour arrangement on the dorsal face presents a more definite pattern. The antennæ, legs, and uropoda, which in *T. spinosus* are coloured, are in *T. stebbingi* generally devoid of pigment."

A. Patience.

29th April, 1907.



A. Patience, del. J. T. Rennie Reid, Lith Edinr

TRICHONISCUS STEBBINGI.

Treasurer's Account for the Year ending April 30th, 1907.

(Presented at the Anniversary Meeting, May 24th, 1907.)

Receipts and Payments from May 1st, 1906, to April 30th, 1907.

Receipts.				£	s.	d.
Balance at Bankers on 1st May, 1906				361	3	4
Interest on Investments				212	19	9
Admission Fees				180	0	0
Annual Conttributions				1548	5	0
Compositions				—	—	—
Sales of Publications:—						
Transactions	£59	3	8			
Journals	69	14	1			
Proceedings and Catalogues	2	2	3			
				131	0	0
Miscellaneous Receipts				105	8	11
Sale of Consols				3855	1	5
" " Westwood Bequest				219	4	8
				£6613	3	1

Payments.				£	s.	d.
Taxes and Insurance				10	18	9
Repairs and Furniture				56	4	2
Coals and Gas				44	3	8
Salaries				798	11	8
Library:—						
Books	£222	9	10			
Binding	91	14	5			
				314	4	3
Expenses of Publications:—						
Printing	£391	18	4			
Illustrations	211	14	8			
Distribution	29	5	0			
				632	18	0
Miscellaneous Printing and Stationery				85	4	10
Petty Expenses (including Tea and Postage)				122	5	0
Re-investment of Cash realised by Sale of Consols				4074	6	1
Investment on April 20th, 1907				30	17	10
Balance at Bankers, 30th April, 1907				443	8	10
				£6613	3	1

Investments on April 30th, 1907.

	£	s.	d.		£	s.	d.
Metropolitan $3\frac{1}{2}$ per cent.	1079	11	3	@ 99	1068	15	3
Great Indian Peninsula Railway, Annuity Class B	42	1	5	@ $21\frac{1}{4}$	894	0	0
Forth Bridge Railway 4 per cent. Stock	450	0	0	@ 114	513	0	0
Metropolitan 3 per cent.	1000	0	0	@ 88	880	0	0
India 3 per cent	500	0	0	@ 89	445	0	0
Eastern Bengal Railway 4 per cent. Debenture Stock	1000	0	0	@ $116\frac{1}{2}$	1165	0	0
Great Western Railway 4 per cent. "	1000	0	0	@ 119	1190	0	0
Metropolitan Water Board 3 per cent. Stock "B" (Westwood Bequest)	232	5	0	@ 89	206	14	0
					£6362	9	3

HORACE W. MONCKTON, *Treasurer.*

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30th April, 1907, and found them correct.

ALFRED B. RENDLE,
HORACE T. BROWN,
HERBERT DRUCE

B. DAYDON JACKSON,
JOHN HOPKINSON,
Auditors.

W. B. KEEN, *Chartered Accountant.*

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2. All books shall be returned before the expiration of Six weeks from the time of their being taken out, but if not required by any other Fellow, they may, *on application,* be kept for a further period of Six weeks.

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OCTOBER 14. *Price* 12*s*.

THE JOURNAL

OF

THE LINNEAN SOCIETY.

VOL. XXX. **ZOOLOGY.** No. 196.

CONTENTS.

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A few Notes on South African Chamæleons, &c.

By G. B. LONGSTAFF, D.M., M.A., of New College, Oxford, and EDWARD B. POULTON, D.Sc., M.A., F.R.S., Hope Professor of Zoology in the University of Oxford, and Fellow of Jesus College, Oxford.

[Read 7th March, 1907.]

THE following observations were made during the visit of the British Association to South Africa in 1905. The conditions were not favourable to continuous investigation: nevertheless, I believe that some of these scattered notes are not without interest, especially those referring to the automatic adjustable countergrading of shadow on the two sides of the chamæleon. It is probable that the independent control of the colours of the two sides of the body has been often observed before, but, so far as I am aware, this is the first attempt to explain the significance of the power. The illuminating effect of a great hypothesis like that of Mr. Abbott H. Thayer's in the realm of protective coloration is well seen in the fact that Dr. Longstaff, Professor C. V. Boys, and the present writer independently grasped the meaning of the colour-change the moment it took place before their eyes. I do not know whether my two friends have studied Mr. Thayer's writings or examined his beautiful models at London, Oxford, or Cambridge *, but I have no doubt that it is the result of his work that interpretation was "in the air."

I have to thank Mr. G. A. Boulenger, F.R.S., for kindly naming the specimens upon which the following observations were made.—E. B. P.

1. *Note on* CHAMÆLEON DILEPIS, *Leach*, ♀. *By* Dr. G. B. LONGSTAFF.

The chamæleon was taken near the Waterworks, Bulawayo, Sept. 9th, 1905 (about 3–4 feet from the ground), on a shrub of *Dombeya* (? *rotundifolia*), the white flowers of which were attracting a number of insects of various orders. I was startled on detecting the animal, which at first escaped my notice.

Description.—Pale yellowish grey, legs and tail darker; streaked and blotched with greenish grey. Throat with six cadmium-yellow stripes. A yellow spot behind the shoulder, another over the ribs, and a yellow lateral line.

It gives vent to a gurgling hiss when disturbed, and once bit me, but not hard.

Kept alive and observed at Victoria Falls, Sept. 16th, 1905. Placed on a plant of young Acacia, the animal soon lost all its darker bands and became almost uniform grey-green, with the above yellow markings. In the

* [I was familiar with Mr. Thayer's models.—G. B. L., July 17, 1907.]

sun it became strongly mottled, with some tendency to be paler on the shady side, but this was not very marked. Excrement consisted of elytra and other insect-fragments.

When chloroformed, it became a uniform pale yellowish, a little paler than my khaki coat: that is to say, assumed its *palest* coloration.

2. *By* Professor E. B. Poulton.

A fine specimen of *Chamæleon dilepis* was found by Mr. A. D. Hall at a station on the railway, Sept. 11th, the day before reaching the Victoria Falls. The chamæleon was hiding in the deserted nest of a weaver-bird. Mr. Hall kindly gave the specimen to me. It lived in its nest on the train and on the steamer for two weeks without making any attempt to escape. During all this time the chamæleon remained of a straw-colour, which admirably matched the tint of the nest. When removed from the nest and placed on various surfaces its colours did not change. It refused all food, and was probably passing through a dry-season hibernation. In about a fortnight its colour became greenish, it drank, and on one occasion began to wander. Finally, on Sept. 29th, it took the first meal, devouring spiders and insects with the utmost avidity. Its chief food throughout the long voyage was the special cockroach of the 'Durham Castle,' *Phyllodromia germanica*, of which it must have eaten hundreds. Having once begun, the chamæleon maintained its appetite, until in the late autumn it was deposited in the Zoological Gardens, where it unfortunately died in the winter. The existence in the dry season of a fasting period, during which the colours are steadfast, was unknown to me and, if hereafter confirmed, would appear to be a fact of considerable interest in the life of this species of chamæleon.

3. *Note on* Chamæleon pumilus, *Daudin*, ♀. *By* Dr. G. B. Longstaff.

Taken on a shrub, about four feet from ground, in the Botanical Gardens, Cape Town, 9th August, 1905.

Description.—Apple-green; at the back of the eye two patches of greyish-pink placed vertically; a lateral stripe of the same colour extending from shoulder to pelvis, widest in middle, where are two dark grey spots. Several orange tubercles on the back. Belly striped with greenish white; underside of head striped blue-green and pink. The ground varies to dusky green.

Kept in confinement. Observations on same made at Durban, 16th Aug., 1905. After it had been kept for some time in the dark it became of the brightest apple-green. On exposure to light it darkened. Placed on a dark "uniform-case" near the window in bright light it darkened *along the dorsal area.*

Taken out into the garden and placed alternately on a black pair of trowsers and on a white towel. It darkened in both cases, but there was no noticeable difference. Then put on a twig of a shrub with bright green leaves it became paler. The side *away from the sun* was of the brightest apple-green, the outer side (towards the sun) was *darker along the back.* The bright green harmonized wonderfully with the young leaves, the creature appeared flat, and was scarcely distinguishable. The neck and belly did not appear to change colour.

It was then killed, being rapidly overcome by chloroform, then becoming more dusky than seen previously: that is to say, it assumed its *darkest* coloration. If the result in the first case was paralytic in its nature, it would appear in the second case to have been stimulant; or *vice versâ.*

4. *By* Professor E. B. Poulton.

Three specimens of *Chamæleon pumilus*, two large and one small, were kindly given to me by a keen naturalist friend, Miss Molly Jenkins, the daughter of my kind host, Rev. Canon Jenkins, D.D., Principal of the Diocesan College, Rondebosch. The small individual soon died, and one of the others did not live long. The third was a very healthy specimen, and upon it the following notes were made. The behaviour of *C. pumilus* afforded the strongest contrast to that of *C. dilepis*, for, with few exceptions, it accepted food whenever offered. The exceptions are of considerable interest. On one occasion it was offered the spinous reddish caterpillar of an *Acræa*, which it made heroic efforts to eat, but finally rejected. At another time a hard rough brown weevil (almost certainly *Spartecerus rudis*, Fåhr.) was seized and instantly abandoned. When it is remembered that both Acræas and weevils are mimicked by species belonging to other and very different groups, the behaviour of the chamæleon is seen to be highly significant. It would be deeply interesting to experiment further and attempt to ascertain whether the weevil was rejected because of the instant recognition of its excessive hardness *, or on account of some other special protection. *C. pumilus* devoured the cockroaches on the ship, but was not nearly so fond of them as its larger relative. Flies appeared to be its favourite food. This specimen was also deposited in the Zoological Gardens, where it lived for some weeks longer than *dilepis*. It died about New Year's Eve.

Good fortune gave me as companions in the same compartment of the train two physicist friends, Captain Creak, F.R.S., and Professor C. V. Boys, F.R.S. One day, when *C. pumilus* was resting on the compartment table, with the long axis of its body parallel to the window, Professor Boys, who was certainly intended for a naturalist, pointed out that the strongly illuminated side, next to the window, was dark green, while the side in deep shadow, away from the light, was of the brightest tint. The same relationship between the illuminated and the unilluminated side was seen on many occasions.

* See Trans. Ent. Soc. Lond. 1902, pp. 322–25.

This appears to be a most interesting adaptation—a dynamic manifestation of the principle discovered in its static form by Mr. Abbott H. Thayer. Mr. Thayer first suggested that the relative shades of the dark back, lighter sides, and white under sides of animals were such as just to counterbalance the diminution of natural illumination from an open sky as we pass from the back down the sides to the under surface; that the object of this countergrading was to neutralise the shadow which would otherwise render the animal conspicuous. *C. pumilus*, as I have said, manifests the same principle in a dynamic form. The side that happens to be turned away from the light is brightened sufficiently to neutralise the shadow; the high illumination of the other side is toned down by darkening, the effect being that all appearance of solidity is dissipated. This result must be of great importance to so large and so defenceless an animal as the chamæleon. But for this adjustable countergrading, the varying degrees of illumination on the side and dorsal slope turned towards the light, combined with the strong shadow on the other side, would cause it to stand out among the leaves as an object of conspicuous solidity and thickness.

5. *Note on the Vitality of the Tail of a South African Gecko*, PACHYDACTYLUS MACULATUS, *A. Smith*. *By* DR. G. B. LONGSTAFF.

The Gecko on which the following observations were made was found under a stone on Hlangwana Hill, Colenso, 24th August, 1905.

Sluggish; eyes large. Body dull pale brown, with a conspicuous row of dark brown spots on either side of the back, outlined with black and outside that with pale ashy; belly flesh-colour.

When chloroformed, the short stumpy tail was cast off (causing slight hæmorrhage), and took much longer to die than the body, wriggling with a spiral movement.

[The vitality and activity of the tails of lizards after they have been cast off are, I believe, an adaptation for the purpose of aiding in the escape from a pursuing enemy. The tail becomes for the moment a more lively and interesting object than the lizard itself, and is likely to distract the attention of an enemy. It is probable that the phenomena are not to be explained merely by the temporary maintenance of vitality in the tissues of an amputated part, but that the special activity manifested is due to accumulation through natural selection. See Proc. Bost. Soc. Nat. Hist. vol. xxvi. 1895, p. 388.—E. B. P.]

[The persistence of movements in the tail under the special conditions described above was doubtless mainly due, as suggested in the discussion by the President, Professor Herdman, to the fact that the amputated part had lost its connection with the respiratory and circulatory organs, by means of which the chloroform is conveyed to the tissues.—E. B. P., July 12, 1907.]

[Professor Herdman's explanation is doubtless the correct one, and tallies with the fact that active insects, such as Humble-bees, succumb much more rapidly to volatile poisons than more sluggish Beetles of the same size. At the time, however, I connected the greater activity of the tail with the absence of a brain.—G. B. L., July 17, 1907.]

On some New Species of *Cheliferidæ*, Hans., and *Garypidæ*, Hans., in the British Museum. By C. J. With, Copenhagen. (Communicated by the Rev. T. R. R. Stebbing, F.R.S., F.L.S.)

[Read 2nd May, 1907.]

(Plates 8–10.)

All the species described in this paper belong to the British Museum, and have been worked out at the request of the authorities of that institution. The treatise is subdivided into two parts and a supplement. In the first part eight, mostly new, species of *Chelifer*, Geoffroy, are described or mentioned; in the second part descriptions are given of several new and old species of the *Garypidæ*, Hansen (*cf.* below). The supplement deals with the remarkable forms of galea found in *Chiridium ferum*, Simon, and *Ideoroncus* ("*Roncus*") *Cambridgei*, L. Koch. In the following pages I often refer to other papers, previously published, dealing with the Chelonethi, as well as one ("An Account of the South-American *Cheliferinæ*, Simon") which I hope will be published in the 'Transactions' of the Zoological Society.

Part I.—Species of *Chelifer*.

A. *Species from Australasia.*

The Australian fauna of Chelonethi is, to judge from the number of species which have as yet been recorded, only poor, but I think that the number of species will be, at least, doubled when these vast regions have been properly explored. Of the described fourteen species of *Cheliferidæ*, Hansen, only two are recorded from other regions; but these statements are very doubtful (*cf.* **14.** p. 98); in this paper I am able to add four new species. Of these eighteen species, eleven at least have accessory teeth on fingers of palps like the *Ch. cimicoides*, F., group; about five belong to the *Ch. birmanicus*; Thorell, and at least one (two?) may be referred to the *Ch. cancroides*, L., group.

The following synoptic key of the four herein described species must be used in connection with that given in my earlier paper (**14.** pp. 95–97 and **15.** p. 328):—

a. Hairs distinctly clavate. Femur 3 times as long as wide, concave anteriorly. Chela 4·3 as long as wide .... 1. *Ch. vigil*, sp. n.

b. Hairs not distinctly clavate. Femur not more than 2·3 as long as wide, not concave anteriorly. Chela less than 3·4 as long as wide.

a'. Hairs short and obtuse. Hand at least 1·2 as long as tibia and 1·6 as long as movable finger, which is much longer than the immovable one .... 2. *Ch. Keyserlingi*, sp. n.

b'. Hairs fairly long and pointed. Hand less than 1·1 as long as tibia and less than 1·4 as long as fingers, which are of about equal length.
  a[2]. Abdomen distinctly granular laterally. Femur 2·1 and chela 3·3 as long as wide; tibia slightly convex and hand almost straight anteriorly .... 3. *Ch. taierensis,* sp. n.
  b[2]. Abdomen not granular laterally. Femur 2·3 and chela 3·1 as long as wide; tibia as well as hand distinctly convex anteriorly .... 4. *Ch. funafutensis,* sp. n.

1. Chelifer vigil, sp. n. (Plate **8**. figs. 1 & 2 ; text-fig., p. 51.)

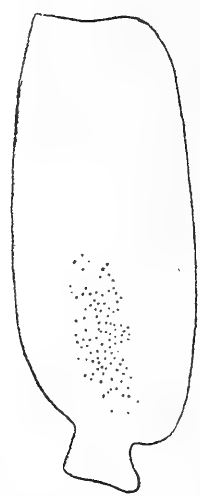
♂. Ocular spots wanting. Cephalothorax somewhat wider than long, with two rather indistinct transverse grooves and distinctly granular. The short, somewhat flattened abdomen with distinctly granular sclerites and with from fourteen to eighteen rather short and distinctly clavate hairs along the hindmost row of each tergite in addition to four in front of the row. Palps more or less distinctly granular, with short, slightly clavate hairs on the anterior surface of the femur. The trochanter has anterior outline distinctly convex and is posteriorly slightly but dorsally distinctly produced ; femur, which is about 3 times as long as wide, is widened out towards the extremity, anteriorly slightly concave and posteriorly almost straight ; tibia 2·8 as long as wide, anteriorly moderately convex and posteriorly slightly so. Chela, which is 4·3 as long as wide, is 1·3 narrower than the trochanter is long ; hand, which is about as long as and 1·2 wider than the tibia, is a little wider than deep and 1·3 as long as finger. Tibia of the first pair of legs 1·2 as long as the tarsus, which is 3·3 as long as deep ; femur IV. 2·7 as long as deep and 1·4 lower than the tarsus is long.

Cephalothorax.—No trace of eyes or *ocular* spots was observed. The cephalothorax, which is somewhat broader behind than it is long, has an anterior, fairly prominent transverse groove, which is slightly curved backwards in the middle, and a posterior very indistinct one. The integument is everywhere strongly granular, with short clavate hairs.

Abdomen.—The abdomen, which is only a little longer than wide and somewhat flattened, seems to have all the tergites with the exception of the eleventh longitudinally divided. The sclerites are distinctly granular and the tergites bear along their hindmost margin from fourteen to eighteen short and distinctly clavate hairs in addition to four in front of the row.

Antennæ.—The terminal hair extends in a slight degree beyond the rather short and clumsy *galea*, which in its distal half bears at least six short teeth. The *flagellum* consists of three hairs.

Palps (Pl. **8**. figs. 1 & 2).—The maxillæ are almost smooth in the middle but laterally slightly granular. The three proximal joints of the palps are more or less distinctly granular except beneath, most distinctly the dorsal protuberance of the trochanter, where the granules are pointed ; the hand is fairly distinctly granular anteriorly, elsewhere more or less smooth. The short hairs are proximally slightly clavate and curved, distally obtuse and dentated. The *trochanter*, which is 1·5 as long as wide, has the anterior outline distinctly convex beyond the stalk and then terminally a trifle concave ; posteriorly it is only slightly produced, but dorsally it is prolonged into a high, almost semicircular protuberance. The *femur*, which has a fairly long and well-defined stalk (beyond which it is widened out somewhat towards the end and then slightly narrower), is about 3·1 as long as wide ; the anterior outline is beyond a short and only slightly marked elevation slightly concave, most distinctly beyond the middle, while the posterior is rather abruptly convex basally, then straight in the middle, and terminally a little convex. The *tibia*, which has a fairly long but not very well-defined stalk, is distinctly shorter and a little wider than the femur, and is 2·8 as long as wide ; the anterior outline is first moderately convex and then a little concave, while the posterior is beyond the



Chelifer vigil, n. sp., ♂. Chela of left palp, in ventral view. × 77.

small condylus and almost obsolete basal elevation straight and then distally a little convex. The *chela*, which is 4·3 as long as wide, is 1·3 narrower than the trochanter is long ; the *hand*, which is about as long as and 1·2 as wide as the tibia, is 2·4 as long as wide, a trifle wider than deep, and 1·3 as long as the fingers, which are almost twice as long as the hand is deep, and which gape considerably when closed ; the lateral outlines of the hand as well as the dorsal and ventral ones are very slightly convex or even straight. The immovable finger has anteriorly five *accessory* teeth and posteriorly eight in the middle and beyond, while the movable finger has eight and nine. Anteriorly the immovable finger bears two *spots* behind the two basal tactile hairs and five in an irregular longitudinal row from the basal tactile hairs to somewhat behind the fourth hair, which is placed in the terminal third, while the movable has two just beyond the base. Posteriorly the immovable finger bears five "spots," and the movable four, arranged as shown in Pl. 8. fig. 2. At the base of the hand ventrally, occupying an area as broad as one-third of the hand and as long as one-fourth of its length, a large number (about 100) of the usual "spots" standing near to each other are observed (text-fig., p. 51).

Coxæ.—The second and the third pair are elongated and fairly distinctly widened out towards the extremity; the fourth pair are very elongated as well as of a somewhat trapezoidal shape, being scarcely enlarged towards the end, and have the hinder margin fairly well separated from the inner, which is scarcely half its length.

Legs.—The proximal joints are distinctly granular. The short hairs are dorsally curved and slightly clavate, while those of the ventral side are obtuse and dentated, only a few being simple. The tarsal *tactile* hairs as well as the long and slender ones of the trochanters and trochantins are wanting. The legs are short and clumsy, with the trochantin of the first pair of legs much deeper than the femur proper, while the tibia is 1·2 as long as the *tarsus,* which is 3·3 as long as deep; the *femur* of the fourth pair of legs is almost 2·7 as long as deep, 1·3 as long as the tibia, and 1·4 lower than the tarsus is long.

Colour.—The palps yellowish brown, while the cephalothorax and the abdomen are darker brown in this very contracted specimen.

Measurements.—Cephalothorax 0·920 (0·966); abdomen 1·380 (1·265) mm.

Palps: trochanter 0·460 (0·310); femur 0·897 (0·285); tibia 0·805 (0·290); hand 0·828 (0·345), depth 0·322; finger 0·647 mm.

Leg I.: femur 0·494 (0·190), trochantin 0·091 (0·198); tibia 0·350 (0·114); tarsus 0·281 (0·084) mm.

Leg IV.: femur 0·646 (0·243); tibia 0·494 (0·129); tarsus 0·350 (0·095) mm.

Variation.—Besides the described male I have examined a very poorly-preserved specimen, probably a female, which differed in the following structures, namely, the much more slender palps, with femur 3·5 as long as wide, &c. The most important difference, which is certainly one of sexual value, is that the area adorned with "spots" at the base of the hand is wanting; number of "spots" of the fingers, which only gape a little when closed, is, anteriorly, in the immovable finger very similar to that of the male, but the movable has five in a longitudinal row.

Material.—Of this species I have examined the two above-mentioned specimens as well as three pale very small ones, collected in Taieri, New Zealand.

Remarks.—This species may easily be distinguished from all other Australian forms by its exceedingly long and slender chelæ, which ventrally are adorned with a number of "spots" in the male.

2. CHELIFER KEYSERLINGI, sp. n. (Plate 8. figs. 3–5.)

♀. Ocular spots obsolete. Cephalothorax somewhat wider than long, without transverse grooves and distinctly granular. The depressed, not very slender abdomen has almost smooth sclerites and has sixteen short slightly clavate hairs along hindmost margin of the tergites in addition to four (?) in front. The palps more or less distinctly granular, with rather short, slightly clavate hairs on the anterior surface of femur. The trochanter has anterior outline strongly convex and is posteriorly somewhat bigibbose; femur, which is 2·2 as long as wide, is distinctly attenuated and posteriorly rather abruptly convex; the tibia, which is 2·1 as long as wide, is anteriorly moderately convex, and posteriorly beyond the deep basal incision at first almost straight and then slightly convex. Chela, which is 3·4 as long as wide, is 1·2 narrower than trochanter is long; hand, which is 1·2 as long as and 1·2 wider than tibia, is 1·2 wider than deep and 1·6 as long as the fingers, of which the movable is distinctly the longer. Tibia of the first pair of legs 1·2 as long as the tarsus, which is 3·4 as long as deep; femur IV. is 2·4 as long as deep and a trifle lower than the tarsus is long.

Cephalothorax.—*Ocular* spots obsolete or even wanting. The cephalothorax, which is somewhat wider behind than it is long and distinctly narrowing towards the front, shows no trace of transverse stripes. The integument is distinctly granular all over and has short, slightly clavate hairs.

Abdomen.—The depressed, not very slender abdomen has all the tergites except the last one indistinctly divided and almost smooth sclerites, but is laterally striated and even indistinctly granular; along hindmost margin of the tergites at least sixteen rather short and slightly clavate hairs are found, in addition to four (?) in front.

Antennæ.—The rather short slender *galea*, which extends a trifle beyond the terminal hair, has about six short terminal teeth. The *flagellum* consists of three hairs, of which the anterior is marginally serrated.

Palps (Pl. 8. figs. 3–5).—The *maxillæ* are smooth in the middle but granular laterally. The palps are distinctly granular in front, less distinctly so behind, and dorsally, but especially ventrally, indistinctly granular or almost smooth. The short hairs are slightly clavate or obtuse. The *trochanter*, which is 1·5 as long as wide, is anteriorly strongly convex and posteriorly produced into a low rounded protuberance; the dorsal protuberance is deep and rounded, almost semicircular, when seen from in front; the whole posterior surface of the femur appears somewhat bigibbose. The *femur*, which has a short well-defined stalk (beyond which it is distinctly attenuated towards the end), is 2·2 as long as wide ; the anterior outline is slightly convex proximally and terminally a trifle concave, while the posterior is rather abruptly convex beyond the stalk and then almost straight. The *tibia*, which has a short and very well-defined stalk, is shorter but somewhat wider than the femur, and is 2·1 as long as wide; anteriorly it is moderately convex proximally and a trifle concave terminally, while the posterior outline is, beyond the large and prominent condylus and rather insignificant basal elevation (separated from each other by a deep incision), almost straight and then slightly convex. The *chela*, which is 3·4 as long as wide, is almost 1·2 narrower than the trochanter is long. The *hand*, which is 1·2 as long as well as wide as the tibia, is almost 2·2 as long as wide, distinctly 1·2 wider than deep and 1·6 as long as the movable finger, which is distinctly longer than the immovable and 1·3 as long as hand is wide, but 1·6 as long as hand is deep ; the hand is very suddenly enlarged beyond the stalk, as the outlines, especially the posterior, are almost perpendicular upon it, and then almost straight. The margins of the fingers are peculiarly shaped ; the immovable finger has the ventral margin concave basally, convex in the middle, and then a little concave again (*cf.* figs. 4 & 5), while the movable is convex basally and then concave towards the terminal fourth, where the fingers touch each other when closed ; as the convexities and the concavities of the two fingers are not equally well marked and do not fit completely into each other, the fingers gape slightly in basal third and fairly distinctly beyond the middle, as seen in the figures ; besides which the movable finger, just where the margin is convex posteriorly, has a swelling, corresponding to an anterior bend, while the immovable has a swelling anteriorly and a bend posteriorly, where the margin is convex but less marked. The fingers cross each other in a slight degree, so that the margin of the immovable finger is terminally covered by the movable, when seen from behind. The fingers bear anteriorly towards the end about three *accessory* teeth, while the immovable finger has posteriorly twelve and the movable eight. The number of *spots* is anteriorly five and three on the immovable and movable fingers respectively, while both fingers bear three posteriorly, arranged as shown in figs. 4 & 5.

Coxæ.—The second and third pairs are very elongated and distinctly widened out towards the extremity, especially the former, which rather suddenly narrows towards the base and has inner margin much shorter than that of the third pair. The fourth pair are almost trapezoidal, not at all widened out towards the end, and have the inner and hinder margins, of which the former is somewhat longer, gradually merging into each other.

Legs.—The proximal joints are slightly granular. The hairs are dorsally short and slightly clavate, and ventrally longer and more simple ; a tarsal "*tactile*" hair seems to be present about in the middle. The legs are rather short and clumsy ; the trochantin of the first pair is distinctly deeper than the femur proper, and the tibia is 1·2 as long as the *tarsus*, which is 3·4 as long as deep ; the *femur* of the fourth pair is 2·4 as long as deep, 1·3 as long as the tibia, and only a trifle lower than the tarsus is long.

Colour.—The palps are light reddish brown ; the cephalothorax and tergal sclerites are pale brown.

Measurements.—Cephalothorax 1·380 (1·495); abdomen 3·8 (2·3) mm.

Palps : trochanter 0·736 (0·506); femur 1·196 (0·535); tibia 1·150 (0·552); hand 1·380 (0·647), depth 0·529 ; finger 0·828 mm.

Leg I. : femur 0·768 (0·243), trochantin 0·106 (0·258); tibia 0·475 (0·160); tarsus 0·384 (0·144) mm.

Leg IV. : femur 1·064 (0·456); tibia 0·836 (0·236); tarsus 0·479 (0·152) mm.

Material.—A single specimen (♀) from Rockhampton examined.

Remarks.—This species is nearly related to *Ch. brevispinosus*, Keyserling (*cf.* **4.** pp. 46–47, & **14.** p. 110), but seems to differ by the long and slender chela, which is much wider than deep, and with the hand very much longer than the finger. This species is best characterized by the peculiar structure of the fingers.

3. CHELIFER TAIERENSIS, sp. n. (Plate **8.** figs. 6–8.)

♀. Ocular spots indistinct. Cephalothorax wider than long, with two rather indistinct transverse stripes and fairly distinctly granular. The fairly long and slender abdomen with sclerites indistinctly shagreened but with the sides distinctly granular, and with twelve rather short slightly clavate hairs along the hindmost margin of the tergite in addition to four in front of the row. The palps partly granular anteriorly and with very long, pointed hairs on the anterior surface of the femur. The trochanter has anterior outline moderately convex and is posteriorly slightly bigibbose; femur, which is 2·1 as long as wide, is only slightly widened out towards the extremity, and posteriorly beyond the stalk abruptly convex and then almost straight ; tibia, which is 2·2 as long as wide, is anteriorly as well as posteriorly towards the end somewhat convex. Chela, which is 3·3 as long as wide, is scarcely as broad as the trochanter is long ; hand, which is almost as long as but 1·2 wider than tibia, is a little wider than deep and 1·3 as long as fingers. Tibia of the first pair of legs 1·2 as long as the tarsus, which is 4·4 as long as deep ; femur IV. 2·2 as long as deep and 1·4 lower than the tarsus is long.

Cephalothorax.—Ocular spots almost obsolete. The cephalothorax, which is somewhat longer than wide, has two broad, not very prominent, transverse *stripes*. The integument is fairly distinctly granular, with short slightly clavate hairs.

Abdomen.—The fairly long and slender abdomen, which has all the tergites with the exception of the eleventh longitudinally divided, has its sclerites indistinctly shagreened, but the interstitial membranes, but especially the sides of the abdomen, distinctly *granular* with pointed granules ; the tergites have about twelve slightly clavate hairs along the hindmost margin in addition to four in front of the row. On the last segments no "tactile" hairs observed in not well-preserved specimen.

Antennæ.—The slender *galea*, which possesses about five terminal teeth, extends distinctly beyond the terminal hair. The *flagellum* consists of three hairs, of which the anterior is marginally serrated.

Palps (Pl. 8. figs. 6–8).—The *maxillæ* are smooth in the middle at least, while the palps are granular on the trochanter posteriorly, and less distinctly on anterior surfaces of the three following joints. The long or very long hairs are pointed, broken or straight, with a single or a few teeth. The *trochanter*, which is 1·6 as long as wide, is anteriorly moderately convex, and posteriorly fairly distinctly produced ; dorsally it is prolonged into a rather deep, somewhat conical protuberance, so that the whole joint appears slightly bigibbose. The *femur*, which has a short well-defined stalk (beyond which the joint is only in a slight degree attenuated), is 2·1 as long as wide ; the anterior outline is moderately convex and then concave, while the posterior is beyond the stalk abruptly convex, then in the middle straight and towards the end slightly convex. The *tibia*, which has a fairly long and well-defined stalk, is somewhat longer and wider than the femur, and 2·2 as long as wide ; anteriorly it is first slightly convex and then terminally a little concave, while the posterior outline is almost straight beyond the condylus and fairly well-marked basal elevation and then terminally moderately convex. The *chela*, which is 3·3 as long as wide, is scarcely as broad as the trochanter is long ; the *hand*, which is about as long as the tibia and 1·2 as wide, is 1·9 as long as wide, a little wider than deep, and 1·3 as long as the fingers, which are much longer than the hand is deep, and scarcely gape when closed ; the posterior and the dorsal margins of the hand are slightly convex, and the anterior and ventral areas are almost straight. Anteriorly no *accessory* teeth were observed, but posteriorly the immovable has four and the movable six. The number of "*spots*" is very insignificant, viz. four anteriorly as well as posteriorly on the immovable finger, and none on the movable (figs. 7 & 8).

Coxæ.—The second and the third pair are somewhat triangularly formed, as the interior margin is only short ; the fourth pair are somewhat widened out towards the extremity, distinctly longer than wide, with inner margin much shorter than hinder and fairly well distinguished from it.

Legs.—The proximal joints are almost smooth. The hairs are dorsally fairly long and pointed, with a single or a few teeth, but ventrally more or less simple. The tarsal "*tactile*" hair is two-fifths removed from the base.

The fairly long and slender legs have the trochantin of the first pair much deeper than the femur proper, while the tibia is 1·2 as long as the *tarsus*, which is 4·4 as long as deep; the *femur* of the fourth pair of legs is 2·2 as long as deep, 1·1 as long as the tibia, and 1·4 lower than the tarsus is deep.

Colour.—The palps are reddish brown, while the cephalothorax and abdominal sclerites are pale brown.

Measurements.—Cephalothorax 0·920 (0·805); abdomen 2·530 (1·219) mm.

Palps: trochanter 0·506 (0·310); femur 0·805 (0·375); tibia 0·897 (0·405); hand 0·874 (0·475), depth 0·437; finger 0·667 mm.

Leg I.: femur 0·578 (0·190), trochantin 0·152 (0·215); tibia 0·441 (0·114); tarsus 0·365 (0·084) mm.

Leg IV.: femur 0·699 (0·319); tibia 0·646 (0·182); tarsus 0·441 (0·114) mm.

Material.—Of this species I have examined a single not well-preserved female from Taieri (New Zealand).

Remarks.—This species is easily distinguished from all other Australasian species by the prominent granulation of the sides of the abdomen, by the clumsy femur and slender chela of the palps, and by their long almost simple hairs.

4. Chelifer funafutensis, sp. n. (Plate 8. figs. 9–12.)

Ocular spots indistinct. Cephalothorax distinctly longer than wide, with anterior stripe fairly indistinct and granular. The fairly long and slender abdomen with small sclerites, and with from 12–14 fairly long and pointed hairs along the hindmost margin of each tergite in addition to four in front of row. Palps almost smooth, with fairly long pointed hairs on the anterior surface of the femur. Trochanter has anterior outline slightly convex and is posteriorly slightly, but dorsally fairly distinctly produced; femur, which is 2·3 as long as broad, is somewhat attenuated, and posteriorly beyond the stalk not very abruptly convex; tibia, which is 2·2 as long as wide, is anteriorly moderately convex, and posteriorly first a trifle concave and then slightly convex. Chela, which is 3·1 as long as wide, is 1·1 as broad as the trochanter is long; the hand, which is about 1·1 as long as but 1·3 wider than the tibia, is almost 1·1 as wide as deep and 1·2 as long as fingers. Tibia of the first pair of legs 1·2 as long as the tarsus, which is 3·6 as long as deep; femur IV. 2·3 as long as deep and 1·3 lower than tarsus is long.

Cephalothorax.—*Ocular* spots are very indistinct. The cephalothorax, which is distinctly longer than wide, has two transverse *stripes*, of which the posterior is almost obsolete, while the anterior is broad, fairly prominent, and slightly curved forwards in the middle. The integument appears smooth in the middle but has laterally minute granules; the hairs are moderately long, slightly obtuse, and with a few terminal teeth.

Abdomen.—The fairly long and slender abdomen, which has probably all the tergites with the exception of the first and the eleventh longitudinally divided, has the sclerites of the abdomen smooth and the dorso-ventral membrane between the sternites and tergites striated longitudinally; the tergites bear along their hindmost margin from 12–14 fairly long or long, almost pointed or simple *hairs.* The eleventh tergite possesses at least a single pair of "tactile" hairs, while the corresponding sternite has two.

Antennæ.—The rather short and slender *galea,* which extends somewhat beyond the terminal hair, has in distal third about six rather short branches, decreasing in length towards the tip. The *flagellum* consists of three hairs, of which the anterior has a few marginal branches.

Palps (Pl. 8. figs. 9–12).—The *maxillæ* are completely smooth and so are the palps, with the exception of the minutely and indistinctly granular anterior surfaces of the femur and tibia. The fairly long hairs are stiff, pointed, and almost simple (a few may be obtuse). The *trochanter*, which is about 1·5 as long as wide, is anteriorly slightly convex and posteriorly a trifle produced ; dorsally it is prolonged into a rounded, somewhat conical, not very deep protuberance. The *femur*, which has a rather short and fairly well-defined stalk (beyond which it is somewhat attenuated towards the end), is about 2·3 as long as wide ; the anterior outline is slightly convex and then a trifle concave, while the posterior is beyond the stalk not very abruptly convex and then very slightly so. The *tibia*, which has a fairly long and not very well-defined stalk, is longer and wider than the femur, and is about 2·2 as long as wide ; anteriorly it is beyond the stalk moderately convex and then terminally slightly concave, while posteriorly it is beyond the rather low condylus and elongated not very well-marked basal elevation first a trifle concave and then slightly convex. The *chela,* which is about 3·1 as long as wide, is 1·1 as broad as the trochanter is long ; the *hand*, which is somewhat longer than the tibia and distinctly 1·3 wider, is 1·7 as long as the fingers, which are 1·4 as long as the hand is wide, and which gape a trifle when closed ; the lateral as well as the dorsal outlines of the hand are slightly convex, while the ventral is almost straight. The fingers bear apparently no *accessory* teeth anteriorly, but posteriorly about five each distally ; anteriorly nine and three (rather large) "*spots*" are observed on the immovable and movable finger respectively, and posteriorly only two basal ones on the immovable finger (*cf.* figs. 11 & 12).

Coxæ.—The second and third pairs are enlarged towards the extremity, most distinctly the latter, while the fourth pair are trapezoidal with the inner margin about as long as the hinder.

Legs.—The proximal joints are smooth. The fairly long or long hairs are dorsally pointed and stiff, with a few terminal teeth, those of the ventral side are more slender and almost or completely simple ; dorsally, in the middle of the tibia of the fourth pair, a distinctly longer, but not simple, hair is found; the tarsal "tactile" hair is distinctly one-third removed from the base and about as long as the tarsus. The legs are rather short and clumsy; the femur of the first pair of legs is scarcely deeper than the trochantin, and the tibia is almost 1·2 as long as the *tarsus*, which is 3·6 as long as deep; the *femur* of the fourth pair of legs is 2·3 as long as deep, 1·3 as long as the tibia, and 1·3 lower than the tarsus is long.

Colour.—The palps and the cephalothorax are yellowish brown.

Measurements.—Cephalothorax 0·782 (0·621); abdomen 2·185 (1·035) mm.

Palps: trochanter 0·386 (0·235); femur 0·621 (0·265); tibia 0·647 (0·299); hand 0·690 (0·400), depth 0·368; finger 0·575 mm.

Leg I.: femur 0·426 (0·160), trochantin 0·076 (0·160); tibia 0·327 0·114); tarsus 0·274 (0·076) mm.

Leg IV.: femur 0·555 (0·247); tibia 0·433 (0·140); tarsus 0·327 (0·091) mm.

Material.—A single mutilated female was obtained by Professor W. J. Sollas in Funafuti, and originally mounted with *Garypinus oceanicus*, sp. n.

Remarks.—This species seems to be nearly related to *Ch. pygmæus*, Keys., but differs by larger size, by the chela, which is as long as the two preceding joints together, not 1·4 shorter, by the shorter fingers (*cf.* Keyserling, **4.** pp. 49–50), and by the tibia of the first pair of legs, which is distinctly longer than the tarsus (*cf.* With, **14.** p. 110). From *Ch. taierensis*, sp. n., it differs distinctly by smaller size, by the dorso-ventral membranes of the abdomen, which is not distinctly granular, and by the different shape of the palps, *e. g.* more convex inner outline of tibia.

B. *Species from Asia.*

So far as the *Cheliferidæ*, Hansen, are concerned I refer to my paper on Indian Chelonethi (**18**): in the following pages three species, included in the collections of the British Museum, will be mentioned or described; they belong to the *Ch. birmanicus*, Thorell, group.

5. Chelifer javanus, *Thorell.* (Plate **8.** figs. 13 & 14.)

1883. Thorell, (**3**) pp. 37–40, tav. 5. figs. 20–22.
1906. With, (**18**) pp. 184–185.

Indistinct ocular spots. Cephalothorax smooth, without transverse stripes. The moderately long and slender abdomen with six fairly long pointed hairs in front of row. The palps distinctly granular anteriorly, with fairly long pointed hairs. Trochanter scarcely bigibbose in female, slightly so in male; femur, which is 2·2 as long as wide, is somewhat attenuated and posteriorly beyond stalk rather abruptly convex; tibia, which has a rather short and well-marked stalk, and is about twice as long as wide, is anteriorly moderately convex and posteriorly beyond low but well-marked basal elevation is first almost straight and then convex. Chela 2·7 (♀) or 2·6 (♂) as long as wide; hand, which is 1·4 (♀) or 1·2 (♂) as wide as tibia, is about 1·1 deeper than wide, and 1·4 (♀) or 1·3 (♂) as long as finger, which is about 1·1 longer than hand is deep. Tibia of the first pair of legs 1·1 as long as the tarsus, which is 4·8 (♀) or 4·4 (♂) as long as deep; femur IV. 2·7 (♀) or 2·4 (♂) as long as deep, and about 1·6 lower than the tarsus is long.

♀.

Cephalothorax.—Ocular spots very indistinct. Cephalothorax, which is somewhat longer than broad behind, has no transverse *stripes*, is smooth and provided with moderately long, almost simple hairs.

Abdomen.—The fairly long and slender abdomen has the tegites, with the exception of the first three and the last one, more or less indistinctly divided longitudinally. The sclerites are smooth, and the median tegites bear along their hindmost margin from 10–12, stiff, pointed, and almost simple fairly long hairs in addition to generally six longer hairs in front of row; the tenth tegite possesses a single "tactile" hair, and the eleventh two pairs; the corresponding sternites bear both two pairs of tactile hairs.

Antennæ.—The fairly long and slender *galea*, which extends distinctly beyond the terminal hair, seems to bear about six distal branches. The *flagellum* consists of four hairs, of which the anterior has only a few teeth.

Palps (Pl. 8. figs. 13 & 14).—The *maxillæ* are smooth. The palps are anteriorly granular, most distinctly so the hand, but elsewhere are more or less smooth. The fairly long and stiff *hairs* are almost simple and pointed; at least the following long, slender, and completely simple hairs are found:—on the femur a single posteriorly in the middle and two terminal, on the tibia one above and one below the basal elevation, and on the hand basally a dorsal, a ventral, and a posterior one, as well as a ventral one beyond the middle. The *trochanter*, which is about 1·5 as long as wide, is anteriorly very slightly convex, and posteriorly produced into a rounded low process; dorsally it is produced into a similar low process, but cannot, in a proper sense, be designated bigibbose. The *femur*, which has a short and well-defined stalk (beyond which it is somewhat attenuated towards the end), is about 2·2 as long as wide; the anterior outline is slightly convex and then concave, while the posterior is just beyond the stalk rather abruptly convex and then almost straight. The *tibia*, which has a moderately long and well-defined stalk, is somewhat longer and wider than the femur and is 2·1 as long as wide; anteriorly it is moderately convex and then concave, and posteriorly beyond the not very prominent condylus and low, but well-marked basal elevation, first almost straight and then moderately convex. The *chela*, which is about 2·7 as long as wide, is almost 1·2 as broad as the trochanter is long ; the *hand*, which is somewhat longer than, but 1·4 as broad as, the tibia, is 1·6 as long as wide, but 1·5 as long as deep, almost 1·1 deeper than wide, and 1·4 as long as the finger, which is scarcely 1·1 as long as the hand is deep ; the outlines of the hand are straight or slightly convex. Anteriorly, the immovable finger has about seven *spots* in a longitudinal row, three being placed behind the basal "tactile" hairs, and the movable five basally ; posteriorly the immovable finger has two "spots" and the movable three, arranged as shown in fig. 14.

Coxæ.—The coxæ are very similar to those figured of *Ch. nidificator*, Balz. (*cf.* **19.** fig. 36 *c*), the second and the third pair being short and distinctly widened out towards the end, and the fourth pair being trapezoidal and not at all widened out, with the inner margin longer than the somewhat concave hinder.

Legs.—Pointed, stiff, moderately long, and not completely simple hairs present, in addition to a long completely simple hair, placed dorsally at the tip of femur IV. ; tarsal "tactile" hair basal and much shorter than the tarsus. The legs are moderately long and slender ; the articulate cavity of the trochantin of the first pair of legs is very wide ; the tibia of the first pair of legs is 1·1 as long as the *tarsus*, which is 4·8 as long as deep. The *femur* of the fourth pair of legs is 2·7 as long as deep, 1·1 as long as the tibia, and 1·7 lower than tarsus is long.

Colour.—The palps are reddish brown with the hand darkest. The cephalothorax and tergal sclerites pale brown.

Measurements.—Cephalothorax 0·920 (0·851) ; abdomen 4·0 (1·6) mm.

Palps : trochanter 0·483 (0·310) ; femur 0·828 (0·375) ; tibia 0·865 (0·414) ; hand 0·897 (0·565), depth 0·610 ; finger 0·647 mm.

Leg I. : femur 0·608 (0·190), trochantin 0·137 (0·213) ; tibia 0·486 (0·140) ; tarsus 0·441 (0·091) mm.

Leg IV. : femur 0·798 (0·296) ; tibia 0·684 (0·185) ; tarsus 0·494 (0·114) mm.

♂.

Antennæ.—The terminal hair extends distinctly beyond the *galea*, which has three almost obsolete distal teeth.

Palps.—The granulation is much better marked than in the female, being very distinctly marked anteriorly, less distinctly posteriorly, and very slightly dorsally. The *trochanter* appears slightly bigibbose, as the dorsal protuberance is deeper and somewhat conical. The *tibia* is scarcely twice as long as wide, and its posterior outline is beyond the basal elevation first a trifle concave and then distinctly convex, the convexity being much better marked than the anterior one, as well the corresponding one in the female. The *chela* is 2·6 as long as wide ; the *hand*, which is scarcely as long as the tibia and 1·2 as wide, is only 1·5 longer than wide, 1·4 longer than deep, and 1·3 as long as the finger. The immovable finger has anteriorly about five "spots," less regularly placed, and posteriorly four, while those of the movable fingers are scarcely different.

Coxæ.—The fourth pair are of a somewhat triangular appearance, as they are somewhat widened out, and as the inner and hinder margins merge gradually into each other, the prominent obtuse angle of the female being scarcely marked.

Legs.—The *tarsus* of the first pair of legs is only 4·4 as long as deep ; the *femur* of the fourth pair of legs 2·4 as long as deep, scarcely 1·1 as long as tibia, and 1·6 lower than tarsus is long.

Colour.—The colour is somewhat darker and the chela is sometimes metallic.

Measurements.—Cephalothorax 0·874 (0·782) ; abdomen 3·0 (1·1) mm.

Palps : trochanter 0·460 (0·299) ; femur 0·805 (0·368) ; tibia 0·865 (0·437) ; hand 0·828 (0·540), depth 0·575 ; finger 0·621 mm.

Leg I. : femur 0·578 (0·182), trochantin 0·137 (0·213) ; tibia 0·464 (0·144) ; tarsus 0·410 (0·093) mm.

Leg IV. : femur 0·737 (0·307) ; tibia 0·684 (0·182); tarsus 0·486 (0·110) mm.

Material.—Of this species I have examined 13 females and 13 males, of which one showed abnormal segmentation (*cf.* With, **14.** p. 137, pl. viii. fig. 1 *a*), collected in Tharrawaddi, Burma, by Mr. Oates, and mounted with 18 females of *Ch. plebejus*, With (*cf.* **18.** p. 187). It has previously been recorded from Java (*cf.* **18.** p. 185).

Remarks.—It is with hesitation I refer the described form to *Ch. javanus*, Thorell, but I do so because the differences may be explained by variation between different specimens and a few trifling mistakes in Thorell's original description ; the most important differences are the palps, which are "subtilissime impresso-punctati," not distinctly granular, and the apparently long tibial stalk of *Ch. javanus*, Thorell. The females of this species are easily distinguished from those of *Ch. plebejus*, With, by the granular, more slender palps, which have the hand not distinctly wider than deep, but deeper than wide, as well as by the much longer and slenderer legs. As I have not had the opportunity of examining any male of *Ch. plebejus*, With, thoroughly, I cannot with certainty point out the differences, but they are undoubtedly very like those which distinguish the females from each other.

6. Chelifer navigator, *With.* (Plate **8.** figs. 15 & 16.)

1906. With, (**18**) pp. 191–193, fig. 22, p. 192, pl. 4. fig. 9 *a*.

To this species I have referred a number of specimens collected by Mr. Oates in Burma, viz., five males in Lower Pegu, and three males and a very imperfect female (?) in Tharrawaddi, in spite of the minutely but distinctly granular anterior surface of the palps. The different specimens show variations in the depth of the trochanteral tubercles as well as in the length and slenderness of the tibial stalks, which have the basal elevation more or less pronounced (*cf.* figs. 15 & 16). To *Ch. elongatus*, Ellingsen, it shows a remarkable similarity, but as minor differences are nevertheless observed in the shape of body and palps, and as the localities are so apart, I think that the two species must be maintained (*cf.* **19**).

7. CHELIFER POCOCKI, sp. n. (Plate **8.** figs. 17–19.)

1900. *Chelifer javanus*, Thorell; Pocock, (**12**) p. 156.

♀. Indistinct ocular spots. Cephalothorax smooth, without transverse stripes. The long and slender abdomen with six fairly long and pointed hairs in front of row. The palps slightly granular anteriorly, with fairly long pointed hairs. Trochanter bigibbose, with dorsal tubercle fairly deep and somewhat conical; femur, which is 2·2 as long as wide, is attenuated towards the end and posteriorly beyond stalk abruptly convex; tibia, which has a moderately long and well-marked stalk, and is scarcely twice as long as wide, is anteriorly distinctly convex and posteriorly beyond well-marked basal elevation is first a trifle concave and then distinctly convex. Chela 2·8 as long as wide; hand, which is 1·2 as wide as the tibia, is 1·1 deeper than wide and 1·5 as long as the fingers, which are about as long as hand is deep. Tibia of the first pair of legs 1·3 as long as the tarsus, which is 4 as long as deep; femur IV. 2·3 as long as deep, and 1·3 lower than the tarsus is deep.

Cephalothorax.—The *ocular* spots are indistinct. The cephalothorax, which is distinctly longer than wide, shows no trace of transverse *stripes*, is smooth and provided with moderately long, almost simple hairs.

Abdomen.—The very long and slender abdomen, which has the fourth to the tenth tergites longitudinally divided and trace of division in the first three, has smooth tergal sclerites. The tergites have from 10–14 fairly long and pointed hairs along the hindmost margin, in addition to six in front in the median segments; the "tactile" hairs were missing in the specimen examined.

Antennæ.—The *galea* is broken, but extends distinctly beyond the terminal hair. The *flagellum* consists of four hairs, of which the anterior has long marginal teeth.

Palps (Pl. **8.** figs. 17–19).—The *maxillæ* are smooth. The palps are almost smooth except anteriorly, where they are minutely granular. The fairly long and stiff hairs are pointed and almost simple; the number and arrangement of the long, slender, and completely simple hairs are probably as in *Ch. javanus*, Thorell (*cf.* p. 60). The *trochanter*, which is about 1·5 as long as wide, is only slightly convex anteriorly, but posteriorly produced into a rounded, rather short protuberance; dorsally it is prolonged into a fairly deep, somewhat conical and rounded tubercle, so that the posterior surface becomes fairly distinctly bigibbose; the trochanter is somewhat deeper than wide, but not so deep as the femur. The *femur*, which has a short, fairly well-defined stalk (beyond which it is distinctly attenuated), is 2·2 as long as wide; the anterior outline is slightly convex and then concave, while the posterior is abruptly convex and then straight. The *tibia*, which has a moderately long and well-marked stalk, is somewhat longer but distinctly wider than the femur and is scarcely twice as long as broad; anteriorly it is distinctly convex and posteriorly beyond well-marked basal elevation is first a trifle concave and then distinctly convex. The *chela*, which is almost 2·8 as long as wide, is about 1·1 as broad as the trochanter is long; the *hand*, which is somewhat longer and 1·2 as wide as the tibia, is 1·7 as long as wide, 1·5 as long as deep, almost 1·1 deeper than wide, and about 1·5 as long as the finger, which is about as long as hand is deep; the outlines of the hand are straight or slightly convex. Anteriorly the immovable finger has eight "spots," arranged as shown in fig. 19; posteriorly both fingers seem to bear a few spots.

Coxæ.—The fourth pair, which have the inner margin much longer than the hinder, appear triangular, as the angle between the two margins is very obtuse.

Legs.—Rather short and stiff, with pointed and almost simple hairs; femur has dorsally a terminal slender, completely simple hair on the fourth pair; the dorsal "tactile" hair is about as long as the tarsus and basal. The legs are rather short and clumsy; the trochantin of the first pair has a very wide articular cavity. The tibia of the first pair is 1·3 as long as the *tarsus*, which is almost 4 as long as deep; the *femur* of the fourth pair of legs is 2·3 as long as deep, 1·2 as long as the tibia, and 1·3 lower than tarsus is long.

Colour.—Palps dark reddish brown, while the cephalothorax and tergal sclerites are pale brown.

Measurements.—Cephalothorax 0·759 (0·647); abdomen 3·11 (1·27) mm.

Palps: trochanter 0·355 (0·230); femur 0·621 (0·280); tibia 0·647 (0·335); hand 0·713 (0·414), depth 0·450); finger 0·460 mm.

Leg I.: femur 0·433 (0·155), trochantin 0·083 (0·175); tibia 0·357 (0·106); tarsus 0·274 (0·071) mm.

Leg IV.: femur 0·608 (0·270); tibia 0·509 (0·154); tarsus 0·342 (0·095) mm.

Material.—A single female was examined from the north coast of Christmas Island.

Remarks.—Pocock has identified this species with *Ch. javanus*, Thorell, but he was wrong, as the trochanter is distinctly bigibbose in *Ch. Pococki*, sp. n., but scarcely so in the other species. This species is distinguished from *Ch. navigator*, With, and *Ch. indicus*, With, to which it shows similarity by the absence of grooves on the cephalothorax and by the hand, which is 1·5 as long as the finger; it differs by the shorter tibial stalk and by the hand, which is almost as deep as the finger is long. From *Chelifer articulosus*, Sim., it differs by the more slender femur; from *Ch. rotundus*, With, to which it in most respects shows very great similarity, by the less distinct granulation of the palps, by the femur (which is much more slender, being 2·2 instead of 2 as long as wide), by the tibia (which has a shorter stalk and less strongly convex outlines), as well as by a few other characters of minor value. They are perhaps male and female of the same species; at the present, however, I prefer to found a new species.

C. *Species from Africa.*

The *Chelifer*-fauna of Tropical Africa has until lately been very imperfectly known; a recently published paper by Ellingsen (**17**) has vastly increased our knowledge by adding a number of new species to those already known, but not so many as might have been expected from the large number of specimens examined. It may nevertheless be regarded as certain that the greatest number has not yet been described. All the main groups of *Chelifer*, Geoffroy, seem to be present; however, representatives of *Lophochernes*, Simon, are with certainty only recorded from Socotra, viz. *Ch. socotrensis*, With, and from Natal, viz. *Ch. sculpturatus*, Lew. In the British Museum collections only a single species in *addition* to *Ch. equester*, With, was represented, viz. *Ch. Simoni*, Balzan, about which the following remarks are offered.

8. CHELIFER SIMONI, *Balzan*.

1891. Balzan, (**6**) pp. 529–531, pl. 2. figs. 20–20 *a*.
1906. Ellingsen, (**17**) pp. 254–255.

Palps.—The *trochanter* is scarcely produced below and posteriorly, only convex. The *hand* is as wide as deep; the fingers gape slightly, have no *accessory* teeth, and anteriorly three basal "spots" on immovable finger, none on movable.

Coxæ.—The fourth pair, which are distinctly enlarged towards the end and much longer than wide, have an elongated and triangular appearance, as the short inner margin merges gradually into the about four times longer hinder.

Legs.—The proximal joints are granular. The rather short hairs are dorsally slightly clavate or obtuse; tarsal "tactile" hair was missing in examined specimen. The legs are long and slender, and the trochantin of the first pair of legs has a structure similar to that of *Ch. subruber*, Simon (*cf.* **18.** figs. 5 *a–b*, p. 37), and *Ch. rufus*, Balzan (*cf.* **19.** figs. 3 *d–e*). The trochantin has anteriorly a small median condylus, from which the narrow articulate membrane starts, becoming broader dorsally and ventrally; posteriorly a small condylus is placed near to the dorsal margin, and below this the margin of the trochantin covers the base of the tibial part; the limitation between the two joints is almost perpendicular on the longitudinal axis of the femur. The tibia of the first pair is scarcely 1·1 as long as the *tarsus*, which is 5 as long as deep; the femur of the fourth pair is 2·7 as long as deep, 1·1 as long as tibia, and about half as deep as tarsus is long.

Measurements.—Leg I.: femur 0·430 (0·137), trochantin 0·114 (0·144); tibia 0·327 (0·091); tarsus 0·304 (0·061) mm.

Leg IV.: femur 0·540 (0·198); tibia 0·494 (0·110); tarsus 0·372 (0·072) mm.

Material.—I have examined a single female, collected by Dr. Ansorge at Huxe, Benguela.

Remarks.—The male of this species as well as of *Ch. angulatus*, Ellingsen, without eyes, and of *Ch. tenuimanus*, Balzan, are, according to Ellingsen, remarkable by the spinous areas found in the median sternites (*cf.* **17.** p. 258). This author does not mention the even more important character found in the femur of the first pair of legs, but I nevertheless concluded that these species also in this respect are similar to *Ch. subruber*, Simon, though I had at that time not yet examined any specimen of *Ch. Simoni*, Balzan (*cf.* **18.** p. 129, footnote). This species shows not only in the shape of the palps, as Mr. Ellingsen suggests, a similarity to *Ch. longichelifer*, Balzan, but also in the structure of the sternites of the male, the flagellum, which consists of four hairs, and in the articulation between the two portions of the femurs in the first pair of legs (*cf.* footnote, **18.** p. 158, and **19**).

Part II.—Garypidæ, *Hansen.*

In the following pages unknown or imperfectly known *Garypidæ*, Hansen, forming part of the British Museum collections, are described; the descriptions are rather short, without diagnoses and without so many figures as might be desired, because I hope at an early opportunity to work out a monograph of this interesting family.

1. Garypus longidigitatus, *Rainbow.* (Plate **8.** fig. 20; *cf.* With, **18.** fig. 3, p. 17, and tab. ii. fig. 3 *a*).

1897. *Chelifer longidigitatus*, Rainbow, (**10**) p. 108, pl. 2. fig. 2.
1898. *Garypus longidigitatus*, Pocock, (**11**) p. 323.

Cephalothorax.—Anterior pair of *eyes* slightly removed from lateral margin, but from front margin a distance about twice their diameter. *Cephalothorax*, which is much wider behind than long, is gradually attenuated towards the eyes, but suddenly narrows in front of the first pair into a long *cucullus*, which is directed somewhat downwards and with deep median incision in front margin. The integument is granular most distinctly anteriorly, with short obtuse hairs. No trace of transverse sutures observed.

Abdomen.—The abdomen, which is somewhat longer than wide, shows no trace of a longitudinal line dorsally, and is distinctly granular on the transverse darker band of tergites, which possess about twenty short and pointed or obtuse hairs along the hindmost margin.

Antennæ.—The short *galea*, which scarcely extends beyond the terminal hair, is acute, similar to an awl. The *serrula* in one specimen as figured (**18.** fig. 3, p. 17) with penultimate tooth squarely truncate, in another with penultimate acute and basal two teeth more similar to those of *G. elegans*, Sim. (*cf.* **18.** tab. ii. fig. 2 *a*). The *flagellum* consists of a single hair, and the lamina interior is composed of a few more or less well-defined teeth (**18.** tab. ii. fig. 3 *a*).

Palps (Pl. **8.** fig. 20).—The granular *maxillæ* are truncate in front, with manducatory part slender, well defined (*cf.* **18.** tab. i. fig. 6 *b*). The palps are distinctly and even coarsely granular, with the exception of the almost smooth fingers and less distinctly granular lower surface. The obtuse or pointed hairs are slender and very short. The *trochanter*, which is about 1·5 as long as wide, is strongly convex in front, and posteriorly produced into a fairly prominent, somewhat rounded distal protuberance; beneath this a better pronounced, and more conical tubercle is found, which is, however, much smaller and only seen from below. The *femur*, which is four times as long as wide, has a short well-defined stalk and has almost straight lateral outlines. The *tibia*, which has a short well-defined stalk (beyond which it is distinctly widened out towards the end), is much shorter and a trifle wider than femur and is 2·6 as long as wide, anteriorly as well as posteriorly a well-marked basal elevation is found, beyond which outlines are almost straight. The *chela*, which is 3·8 as long as wide, is 1·7 as wide as the tibia; the *hand* is 1·6 as long as wide, somewhat wider than deep, and 1·3 shorter than the fingers; the anterior outline of the hand is strongly convex, but the posterior only slightly so. The immovable finger has from near base to tip about 40 conical teeth, as widely removed from each other as their size at base; in addition to these about ten *accessory* teeth are found anteriorly in the middle, standing widely apart; the movable finger has 40 marginal teeth, which from the base to tip change from low and rounded to long and conical ones. The immovable finger has anteriorly in the middle five "spots," placed in a longitudinal row, and posteriorly six; anteriorly only three tactile hairs observed on immovable finger, and posteriorly four on both fingers.

Coxæ.—The coxæ are very similar to those of *G. elegans*, Sim., the fourth pair only being somewhat more slender (*cf.* **18.** fig. 16, p. 92).

Legs.—The proximal joints granular; the hairs dorsally rather short and somewhat obtuse, but ventrally longer and pointed. The *arolium* extends distinctly beyond claws at least on fourth pair of legs. The basal *femoral* part of the first pair of legs, which is distinctly widened out towards the end and there deeper than the distal part, is 3 as long as deep and 1·9 as long as the distal; the combined tarsi, of which the first is 1·1 as long as the second, are 1·3 as long as the tibiæ. The *femur* of the fourth pair of legs is about 3 as long as deep and the tarsal joints are about 1·1 as long as the tibia.

Colour.—The palps, head, and darker band of tergites reddish brown; rest of body yellowish.

Measurements.—Cephalothorax 0·690 (0·575); abdomen 1·38 (1·10) mm.

Palps: trochanter 0·253 (0·161); femur 0·647 (0·161); tibia 0·445 (0·175); hand 0·483 (0·299), depth 0·276; finger 0·647 mm.

Leg I.: femur I. 0·304 (0·099); femur II. 0·170 (0·095); tibia 0·220 (0·065); tarsus I. 0·160 (0·053); tarsus II. 0·140 (0·035) mm.

Leg IV.: femur 0·456 (0·155), trochantin 0·114; tibia 0·342 (0·084); tarsus I. 0·190 (0·061); tarsus II. 0·175 (0·043) mm.

Material.—Of this species I have examined Pocock's specimens from Funafuti, collected by Professor Sollas; typical specimens are from the same island.

Remarks.—The described species may at present be regarded as identical with the form so imperfectly described by Rainbow. This species is nearly related to *G. irrugatus*, Sim., but seems to differ by longer finger and even more strongly convex anterior outline of the chela; but nevertheless the similarity is so great that I should not have maintained the two species, if it had not been for the widely separated localities and the fact that they had once been established.

2. Garypus maculatus, sp. n. (Plate **9**. figs. 21–25.)

♂.

Cephalothorax (Pl. **9**. fig. 21).—The anterior pair of *eyes* are placed on lateral margin and removed from the front margin a distance about three times their diameter. The *cephalothorax* is as long as wide behind, and of almost equal breadth at posterior margin and somewhat behind the eyes, but is there suddenly attenuated, forming a long *cucullus*, which is directed somewhat downwards and has a shallow incision in the middle of the front margin. No transverse sutures were visible. The integument is distinctly shagreened, most prominently in front and laterally; the hairs are fairly long and obtuse.

Abdomen.—The abdomen is as broad as long and short obovate in shape; the darker parts of the tergites are strongly granular, while the lighter are less distinctly so; along the hindmost margin about 30 very short and thick hairs are observed in addition to two lateral in front on each side.

Antennæ.—The *galea* is exceedingly short, suddenly acute and not at all extending beyond the terminal hair. The *serrula exterior* seems to be similar to that of *G. elegans*, Sim. The *flagellum* consists of a single hair.

Palps (Pl. **9**. figs. 22 & 23).—The laterally shagreened *maxillæ* are truncate in front, with the manducatory part well defined posteriorly (fig. 23). The palps are coarsely granular, with the exception of the smooth fingers and indistinctly granular lower surface. The hairs are extremely short and obtuse. The *trochanter*, which is about 1·5 as long as wide, is strongly convex in front and posteriorly somewhat produced towards the end; the ventral tubercle is almost obsolete. The *femur*, which is 3·2 as long as wide, has a short fairly well-defined stalk and almost straight lateral outlines. The *tibia*, which has a short and well-defined stalk (beyond which it is somewhat widened out), is much shorter and a little narrower than the femur, and is 2·4 as long as wide; anteriorly as well as posteriorly a not very well-marked basal elevation is found, beyond which outlines are first almost straight and then slightly convex. The *chela*, which is about 3·2 as long as wide, is 1·7 as wide as the tibia; the *hand* is 1·5 as long as wide, wider than deep, and about 1·1 shorter than the fingers; the anterior outline of the hand is strongly convex, but the posterior only slightly so. The immovable *finger*, which dorsally beyond the middle becomes suddenly depressed, has about 25 pointed conical teeth from near base to tip, removed from each other as much as a tooth is wide at the base; in addition to these 18 conical *accessory* teeth, more widely apart, are found anteriorly from before middle to tip. The movable finger has about 35 teeth, changing from a low, closely placed one at base to pointed conical ones placed distally and more apart. The immovable finger has anteriorly at least about six "spots" placed in the middle in a longitudinal row.

Coxæ (Pl. **9**. fig. 23).—The coxæ, especially the fourth pair, are of an elongated appearance as shown in figures, somewhat resembling those of *G. floridensis*, Bks.

Legs (Pl. **9**. figs. 24 & 25).—The proximal joints are distinctly granular; the hairs are dorsally most often short and obtuse, ventrally longer and pointed. The *arolium* extends distinctly beyond the claws. The basal *femoral* part of the first pair of legs, which is distinctly widened out towards the end and here deeper than the distal part, is about twice as long as deep, 1·5 as long as the distal; the *tarsal* joints, of which the first is 1·1 as long as the second, is 1·5 as long as the tibia. The *femur* of the fourth pair of legs is 2·7 as long as deep, and the tibia is about 1·1 as long as the tarsal joints.

Colour.—The palps have trochanter yellowish and the chela reddish brown; the cephalothorax brown with the posterior portion in the middle yellowish. The first two abdominal tergites with a median and two lateral dark spots, and the following two median and two lateral spots, sometimes in front connected with a transverse band; the median spots always darker brown than the lateral; the skin between yellowish.

Measurements.—Cephalothorax 0·578 (0·610); abdomen 1·08 (1·08) mm.

Palps: trochanter 0·253 (0·161); femur 0·552 (0·172); tibia 0·391 (0·161); hand 0·425 (0·276), depth 0·235; finger 0·483 mm.

Leg I.: femur I. 0·225 (0·106); femur II. 0·152 (0·099); tibia 0·160 (0·072); tarsus I. 0·125 (0·053); tarsus II. 0·114 (0·042) mm.

Leg IV.: femur 0·372 (0·140), trochantin 0·122; tibia 0·304 (0·091); tarsus I. 0·160 (0·057); tarsus II. 0·122 (0·050) mm.

Material.—Of this species I have examined a single female, collected in the month of August in thickets near stream, in brush, near Balthazar (windward), Island of Grenada.

Remarks.—The described form differs from *G. cuyabanus*, Balz. (**5.** p. 441, and **6.** p. 549) by the very differently-shaped galea, by the absence of a transverse suture on the cephalothorax, by the femur of the palps, which is 3·2 instead of 3·5 as long as wide, and by the shorter hand, which is not so long as the finger, and last, but not least, by the less slender legs, which in the fourth pair have the first tarsal joint much longer than the second (*cf.* **5.** fig. 22). All these differences taken in consideration, and remembering that other members of the *Ch. irrugatus* group (*cf.* **18.** p. 101), to which this species belongs, have the galea alike in both sexes, I feel obliged to establish a new species. The examined specimen was covered with a number of "spores of fungi" (*cf.* **18.** p. 152).

3. Garypus floridensis, *Banks.* (Plate **9.** figs. 26–28; *cf.* With, **18.** fig. 9, p. 41, tab. 2. figs. 4 *a–d.*)

1895. Banks, (**9**) p. 9.

♀.

Cephalothorax (Pl. **9.** fig. 26).—Anterior pair of *eyes* slightly removed from lateral margin, but from the front margin a distance equal to three times their diameter. The *cephalothorax*, which is much longer than wide behind, is gradually attenuated towards the second pair of eyes, but in front distinctly narrows, forming a fairly long *cucullus* with a deep notch in the middle of the front margin. Two almost straight transverse *grooves*, of which the posterior is the deepest, are found, the anterior being placed much nearer to the hindmost than to the front margin. The skin is granular, with short obtuse hairs.

Abdomen.—The fairly long and slender abdomen has all the tergites but the first, partly second, and eleventh divided longitudinally by a broad band. The sclerites appear somewhat granular, and along the hindmost row of the tergites 12–14 short somewhat obtuse hairs are placed, in addition to two lateral in front of row on each side.

Antennæ.—The *galea*, which extends distinctly beyond the terminal hair, has about six terminal and ventral branches (*cf.* **18.** tab. ii. fig. 4 *c*). The *serrula exterior* has median teeth, the shortest increasing in length towards the basal and terminal ones, of which the former is the longer (*cf.* **18.** fig. 4 *c*). The *flagellum* consists of three short somewhat dentated hairs (*cf.* **18.** fig. 4 *b*), and the *lamina interior* consists behind the terminal spine of a number of fairly well-marked squarely truncate "teeth."

Palps (Pl. **9.** fig. 27).—The partly granular maxillæ are gradually attenuated towards the end, as the manducatory part is not well defined behind, providing similarity to those of *G. saxicola*, With (**18.** fig. 15, p. 92). The surface of the three proximal joints is covered by a mosaic of rounded plates, partly falling off in small pieces, as if they formed only a covering ; the hand is very minutely granular ; number of short obtuse hairs present. The *trochanter*, which is about 1·6 as long as wide, is strongly convex anteriorly and slightly produced posteriorly. The *femur*, which is 4·5 as long as wide, is beyond the short and not well-defined stalk gradually and distinctly enlarged towards the end, with both outlines almost straight. The *tibia*, which has a fairly long, not very well-defined stalk (beyond which it is distinctly widened out towards the end), is distinctly shorter and wider than the femur ; it is almost 3·5 as long as wide with nearly straight lateral outlines. The *chela*, which is almost four times as long as wide, is 1·8 wider than the tibia. The *hand* is 1·8 as long as wide, distinctly wider than deep, and almost 1·2 shorter than the fingers ; the anterior outline is strongly convex, the posterior and the dorsal and ventral outlines are only slightly so. The *fingers* bear a close row of short pointed marginal teeth from base to tip ; the number of the immovable fingers is at least 100.

Coxæ.—The coxæ are very long and slender, especially the fourth pair, which have inner and hinder margins merging into each other without limitation and which are 3·5 as long as wide, being as a whole scarcely different from those of *G. saxicola*, Wath. (*cf.* **18.** fig. 15, p. 92).

Legs (Pl. **9.** fig. 28 ; *cf.* **18.** figs. 9 *a–b*, p. 41).—The proximal joints with mosaic of plates like the palps ; the hairs are dorsally short, widest in the middle and then suddenly pointed, ventrally longer and generally pointed, especially those of the tarsi, which are somewhat similar to spines. The *arolium* scarcely extends beyond the slender, strongly curved claws. The basal *femoral* part of the first pair of legs, which is distinctly widened out towards the end and there somewhat deeper than the distal part, is 2·8 as long as deep and 1·7 as long as the latter. The *tarsal* joints, of which the first is at least 1·1 as long as the second, are at least 1·3 as long as the tibia. The *femur* of the fourth pair of legs is about 4 as long as deep, and the tibia is 1·3 as long as the tarsal joints.

Colour.—The palps are yellowish with reddish chelæ. The cephalothorax is dark brown with two yellowish spots in each of the tergites. The tergal sclerites of the abdomen are brownish with yellowish spots in the middle and yellow hairs ; rest of abdomen yellowish.

Measurements.—Cephalothorax 1·27 (1·08) ; abdomen 3·7 (2·3) mm.

Palps : trochanter 0·647 (0·414) ; femur 1·541 (0·345) ; tibia 1·354 (0·392) ; hand 1·288 (0·713), depth 0·667 ; finger 1·518 mm.

Leg I. : femur I. 0·585 (0·207) ; femur II. 0·355 (0·195) ; tibia 0·506 (0·125) ; tarsus I. 0·368 (0·115) ; tarsus II. 0·322 (0·095) mm.

Leg IV.: femur 1·150 (0·285), trochantin 0·345; tibia 1·081 (0·161); tarsus I. 0·445 (0·138); tarsus II. 0·368 (0·115) mm.

♂.

Abdomen, etc.—A fairly distinct genital area is present. The rather short *galea* extends only slightly beyond the terminal hair and has a few branches (*cf.* **18.** tab. ii. fig. 4 *d*).

Palps.—The proportions are slightly different from those of the female, as may be realised by comparing the measurements: the most important difference being that the hand is only 1·7 as broad as the tibia, 1·9 as long as wide, and at least 1·2 as long as fingers; its anterior outline is less strongly convex.

Coxæ.—The fourth pair are less slender, being only three times as long as wide.

Measurements.—Cephalothorax 1·15 (0·92); abdomen 2·8 (1·7) mm.

Palps: trochanter 0·552 (0·345); femur 1·288 (0·299); tibia 1·196 (0·322); hand 1·035 (0·552), depth 0·495; finger 1·288 mm.

Material.—I have examined a single male, four females, and two young specimens, of which one was probably newly hatched, all collected together and mounted, with a label which reads: "Mustique Island, June; sandy seashore under drift-wood; each one in a thin round flat silken nidus, about $\frac{1}{3}$ inch in diameter, attached to lower side of log, close together. Two of the females carried bundles of eggs." Previously mentioned from Florida.

Remarks.—In spite of Banks's rather imperfect description, I do not hesitate to refer the described characteristic form to his *G. floridensis*, Bks.

4. Olpium cordimanum, *Balzan* (*cf.* With, **18.** fig. 1, p. 17, tab. 2. figs. 6 *a–b*).

1891. Balzan, (**6**) pp. 536–537, pl. 12, fig. 28.

In the main, I refer to Balzan's good and fairly complete description. The *galea* extends somewhat beyond the terminal hair; in the female it has about five terminal teeth and is in the male without any teeth (*cf.* **18.** fig. 1, p. 17); the *serrula exterior* has all its teeth squarely truncate, of equal length; and the *flagellum* consists of three hairs (**18.** tab. ii. fig. 6 *b*); the *lamina interior* has a plate-shaped basal portion, three dentated lobes, and a long pointed terminal spine (**18.** fig. 6 *a*).

The *femur* of the palps has a "tactile" hair dorsally near the base and the fingers possess a close row of marginal teeth; no "spots" are found anteriorly. The rather short *coxæ* are in the main like those of *Olpium birmanicum*, With (**18.** fig. 7 *f*).

The first tarsal joint of the fourth pair of legs has a basal "tactile" hair. The legs are slender, especially the distal joints; *femur* I. of the first pair of legs is three times as long as deep and almost twice as long as the distal femoral part; the *tarsal* joints, of which the first is 1·2 as long as the second, are 1·4 as long as the tibia. The *femur* of the fourth pair of legs, which is suddenly raised beyond the stalk and attenuated towards the end, is 2·4 as long as deep; the tarsal joints are a little longer than the tibia.

Measurements ♀.—Leg I.: femur 0·410 (0·137); femur II. 0·220 (0·122); tibia 0·288 (0·084); tarsus I. 0·228 (0·065); tarsus II. 0·128 (0·046) mm.

Leg IV.: femur 0·737 (0·304), trochantin 0·228; tibia 0·562 (0·129); tarsus I. 0·342 (0·088); tarsus II. 0·243 (0·061) mm.

Material.—Of this species I have examined 27 females and 15 males from New Granada and a few from Bogota (Keys. Coll.). It has previously been recorded from Venezuela.

5. OLPIUM FURCILIFERUM, *Balzan.*

1881. Balzan, (**6**) pp. 537–538, pl. 12, figs. 30–30 *b*.

About this species I will only add a few remarks to Balzan's description. The *femur* of the palps has a "tactile" hair dorsally at the base; the fingers have close rows of marginal teeth. The *coxæ* are as in the preceding species. The tarsus of the fourth pair of legs has a basal "tactile" hair, and the *arolium* extends, as in the preceding species, distinctly beyond the claws. The legs are less slender than in *Olp. cordimanum*; the *tarsal* joints of the first pair of legs, of which the first is 1·3 as long as the second, are 1·3 as long as the tibia; the *femur* of the fourth pair of legs is twice as long as deep, and the tibia is almost 1·1 as long as the tarsal joints.

Measurements.—Leg I.: femur I. 0·296 (0·106); femur II. 0·152 (0·102); tibia 0·243 (0·068); tarsus I. 0·182 (0·049); tarsus II. 0·137 (0·038) mm.

Leg IV.: femur 0·555 (0·277), trochantin 0·190; tibia 0·456 (0·122); tarsus I. 0·243 (0·068); tarsus II. 0·175 (0·050) mm.

Of this species, which has been previously recorded from Venezuela, I have examined a single male collected in St. Vincent by Mons. E. Simon.

6. OLPIUM BREVIPES, sp. n. (Plate **9**. figs. 29–33; *cf.* With, **18**. fig. 13, p. 89.)

♀.

Cephalothorax.—The anterior pair of *eyes* are placed on the lateral margin and removed from the front margin a distance somewhat smaller than their diameter. The *cephalothorax*, which is a little narrower behind than it is long, is only slightly attenuated towards the eyes and then distinctly narrowing, forming a short *cucullus*, which has a shallow notch on the front margin (*cf.* **18**. fig. 13, p. 89). No trace of transverse sutures observed; the skin is almost smooth, somewhat polished, and with moderately long pointed hairs.

Abdomen.—The fairly long and slender abdomen has the undivided sclerites almost smooth, but not polished; the sclerites of the two first segments are almost obsolete. The tergites bear along their hindmost margin about ten pointed generally long hairs; last segment at least with "tactile" hairs.

Antennæ (Pl. **9**. fig. 29).—The *galea*, which extends distinctly beyond the terminal hair, has three branches near tip. The *serrula exterior* (fig. 29) has all its teeth somewhat rounded. The *flagellum* consists of three hairs, very similar to those of *Olp. cordimanum*, Balz.

Palps (Pl. **9**. fig. 30).—The smooth *maxillæ* are gradually attenuated towards the end. The palps are completely smooth, with the exception of the femur and tibia, which anteriorly are minutely and indistinctly granular, as well as the hand, which behind shows trace of granulations, and in front, especially at the base of fingers, has very distinct prominent granulations placed rather apart. The *hairs* are long and pointed ; the femur has dorsally at the base a " tactile " hair. The *trochanter*, which is 1·4 as long as wide, is anteriorly moderately convex and posteriorly very slightly produced towards the end, being as a whole calyciform. The *femur*, which is 2·2 as long as wide, is, beyond the short well-defined stalk, of almost equal length throughout and has almost straight lateral outlines. The *tibia*, which has an exceedingly short and badly defined stalk, is somewhat longer and wider than the femur and twice as long as broad ; the anterior outline is moderately convex and the posterior very slightly so. The *chela*, which is 2·6 as long as wide, is 1·4 as wide as the tibia ; the *hand* is 1·5 as long as wide, somewhat wider than deep, and 1·3 as long as the finger ; the lateral outlines are moderately convex. The fingers have a close row of marginal teeth.

Coxæ.—The coxæ are rather short, the fourth pair are somewhat triangular, as the inner and hinder margins, which are of almost equal length, merge gradually into each other, showing great similarity to that of *Olp. birmanicum*, With (*cf.* **18**. fig. 7 *f*, tab. 2).

Legs (Pl. **9**. figs. 31 & 32).—Fairly long and pointed hairs are found in addition to a much longer and slenderer one dorsally at the base of the tibia of the fourth pair of legs, as well as a dorsal " tactile " one at the base of the tarsus of the fourth pair of legs. The *arolium* extends distinctly beyond the claws. The legs are very short and clumsy. The basal *femoral* part of the first pair of legs, which is widened out towards the end and there scarcely deeper than the distal part, is scarcely 1·9 as long as deep and almost 1·3 as long as the latter ; a median condylus is placed anteriorly as well as posteriorly ; the *tarsal* joints, of which the first is distinctly longer, are 1·1 as long as the tibia. The *femur* of the fourth pair of legs, which is fairly suddenly raised beyond the stalk and then somewhat attenuated, is scarcely twice as long as deep, and the tibia is 1·3 as long as the tarsal joints.

Colour.—The proximal joints of the palps are yellowish brown, and the chela is reddish brown. The cephalothorax is dark brown, and the tergal sclerites are yellowish brown.

Measurements.—Cephalothorax 0·506 (0·460) ; abdomen 1·54 (0·85) mm.

Palps : trochanter 0·276 (0·195) ; femur 0·437 (0·195) ; tibia 0·460 (0·230) ; hand 0·506 (0·335), depth 0·285 ; finger 0·391 mm.

Leg I.: femur I. 0·190 (0·103); femur II. 0·152 (0·099); tibia 0·182 (0·072); tarsus I. 0·106 (0·050); tarsus II. 0·091 (0·038) mm.

Leg IV.: femur 0·456 (0·232), trochantin 0·190; tibia 0·350 (0·118); tarsus I. 0·152 (0·072); tarsus II. 0·122 (0·061) mm.

♂.

Abdomen, etc.—The *genital* area is not prominent, but nevertheless easy to distinguish from that of the female. The *galea*, which scarcely extends beyond the terminal hair, is much more slender, with branches much shorter (Pl. **9**. fig. 33).

Palps.—The *chela* is 2·7 as long as wide and only 1·4 as wide as tibia; the *hand* is scarcely wider than deep and 1·1 as long as the fingers.

Measurements.—Cephalothorax 0·460 (0·437); abdomen 1·20 (0·58) mm.

Palps: trochanter 0·253 (0·184); femur 0·425 (0·184); tibia 0·437 (0·220); hand 0·450 (0·315), depth 0·315; finger 0·405 mm.

Leg I.: femur I. 0·182 (0·091); femur II. 0·152 (0·094); tibia 0·175 (0·068); tarsus I. 0·106 (0·046); tarsus II. 0·091 (0·038) mm.

Leg IV.: femur 0·437 (0·224), trochantin 0·160; tibia 0·342 (0·110); tarsus I. 0·152 (1·061); tarsus II. 0·122 (0·053) mm.

Material.—Of this species I have examined three males, two females and a young one, collected by M. E. Simon at St. Vincent.

Remarks.—One of the main differences between the described form and *Olp. brevifemoratum*, Balzan (**5**. p. 440 and **6**. p. 549) is that found in the chela of the palps, which is 2·7 (♂) instead of 2·9 as long as wide, and 1·4 instead of 1·3 as wide as the tibia, with the hand 1·3 (♀ or ♂) as long as the finger instead of 1·6. The differences between the legs are even more striking, the second tarsal joint being much shorter instead of much longer than the first for instance, and I consequently think that the establishment of a new species is necessary.

7. Olpium pacificum, sp. n. (Plate **9**. figs. 34–38, Plate **10**. fig. 39; *cf.* With, **18**. fig. 12, p. 89.)

Cephalothorax.—The anterior pair of *eyes* are placed on the lateral margin and at a distance about equal to their diameter from the front margin. The *cephalothorax*, which is somewhat longer than it is broad in the middle, where it is broadest, narrows in front of the eyes, thus producing a short *cucullus*, which has an indistinct notch in the middle of the front margin. The cephalothorax shows in the middle trace of a transverse suture distinctly curved backwards (*cf.* **18**. fig. 12, p. 89, in which figure, however, it is too prominent). The integument is smooth and polished, and the hairs are moderately long and pointed.

Abdomen.—The long and slender abdomen has the undivided sclerites smooth and polished and provided with long and pointed hairs; the eleventh tergite at least possesses "tactile" hairs.

Antennæ (Pl. 9. figs. 34 & 35).—The long and slender *galea*, which has three terminal branches, extends very much beyond the terminal hair. All the teeth of the *serrula exterior* are equally truncate and of almost equal length, with the exception of the basal, which is longer and distally widened out (fig. 35). The *flagellum* consists of three hairs, of which the anterior, which is marginally serrated, is much longer than the other two.

Palps (Pl. 9. fig. 36).—The smooth *maxillæ* are gradually attenuated towards the end. The palps are smooth or almost so, except the femur and tibia, which are anteriorly slightly granular, and the hand, which has larger granulations. The hairs are long and pointed; the femur has at the base a dorsal "tactile" hair. The *trochanter*, which is about 1·5 as long as wide, is anteriorly slightly convex and posteriorly somewhat bigibbose; it can scarcely be designated calyciform. The *femur*, which is 2·7 as long as wide, has a short and well-defined stalk and is beyond the middle somewhat attenuated; the anterior outline is slightly convex basally and the posterior is almost straight. The *tibia* has a fairly long and well-defined stalk, is scarcely as long as but distinctly wider than the femur, and is about twice as long as broad; the anterior outline is moderately convex and so is the posterior distally, but proximally straight. The *chela*, which is about 3 as long as broad, is almost 1·3 as wide as the tibia; the *hand* is 1·5 as long as wide, scarcely as wide as deep and 1·1 shorter than the finger; the lateral outlines of the hand are moderately convex.

Coxæ (Pl. 9. fig. 37).—The fourth pair are very elongated, of a somewhat trapezoidal appearance.

Legs (Pls. 9–10. figs. 38 & 39).—Fairly long and pointed hairs are found in addition to a very long and slender one dorsally at the base of the tibia of the fourth pair of legs; the dorsal "tactile" hair at the base of the first tarsal joint is exceedingly long. The *arolium* extends distinctly beyond the short and clumsy claws. The legs are rather short and thick. The basal *femoral* part of the first pair of legs, which is widened out towards the end and there somewhat deeper than the distal part, is only 1·6 as long as deep and about 1·1 as long as the latter; the condyli are placed near dorsal margin; the tibia is a trifle longer than the *tarsal* joints, of which the first is the longer. The *femur* of the fourth pair of legs, which is not suddenly raised beyond the stalk, is distinctly twice as long as deep, and the tibia is almost 1·4 as long as the tarsal joints.

Colour.—The palps and the cephalothorax are reddish brown, and the abdomen is blackish.

Measurements.—Cephalothorax 0·621 (0·540); abdomen 1·56 (0·69) mm.

Palps: trochanter 0·322 (0·207); femur 0·585 (0·220); tibia 0·552 (0·265); hand 0·506 (0·332), depth 0·345; finger 0·552 mm.

Leg I.: femur I. 0·205 (0·129); femur II. 0·182 (0·125); tibia 0·243 (0·088); tarsus I. 0·122 (0·065); tarsus II. 0·114 (0·053) mm.

Leg IV.: femur 0·494 (0·240), trochantin 0·190; tibia 0·414 (0·137); tarsus I. 0·160 (0·080); tarsus II. 0·144 (0·068) mm.

Material.—I have examined a single female, collected in Stewart Island (New Zealand) by Mr. H. B. Kirk.

Remarks.—This species differs from *Olp. longiventer*, Keys. (**4**. p. 50), among other particulars by less long and slender palps, the femur being only 2·7 instead of distinctly 4 as long as wide, and the chela being shorter not longer than the combined femur and tibia.

8. GARYPINUS OCEANICUS, sp. n. (Plate **10.** figs. 40–47.)

1898. *Olpium longiventer*, Keyserling; Pocock, (**11**) p. 323.

♀.

Cephalothorax.—The *eyes* are placed on the lateral margin and the distance of the first pair from the front margin is scarcely as long as their diameter. The *cephalothorax* has a rather curious shape, as the hindmost fifth is pale and not enclosed by the well-chitinised shield, the hindmost margin of which is almost straight; the whole cephalothorax is distinctly longer than wide, but the cephalothoracic shield is as long as wide. The head is somewhat narrow in front of the eyes, forming a short *cucullus*, which has a median incision in the front margin. No trace of transverse suture was observed and the skin is smooth and polished with rather short hairs.

Abdomen.—The long and slender abdomen, which has its tergites undivided, has a curious appearance on account of the almost or complete absence of sclerites from the first two tergites and the short but distinct third one. The almost smooth tergal sclerites show trace of a transverse keel, along which the fairly long pointed hairs are placed in white spots, well removed from the hinder margin.

Antennæ (Pl. **10.** fig. 40).—The slender *galea*, which extends distinctly beyond the terminal hair, has three branches. All the teeth of the *serrula exterior* are squarely truncate and of almost equal length (fig. 40). The *flagellum* consists of three hairs without ramifications or with almost obsolete teeth along the front margin of the first hair (*cf.* fig. 45).

Palps (Pl. **10.** figs. 41 & 42).—The smooth *maxillæ* are gradually attenuated towards the end. The palps are smooth with the exception of the anterior surface of the hand, which has a few granulations at the base of the fingers. The hairs are moderately long and pointed. The *trochanter*, which is 1·4 as long as wide, is slightly convex anteriorly, a trifle produced posteriorly and appears calyciform. The *femur*, which is 2·5 as long as wide, has a short. fairly well-defined stalk and is of almost equal width throughout, with nearly straight lateral outlines. The *tibia*, which has a rather short, well-defined stalk, is somewhat longer and wider than the femur and about 2·2 as long as wide; the lateral outlines are slightly convex. The *chela*, which is about 3 as long as broad, is 1·3 as wide as the tibia; the *hand* is 1·8 as long as wide, a trifle wider than deep, and 1·3 as long as the finger; the lateral outlines of the hand are slightly convex. The *fingers* bear a close row of rather short, conical, marginal teeth; the immovable finger has anteriorly four tactile hairs, but posteriorly three at the base, one above the other, one in the middle, and one near the tip; the movable finger has three tactile hairs close together at the base and one in the middle.

Coxæ (Pl. **10.** fig. 41).—The coxæ are fairly elongated, with the fourth pair of a somewhat triangular appearance, as inner and hinder margin, which are of almost equal length, are not well distinguished from each other.

Legs (Pl. **10.** figs. 43 & 44).—The pointed hairs change from rather short to long; at the base of the first tarsal joint of the fourth pair of legs a long "tactile" hair is observed. The arolium extends distinctly beyond the short claws, but is not bifurcate. The basal *femoral* part of the first pair of legs, which is widened out towards the end and there somewhat deeper than the distal part, is scarcely 1·2 as long as deep and 1·4 shorter than the latter. The anterior condylus is placed almost median and so is the posterior, but more dorsally; as the margin of the basal femoral part posteriorly is placed more distally an oblique articular cavity is produced; but it must be admitted that the articulation is as a whole more similar to the usual hinge-joint than to that of *G. nobilis*, With (*cf.* **18.** fig. 7, p. 38). The *tarsal* joints, of which the second is the longer, are 1·2 as long as the tibia. The *femur* of the fourth pair of legs, which is not very suddenly raised beyond the stalk and attenuated, is 2·1 as long as deep, and the tibia is almost 1·2 as long as the tarsal joints.

Colour.—The palps are yellowish brown with darker chela. The cephalothoracic shield is blackish green and the tergal sclerites—first two excepted—are brown, while the hindmost part of the cephalothorax and the first two tergites are yellowish, the body thus getting a very characteristic appearance.

Measurements.—Cephalothorax 0·506 (0·414); abdomen 1·61 (0·81) mm.

Palps: trochanter 0·207 (0·150); femur 0·405 (0·161); tibia 0·414 (0·195); hand 0·437 (0·242), depth 0·242; finger 0·345 mm.

Leg I.: femur I. 0·110 (0·095); femur II. 0·152 (0·091); tibia 0·165 (0·065); tarsus I. 0·080 (0·046); tarsus II. 0·095 (0·038) mm.

Leg IV.: femur 0·372 (0·179), trochantin 0·144; tibia 0·281 (0·088); tarsus I. 0·110 (0·061); tarsus II. 0·129 (0·049) mm.

♂.

The size is much smaller. A complicated, fairly prominent *genital* area, resembling somewhat about that of *G. nobilis*, With. The *galea*, which only extends beyond the terminal hair in a slight degree, has three short distal teeth (Pl. **10.** figs. 45–47). The *palps* seem to be somewhat more clumsy, but their hand is only 1·2 as long as the finger. The legs are less slender, but only in a slight degree, as seen when comparing the measurements.

Measurements.—Palps: trochanter 0·175 (0·125); femur 0·335 (0·138); tibia 0·345 (0·161); hand 0·355 (0·207); finger 0·299 mm.

Leg I.: femur I. 0·099 (0·076); femur II. 0·129 (0·072); tibia 0·144 (0·053); tarsus I. 0·068 (0·040); tarsus II. 0·091 (0·035) mm.

Leg IV.: femur 0·296 (0·152), trochantin 0·120; tibia 0·243 (0·072); tarsus I. 0·084 (0·050); tarsus II. 0·106 (0·041) mm.

Material.—Of this pretty little species I have examined five males and six females, all collected in Funafuti by Professor Sollas, and by Pocock wrongly referred to *Olp. longiventer*, Keys.

Remarks.—This species is easily distinguished from *Olp. longiventer*, Keys., for instance, by the much shorter and clumsy palps, with the femur 2·5 instead of four times as long as wide. This species is related to *G. nobilis*, With, and shows in the shape of the palps the nearest similarity to it, but its flagellum consists of three hairs instead of four, its basal femoral part is longer, and the areola are not bifurcate.

9. GARYPINUS MIRABILIS, sp. n. (Plate **10.** figs. 48–53; *cf.* With, **18.** fig. 2, p. 17.)

1900. *Olpium longiventer*, Keyserling; Simon, (**13**) p. 519.

Cephalothorax (Pl. **10.** fig. 48).—*Eyes* placed on the lateral margin, and distant from the front margin less than the diameter of the first pair. The *cephalothorax* is distinctly longer than wide and narrows somewhat in front of the first pair of eyes, forming a short *cucullus*, which has the front margin obtuse-angled. Skin without transverse grooves and smooth with simple hairs.

Abdomen.—The long and slender abdomen has the smooth and polished tergites divided by a longitudinal line from the fourth to the tenth. Long and pointed hairs are present in addition to "tactile" ones in the last two segments.

Antennæ (Pl. **10.** figs. 49 & 50).—The *galea*, which extends somewhat beyond the terminal hair, has three terminal branches (fig. 49). The *serrula exterior* (fig. 50; *cf.* **18.** fig. 2, p. 17) has basal tooth distinctly widened out and terminal almost free and fairly slender, while those between are squarely truncate. The *flagellum* (fig. 50) consists of four hairs, of which the anterior has several marginal teeth, while the two following have a few. *Lamina interior* with well-divided plate-shaped portion and five more or less distinct dentated lobes in addition to the terminal spine.

Palps (Pl. **10.** fig. 51).—The palps are smooth, with fairly long pointed hairs. The *trochanter* is slightly convex anteriorly and somewhat produced behind. The *femur*, which is about three times as long as wide, has a short stalk and almost straight outlines. The *tibia*, which is about as long as, but wider than, the femur, has a moderately short stalk and slightly convex outlines. The *chela*, which is at least 3·5 as long as broad, is about 1·2 as long as the tibia, with almost straight lateral outlines; the hand is a trifle longer than the finger.

Legs (Pl. **10.** figs. 52 & 53).—The *arolia* extend distinctly beyond the claws and are bifurcate. The *femur* of the first pair of legs has a basal trochantin and a tibia which is of about equal length to the *tarsal* joints, of which the second is much longer than the first. The *femur* of the fourth pair of legs is at least twice as long as deep, and the tibia is much longer than the tarsal joints.

Colour.—The palps are pale reddish brown; the cephalothorax and, in a less degree, the abdomen are darker brown.

Measurements.—Cephalothorax 0·56 (0·51); abdomen 1·8 (0·75) mm.

Material, etc.—During a stay in London I examined a single female (?) of this form from Kauai, one of the most western islands of the Sandwich Archipelago, and by E. Simon wrongly identified with *Olp. longiventer*, Keyserling. As I had the opportunity of examining this interesting species only a few days before leaving, I had no time to furnish a more detailed description; but the above will certainly be more than sufficient for a sure identification.

As hitherto no species of *Garypinus*, Dad., has been recorded from Africa, I shall only mention that Dr. Ansorge has collected at Huxe in Benguela a young form of this genus.

SUPPLEMENT.

1. CHIRIDIUM FERUM, *Simon.* (Plate **10.** figs. 54–57.)

1879. Simon, (**2**) pp. 44–45, pl. 18. fig. 21.

Of this most interesting species I have examined a large number of specimens from Ille-et-Vilaine, France, viz. five females and a single male from Le Bosq and fourteen females and five males from Bois de Lupin, and mention it in this paper on account of the most remarkable structure of the antennæ. While the galea of *Ch. museorum*, Leach, is a simple stiletto, and in *Ch. corticum*, Balzan, somewhat branched in the female but simple in the male (**5.** tab. xiv. fig. 8), it consists in the female of this species of three independent, pointed and unbranched "*galeæ*," one placed somewhat above the other (fig. 54) and slightly extending beyond the terminal hair. When these three "galeæ" are observed from the sides (fig. 53) they seem to be basally fused, and are perhaps to be regarded as branches only of a trifid galea with an exceedingly short basal part. In the male only two rather short "galeæ" are observed (figs. 56 & 57). The *serrula* is very similar to that usually found in *Chelifer*, Geoff., and consists of nine completely fused rounded teeth, of which the basal is much the longest and distinctly widened out (fig. 57). The *flagellum* is similar to that of *Ch. museorum*, Leach, but the anterior marginally-serrated hairs are less slender (fig. 57) : the *lamina interior* has beyond the large plate-shaped portion a single or two scarcely dentated lobes, in addition to the simple spine. The *femur* of the fourth pair of legs shows no trace of a basal trochantin, but in the first pair we find posteriorly a fairly well-marked basal suture which bounds a triangle, the acute angle of which is one-fourth removed from the base ; this suture is continued anteriorly, and there placed very near to the base ; the whole structure shows a marked similarity to that found in most species of *Chelifer*, Geoff.

2. Ideoroncus Cambridgei (*L. Koch*). (Plate **10.** fig. 58.)

1873. *Roncus Cambridgei*, L. Koch, (**1**) pp. 45–46.
1879. *Obisium lubricum*, Simon, (**2**) pp. 63–64, pl. 18. fig. 22.
1892. *Roncus Cambridgei*, Cambridge, (**7**) p. 217, pl. B. figs. 9–9 *b*.

Of this species I have examined a single female and two young specimens, collected in Argyll (Scotland) and determined by R. Godfrey. I only mention this well-characterized species, which is certainly identical with that originally described by L. Koch from England, on account of the presence of a well-developed galea, a structure hitherto completely overlooked *. The *galea* is divided into five branches, as shown in the figure (58) ; the *serrula exterior*, which is free in its distal two-fifths, has at least the distal teeth rounded and dentated, providing similarity to that of *Ideobisium crassimanum*, Balzan (*cf.* Hansen, **8.** tab. 5. fig. 7) ; the *flagellum* has also a structure completely like that of the species mentioned (*cf.* **8.** tab. 5. fig. 6), consisting of seven slender unilaterally pinnate hairs ; the *serrula interior* has also a similar structure (*cf.* **8.** tab. v. fig. 6), but its terminal spine is completely fused with the main portion, not placed on a lower level.

The *subterminal* hairs of the legs are not well pronounced, bearing only a few indistinct teeth. The tarsal joints, of which the second is scarcely twice as long as the first, are in the first pair of legs somewhat longer than the tibiæ, but in the fourth pair much shorter. The articular membrane between the two parts of the femur of the fourth pair of legs, of which the distal is distinctly the longer, is better developed than is usually the case, being somewhat widened out ventrally.

The presence of a well-developed galea in at least the female of this species, which to all appearance is nearly related to *R. lubricus*, L. Koch, which has, according to Ellingsen, no galea, makes the value of this character in the

* This remark is not quite correct, as Mr. H. Wallis Kew, in a private letter received several months after the writing of this passage, says : "I noticed in January 1904 that '*Roncus*' *Cambridgei*, L. Koch, is an *Ideoroncus* with a distally toothed galea. . . ."

definition of the *Obisiinæ*, Dad., and *Pseudobisiinæ*, Hansen, very doubtful. As even the character found in the tactile hairs of the hand fails—for in *I. Cambridgei*, L. Koch, only the fingers seem to bear hairs—I really think that the two subfamilies, at least as hitherto defined, may be abandoned, and that the limitation between the established genera is less sharp than desirable (*cf.* With, **18**. p. 76). But, with only scanty material at my disposal, I do not wish at present to make alteration in the established system. Although a determination of the *Obisiidæ*, Hansen, forming part of the British Museum's collections, has convinced me that this family is in sore need of a complete revision, based on rich material and on modern lines, nevertheless alterations, even improvements, are not to be recommended in classification unless they are absolutely necessary and can be made with certainty.

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EXPLANATION OF THE PLATES.

Plate 8.

1 & 2. *Chelifer vigil*, sp. n.

Fig. 1. ♂. Left palp, × c. 15.
2. ♂. Chela of right palp in posterior view, × 38.

3–5. *Chelifer Keyserlingi*, sp. n.

Fig. 3. ♀. Right palp, × 13·5.
4. ♀. Chela of left palp in anterior view, × 24.
5. ♀. Chela of left palp in posterior view, × 44.

6–8. *Chelifer taierensis*, sp. n.

Fig. 6. ♀. Left palp, × 17·5.
7. ♀. Immovable finger of right palp in anterior view, × 24.
8. ♀. Chela of right palp in posterior view, × 24.

9–12. *Chelifer funafutensis*, sp. n.

Fig. 9. ♀. Left palp, × 24.
10. ♀. Tibia of right palp in anterior view, × 44.
11. ♀. Chela of right palp in anterior view, × 44.
12. ♀. Fingers of right palp in posterior view, × 44.

13 & 14. *Chelifer javanus*, Thor.

Fig. 13. ♀. Left palp, × 21.
14. ♀. Chela of right palp in posterior view, × 24.

15 & 16. *Chelifer navigator*, With.

Figs. 15 & 16. ♂. Left tibia in dorsal view, × 24.

17–19. *Chelifer Pocockii*, sp. n.

Fig. 17. ♀. Trochanter and femur of right palp in anterior view, × 44.
18. ♀. Left palp, × 24.
19. ♀. Chela of right palp in anterior view, × 44.

20. *Garypus longidigitatus*, Rainb.

Fig. 20. ♂ (?). Left palp, × c. 30.

PLATE 9.

21–25. *Garypus maculatus*, sp. n.

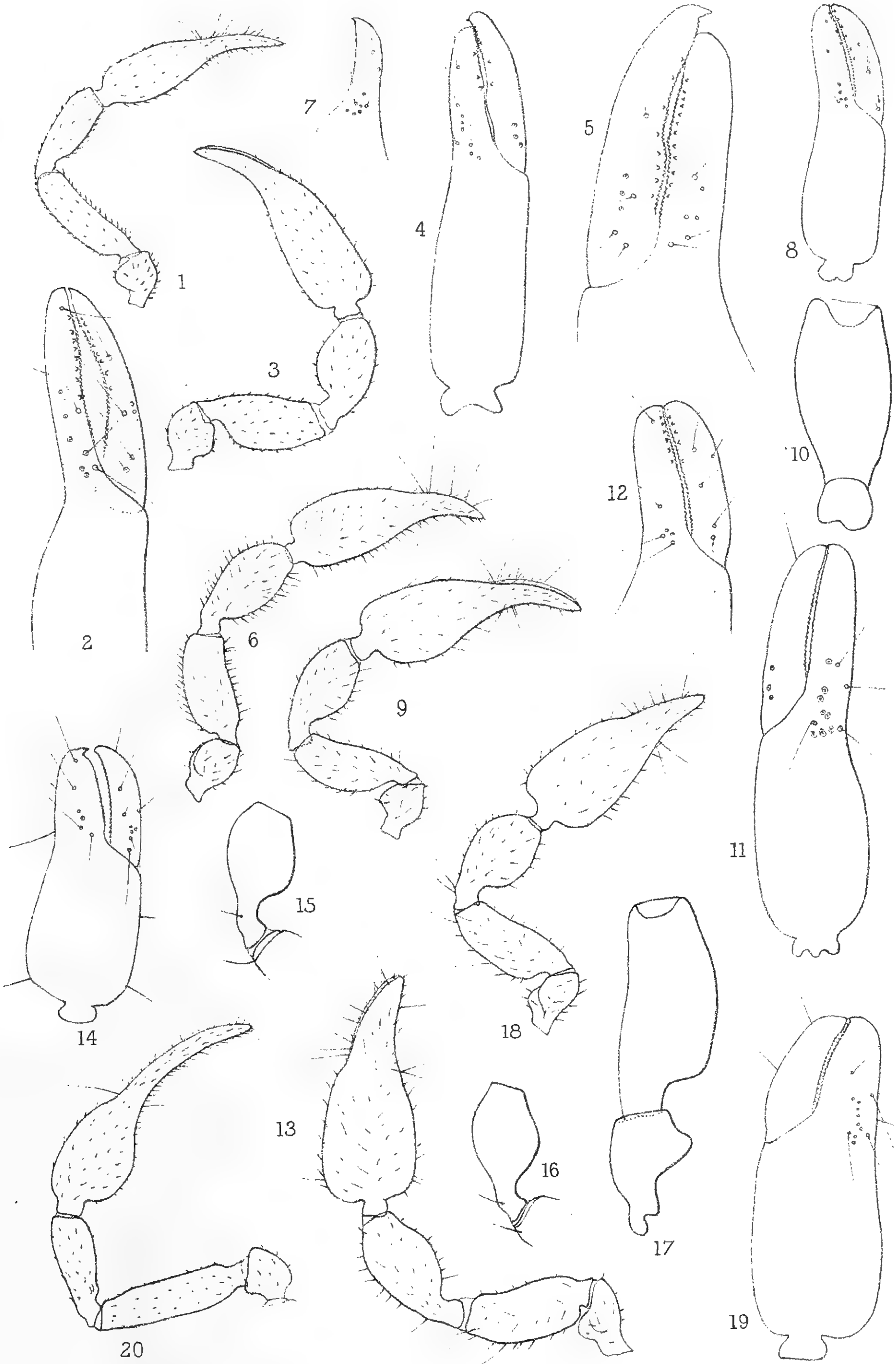
Fig. 21. ♂. Cucullus, × c. 90.
22. ♂. Left palp, × c. 35.
23. ♂. Maxillæ and coxæ, × c. 55.
24. ♂. Left leg I. in anterior view, × c. 70.
25. ♂. Left leg IV. in anterior view, × c. 70.

26–28. *Garypus floridensis*, Bks.

Fig. 26. ♀. Cucullus, × c. 30.
27. ♀. Left palp, × 13.
28. ♀. Dorsal hair of femur I. of first pair of legs, × c. 370.

29–33. *Olpium brevipes*, sp. n.

Fig. 29. ♀. Movable finger of left antenna, × c. 220.
30. ♀. Left palp, × 38.
31. ♀. Left leg I. in anterior view, × 57.
32. ♀. Left leg IV. in anterior view, × 57.
33. ♂. Left galea, × c. 220.



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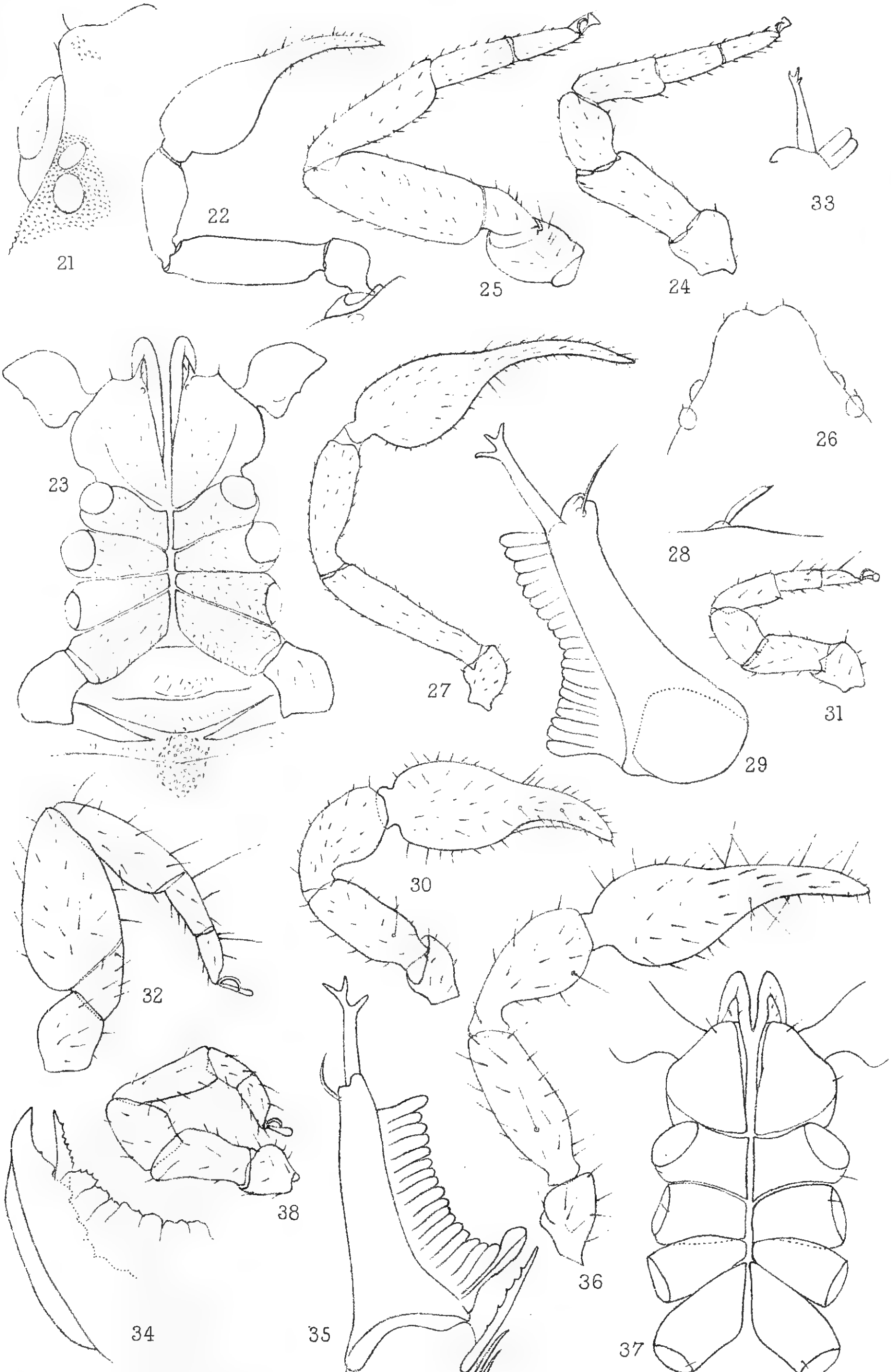
CHELIFERIDAE & GARYPIDAE.



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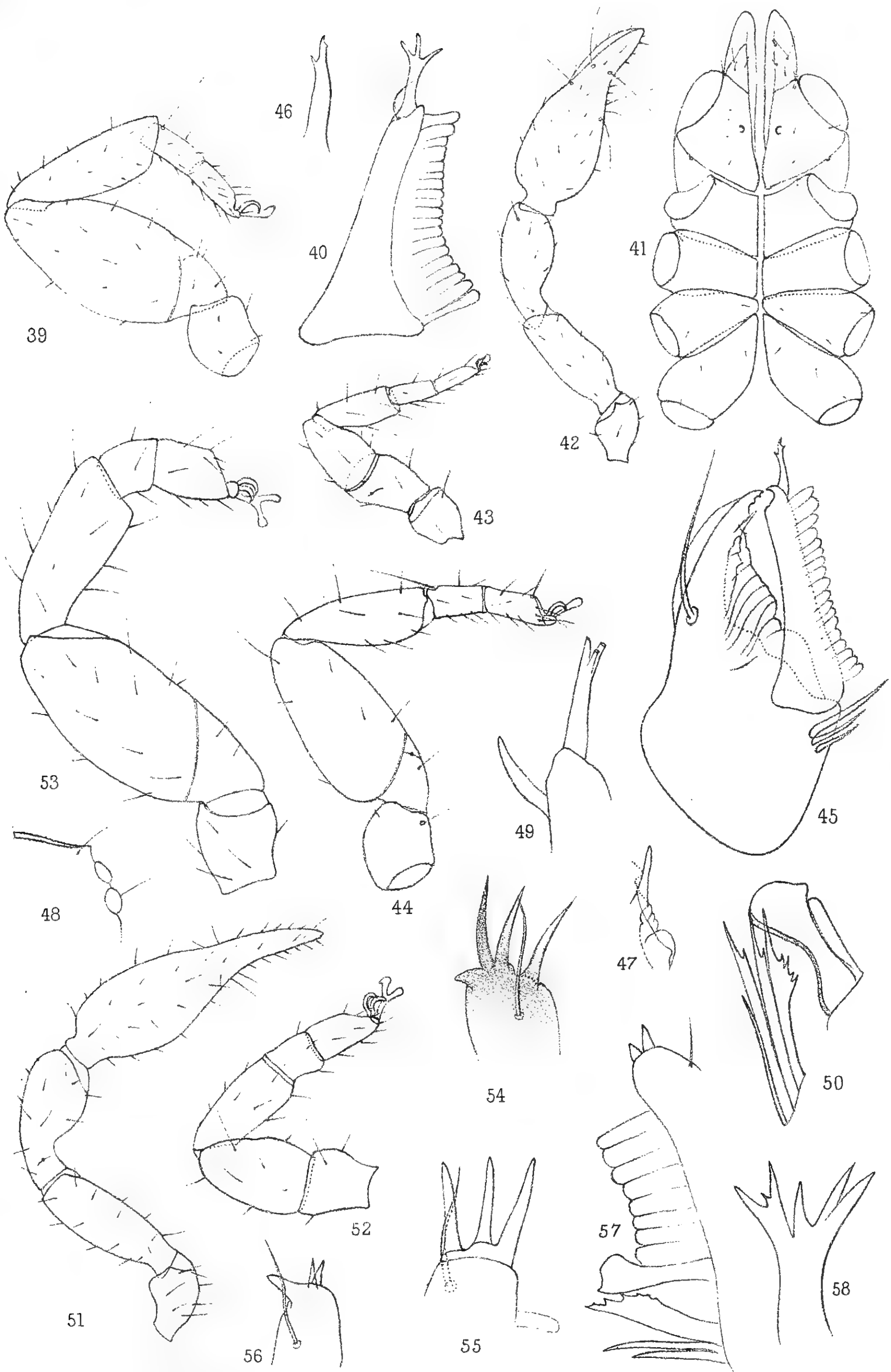

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CHELIFERIDÆ & GARYPIDÆ.

34–38. *Olpium pacificum*, sp. n.

Fig. 34. ♀. Immovable finger of left antenna from below, × c. 315.
35. ♀. Movable finger of left antenna, × c. 235.
36. ♀. Left palp, × c. 35.
37. ♀. Maxillæ and coxæ, × c. 60.
38. ♀. Left leg I. in anterior view, × c. 60.

Plate 10.

39. *Olpium pacificum*, sp. n.

Fig. 39. ♀. Left leg IV. in anterior view, × c. 60.

40–47. *Garypinus oceanicus*, sp. n.

Fig. 40. ♀. Movable finger of left antenna, × c. 280.
41. ♀. Maxillæ and coxæ, × c. 70.
42. ♀. Left palp, × c. 45.
43. ♀. Left leg I. in anterior view, × c. 75.
44. ♀. Left leg IV. in anterior view, × c. 75.
45. ♂. Left antenna from below, × c. 280.
46. ♂. Left galea, × c. 550.
47. ♂. Tip of left lamina interior from below, × c. 550.

48–53. *Garypinus mirabilis*, sp. n.

Fig. 48. ♀. Cucullus, × c. 55.
49. ♀. Left galea and terminal tooth of serrula exterior, × c. 350.
50. ♀. Flagellum and two basal teeth of serrula exterior, × c. 350.
51. ♀. Left palp, × c. 40.
52. ♀. Right leg I. in posterior view, × c. 75.
53. ♀. Right leg IV. in posterior view, × c. 75.

54–57. *Chiridium ferum*, Sim.

Fig. 54. ♀. Tip of movable finger of right antenna almost in dorsal view, × c. 800.
55. ♀. As preceding, but in exterior, partly dorsal view, × c. 800.
56. ♂. Tip of movable finger of right antenna in dorsal view, × c. 800.
57. ♂. Flagellum, serrula, and galea of right antenna from inner side, × c. 800.

58. *Ideoroncus Cambridgei*, L. Koch.

Fig. 58. ♀. Galea of left antenna in exterior view, × c. 800.

On the Direction of the Aqueous Current in the Spiracle of the Dogfish; together with some Observations on the Respiratory Mechanism in other Elasmobranch Fishes.

By A. D. DARBISHIRE, Demonstrator of Zoology in the Royal College of Science, London. (Communicated by Professor A. DENDY, D.Sc., Sec.L.S.)

(With 3 Text-figures.)

[Read 2nd May, 1907.]

THE observations which I have to record are the outcome of a suggestion made to me by Prof. Dendy that I should find out whether water entered, or came out of, the spiracle in the Dogfish. The point seems simple; yet it is one on which it is impossible to obtain definite information from text-books of zoology.

The observations were begun with Prof. Dendy, at the Royal College of Science, on small Dogfish which had only just hatched; and were continued by me at the Laboratory of the Marine Biological Association at Plymouth, where I occupied the British Association Table. I wish to record my indebtedness to the Staff of the Laboratory at Plymouth for the trouble they took in obtaining fish for me, and to Mr. A. I. Smith, in particular, for his help in my observations.

I shall first give an account of the general mechanism of respiration in *Scyllium canicula*. This account is based on observations of more than twenty Dogfish, which varied in length between 1 and 2 feet. The observations were made partly in the large brick tank with a bottom of shingle and sand, behind the Laboratory at Plymouth; and partly, when closer examination was desired, in a glass vessel, to be described further on.

The results obtained with the just-hatched Dogfish were not conclusive: I shall therefore postpone reference to them until after I have dealt with the respiration as observed in the adult fish.

SCYLLIUM.

Each separate respiratory act in the Dogfish consists of an inspiratory and of an expiratory phase.

The term inspiratory phase may be given to the first phase of the act of respiration, which commences when the whole branchial region begins to expand and ends when this expansion has reached its full extent. Directly this expansion begins (i) the mouth opens slightly, and (ii) the skin forming the outer wall of each gill-slit becomes closely pressed against its corresponding inner wall, evidently as a result of the incipient movement of water towards it. This apposition of the two walls of each gill-slit continues until the branchial region has reached its full state of expansion. The process of expansion can be seen both from above and from below ; and consists therefore in the lowering of the wall of the pharynx as well as in the outward movements of its sides. It has the appearance of being the result of a considerable effort on the part of the fish.

Just before the end of the inspiratory phase the mouth shuts : then the branchial region suddenly collapses, water rushes out of the gill-slits, and the expiratory phase has begun ; and scarcely has it begun before it is at an end, for it takes about half the time occupied by the inspiratory phase.

We must now consider the question of the direction of the water in the mouth and spiracle. In order to determine the direction of the water in these apertures, I placed the Dogfish in 3 to 4 inches of water in a flat-bottomed glass dish. This dish was raised on four corks about 2 inches high ; so that, by placing a mirror below the dish, one could examine the fish from the ventral aspect. The method I adopted for determining the direction of the current in the mouth and spiracle was to gently liberate from a pipette a little finely powdered carmine suspended in sea-water in the immediate proximity of these apertures.

When the mouth opens at the beginning of the inspiratory phase, water is vigorously drawn in : and this inhalation continues so long as the mouth remains open. Water containing carmine which enters the left side of the mouth emerges only from the gills of the left side ; and water entering at the right side emerges only from the gills of the right side. The lumen of the pharynx is, therefore, divided in front of the first gill-slit into two channels which do not communicate with one another. Carmine liberated in front of the middle of the mouth emerges from the gills of both sides, as a result, presumably, of the equal distribution of the cloud of carmine to the two channels.

The carmine sucked in through the mouth does not emerge equally from all the gills ; but in considerably greater volume from the last three, especially from the last one. My attention was first called to this by Dr. Allen, who was watching one of my observations.

Lastly, if carmine is liberated sufficiently near the nostril, the very slightest current, entering it, can be detected.

To turn now to the spiracle. At first sight this aperture seems to give rise to two channels entering the head, a dorsal and a ventral one. The dorsal one is not a channel, but is the spiracular cæcum ; the ventral one is the inspiratory aperture. During the inspiratory phase the inspiratory aperture is open ; but during the expiratory phase it is closed by a valve which extends backwards over it like a curtain, from the anterior wall of the spiracle.

Carmine liberated near the spiracle is vigorously drawn into the inspiratory aperture during the inspiratory phase. During normal breathing there is no expulsion of water from the spiracle, though the faintest outward disturbance in the cloud of carmine caused, possibly, by the shutting of the valve can just be detected. Occasionally, however, the Dogfish clears his spiracle, so to speak, by expelling a considerable volume of water from it. This only happens after a number of trials with carmine, and is evidently a means of ridding the pharynx of unpleasant matter.

The carmine which is drawn into the spiracle emerges from the first three gills, but especially from the first one, or two. It will be remembered that water which entered the mouth emerged from the posterior two or three gills. It seems reasonable to suppose that this difference between the course of the oral and spiracular currents is, in some way, connected on the one hand with a slight difference between the degree of oxygenation of the water composing the two currents (like that between systemic and carotid blood in the Frog), and on the other with that aggregation of the roots of the afferent branchial vessels which affects the first two in *Scyllium*, and the last three as well as the first two in *Raja*.

The observations made on the just-hatched Dogfish at the Royal College of Science were not conclusive, partly because of the smallness of the spiracle, which made it very difficult to determine the direction of the current; and partly because in two of the three youngsters no trace of an ingoing current could be detected, whilst in the third carmine was most distinctly drawn in. Whether this apparent difference between the fish was due to difficulties in observation or to real differences between the fish, I am not prepared to say definitely, though I am inclined to attribute it to the latter.

To return to the observations made at Plymouth. In *Sc. catulus* the amount of disturbance in the cloud of carmine, caused, as we have supposed, by the shutting of the spiracular valve, is greater than in the case of *Sc. canicula*. This was particularly noticeable in some experiments I made with a large Nursehound over 3 feet long.

Raja.

The observations were made on fairly young specimens of *R. batis* measuring less than one foot from snout to tip of tail. The respiratory act in this fish is, in its main features, the same as in the Dogfish. In correspondence with the very much greater size of the spiracle and the greater differentiation of its valve (which has a serrated edge and is strengthened by the spiracular cartilage), the rapidity of the current and the volume of water drawn in at the spiracle is considerably greater than in *Scyllium*. Another difference between the two lies in the fact that when a Skate is resting he inhales water solely through his spiracle: it is only when he becomes restless and crawls or swims that water enters the mouth. A Skate clears his spiracle more forcibly and more often than a Dogfish does under the same treatment. A sleeping Dogfish will inhale suspended carmine for an indefinite time; but a sleeping *Raja* wakes and moves away after a very few trials with the carmine.

The existence of pigment on the anterior wall of the spiracle underneath the valve and the rich nerve-supply from the palatine branch of the 7th nerve to the spiracle itself, coupled with the above-mentioned facts relating to the respiratory current in this form, all point to the greater differentiation of the spiracle in the Ray than in *Scyllium*.

The observation of the exit of the water from the gills was not so easy a matter in the case of *Raja* as in that of the Dogfish. For, in the first place, *Raja* is much more easily made restless by the inhalation of carmine; and in the second, the water is not, so to speak, ejected directly to the exterior as in the case of the Dogfish, but to an intermediate closed chamber whose floor is the base of the vessel and whose roof and sides are the ventral surface of the fish. So far as I was able to observe, however, carmine liberated near the spiracle emerged chiefly from the foremost four gills; and, as in the Dogfish, carmine entering at the left side of the mouth emerged through the left gills, but also, though to a less extent, through the right ones.

The Ray occasionally did what I never observed *Scyllium* to do, namely, ejected water from the spiracle at each respiratory act for a considerable number of times. This regular and repeated reversal of the current in the spiracle was a very different thing from the occasional violent spasmodic expulsion of water, to which reference has already been made. The former barely disturbed the surface of the 2 inches of water in which the fish lay; the latter sometimes sent a spout of water half an inch from the surface.

It will be noted that in the foregoing account I have referred to that part of the anterior wall of the spiracle which moves backwards at each expiratory phase as the spiracular valve. I regard the behaviour of this structure sufficient justification for this name. But it must be pointed out that this valve is, certainly in the Ray, and, as far as I can discover, in the Dogfish too, identical with what is known as the pseudo-branch. It is not my intention to discuss the question whether this structure really represents a rudimentary gill or not: I am here merely concerned in pointing out the relation of its movements to the respiratory currents.

Rhina squatina.

Rhina differs from both *Raja* and *Scyllium* in the following characters:—The mouth is terminal. The spiracle is much more elongate transversely even than in the Skate; it is, as shown in fig. 1, a considerable distance behind the eye; whereas in the Dogfish it is close behind it, and in the Ray it is even overlapped by the upstanding eye *. The spiracle possesses no

* The closeness of the eye to the spiracle in the Skate is the cause of a curious belief which, according to Dr. Masterman (to whom I am indebted for my acquaintance with it), exists among fishermen. They believe that the spiracle enables the fish to look into its pharynx and satisfy itself as to the quality of the food which it has swallowed.

The eye is certainly capable of a considerable degree of rotation.

valve. The gape of each gill-slit is much greater than is the case either in the Dogfish or the Skate. The gill-slits themselves appear crowded together in the postero-lateral angle of the pharyngeal region, as shown in fig. 2. This crowding is, however, only apparent, and is due to the great length of the gill-covers, and especially of the anterior ones, as shown in fig. 3.

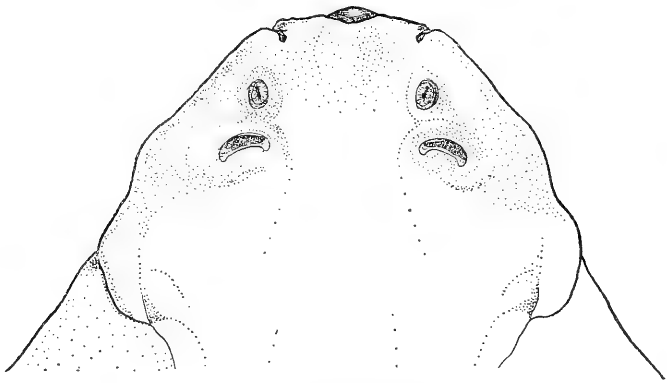


Fig. 1.—Dorsal view of Head and Pharyngeal Region of *Rhina*. ($\frac{3}{8}$ nat. size.)

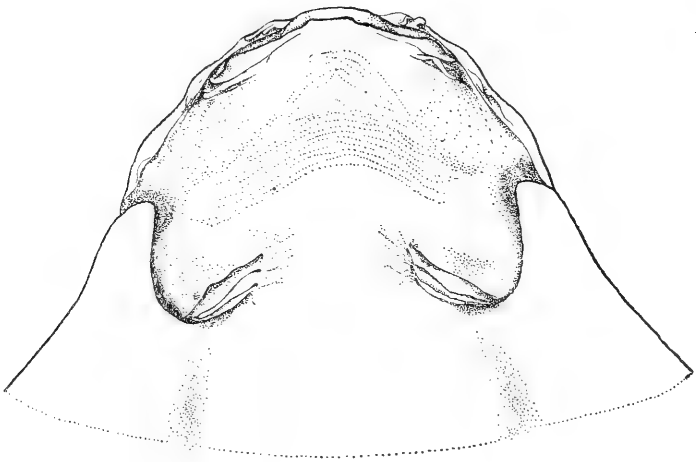


Fig. 2.—Ventral view of Head and Pharyngeal Region of *Rhina*. ($\frac{3}{8}$ nat. size.)

What strikes one most, when one looks at a living *Rhina* resting on the bottom of a tank or glass vessel, is its motionlessness. In a full-grown Angel-fish over 2 feet long, not only was there no trace of that regular heaving of the pharyngeal region which is so characteristic a feature of a resting Dogfish or Ray, but no movement of any kind in the anterior region of the body could be discerned. But in two younger Angel-fish the slightest signs of pulsation could be seen in the flaps of skin (fig. 1), which conceal the anterior extremities of the pectoral fins which can best be seen from below (fig. 2).

If we look a little closer, but still confine our examination to the upper and anterior part of the fish, we can see no sign of movement either in the spiracle or in the mouth, which is slightly open.

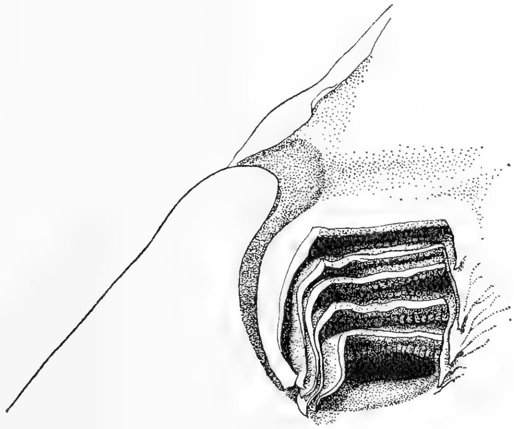


Fig. 3.—Ventral view of the postero-lateral angle of the pharyngeal region of *Rhina*, with part of the gill-covers cut away, to show their absolute and relative lengths. (About $\frac{5}{8}$ nat. size.)

It is not until we examine the ventral surface of the fish in the mirror that we can see any signs of movement, and even then we find the movement confined to the gill-covers themselves. The movement is expressed on the surface of the first gill-cover, and on as much of the others as can be seen, as a wave passing along it from its fixed anterior to its free posterior edge, and has very much the same appearance as a wave on a field of corn in the wind. There is absolutely no movement of the floor of the pharynx and still less that regular action of the floor which is so characteristic a feature of the living Dogfish, and (though to a less extent) of the Ray.

The list of differences between *Rhina* on the one hand, and *Scyllium* and *Raja* on the other, is not yet complete. Perhaps the most remarkable feature which distinguishes the Angel from the other fish examined is revealed by the experiments with carmine. Carmine liberated near the spiracle enters it in a *uniform stream* ; that is to say, it is not drawn in rhythmically, as it is in the Dogfish and Ray, at each inspiration. In the case of the adult Angel the stream was perfectly uniform ; in the case of two younger ones there was the faintest trace of pulsation, but this consisted merely in the slightest rhythmical acceleration of the current and not in the alternation of 'current' with 'no current.' Carmine liberated near the mouth entered it also in a uniform stream.

The uniformity of the stream is evidently due to the manner in which the respiratory current is brought about. It is effected by the undulation of the gill-covers, which expels the water underneath them to the exterior. Water enters the mouth and spiracles because these are the only channels through which it can enter the pharynx to replace that which has been expelled by the undulation of the gill-cover. The uniformity of the current is accounted for by the fact that by the time a wave has reached the hinder end of the gill-cover another has started at its anterior end.

It is evident how different is the method by which water is drawn in, in *Rhina* on the one hand and *Scyllium* and *Raja* on the other. For in these latter, as we have seen, this is effected by the expansion of the whole pharyngeal region accompanied by the simultaneous closing of the gill-slits and opening of the mouth and spiracle.

Water is drawn into the mouth and spiracle of *Rhina* in the same way as air is drawn into the door of a room which has a revolving ventilator in its roof. Water is drawn into these apertures in the Dogfish and Ray in the same way that smoke is drawn into the mouth from a tobacco-pipe or cigarette. In the first instance, the lumen of the chamber into which water (or air) is drawn is not enlarged; in the second, the lumen of the chamber into which water (or smoke) is drawn is enlarged.

We have said that when a living *Rhina* is examined no movement can be detected in the walls of the spiracle. The spiracle is, however, sometimes found open and sometimes shut; but from the fact that I have never seen the slightest movement on the part of the spiracle, although I examined it repeatedly whilst it was gradually but imperceptibly closing, I imagine that it never closes rapidly. In the case of the adult Angel which was examined in the large tank at Plymouth, the spiracle was always closed when the fish was undisturbed—for example, when I first visited it in the morning; but if it was disturbed and made to swim about, the spiracle gradually opened. But in the case of the two younger Angels which were confined to a shallow glass vessel in the laboratory in London, the spiracle was permanently open for a space of two days.

Judging the normal behaviour of the spiracle from the observations made in the large tank behind the Laboratory at Plymouth, we find that it is curiously different from that of the spiracle in the Ray. For whilst in the undisturbed Ray the water is drawn solely through the spiracle and not through the mouth at all, in the undisturbed Angel the spiracle is shut and water enters solely through the mouth.

The spiracle closes by the backward movement of its anterior border. This I was able to determine on a fish that had just died. One of the reflex movements executed as a result of pressing the back of the fish was the shutting of the spiracle, which was brought about in the manner described.

Summary of Results.

1. Water is drawn into the mouth and spiracle of the Dogfish by the expansion of the whole pharyngeal region. Water is prevented from entering the gill-slits by their automatic closure. The gill-covers are passive agents in determining the respiratory current.

2. The respiratory current in the Ray is brought about in essentially the same way as in the Dogfish.

3. The differences between the Dogfish and Ray in this respect all relate to the flat shape and bottom-living habit of the Ray. (*a*) In the former the greater part of the inhaled water enters through the mouth ; in the latter, through the spiracle, and indeed, when the fish is at rest, solely through the spiracle ; in the Dogfish, water never enters solely through the spiracle. (*b*) The Dogfish is capable of occasionally ejecting water from the spiracle ; the Ray can not only do this with much greater vehemence, but is capable of definitely reversing the current for a considerable number of respiratory acts. (*c*) In correspondence with the greater control which the Ray has over its spiracle, this aperture is both much larger than it is in the Dogfish and provided with a more efficient valve.

4. In *Rhina* the water is drawn into the mouth by an entirely different mechanism from that which obtains in the Dogfish and the Ray ; namely, by the undulation of the gill-covers themselves. The gill-covers in this fish therefore are active agents in determining the respiratory current. The current entering the mouth and spiracle is uniform and not rhythmical ; this is the result of the method by which the water is drawn in. The spiracle in *Rhina* is only capable of slow and imperceptible opening and closing ; it does not open and shut rhythmically, as in the case of the Ray and Dogfish.

5. The profound difference between the respiratory mechanism in *Rhina* on the one hand, and *Scyllium* and *Raja* on the other, makes strongly against the view, which Regan * opposes on anatomical grounds, that *Rhina* is a connecting link between the Sharks and Rays. At the same time, this mechanism in *Rhina* is as different from that in the Dogfish as it is from that in the Ray. Our attitude to the conclusion arrived at by Regan, that *Rhina* is a Shark and not a Ray, depends on the significance we attribute to physiological characters of this kind, in classification.

An abstract of this paper was read in the meeting of the Linnean Society. The experiments with carmine were demonstrated on two Rays, two Dogfish, and two Angel-fish, sent up from Plymouth for the occasion ; so that any of my statements which did not carry conviction could be immediately subjected

* P. Z. S. 1906, p. 751.

to the test of experiment on the living animal. The only one of my propositions, which was objected to, was that which referred to the passivity of the gill-covers in the Dogfish as contrasted with the activity of these in *Rhina*. Prof. Herdman, who disclaimed familiarity with the behaviour of these structures in *Rhina*, said that from watching living dogfish on other occasions he had come to the conclusion that the gill-covers were not passive but active agents in determining the respiratory current. Dr. Masterman, however, was in agreement with the view which I had expressed. After looking into the matter again in the light of these criticisms, I have come to a conclusion which reconciles these two apparently opposite views. The anterior half of each gill-cover is supported by the gill-rays which are borne by the anterior four epibranchial cartilages. If we look at the living dogfish, we see that the anterior part of each gill-cover certainly does seem to move of its own accord, so to speak, and not merely as the result of the outgoing rush of water. Indeed, when we consider that the gill-rays, which support the anterior part of the gill-cover, are attached to the branchial cartilages to whose movement the expansion of the pharynx is largely if not wholly due, it is difficult to imagine that it could be otherwise. On the other hand, there can be no doubt that that part of the gill-cover which is not supported by the gill-rays is an absolutely passive agent and that its movements, like those of any valve, are solely determined by the direction of the current which plays upon it.

Postscript.—After this paper had been sent to press, my attention was called to an article in the 'American Naturalist' (May 1907) by Herbert W. Rand, "On the Functions of the Spiracle in the Skate." I am happy to find that Mr. Rand's results, made on a species of *Raja* I have not examined, are in complete accord with those of my own which refer to the Skate.

Some Additions to our Knowledge of the New Zealand Holothurians.

By ARTHUR DENDY, D.Sc., Sec.L.S., Honorary Member of the New Zealand Institute, Professor of Zoology in King's College, University of London; and E. HINDLE, A.R.C.Sc.Lond., Assistant-Demonstrator of Zoology in the Royal College of Science, London.

(PLATES **11–14** and 3 Text-figures.)

[Read 6th June, 1907.]

THE following pages contain an account of a collection of Holothurians brought from New Zealand by one of us some years ago, and may be regarded as a continuation of the "Observations on the Holothurians of New Zealand" published in the Linnean Society's Journal (Zoology) in 1897 (vol. xxvi. p. 22). Since that date only three species have been added to this section of the New-Zealand fauna, viz. *Cucumaria Filholi*, *Phyllophorus anatinus*, and *Caudina pulchella*, all of which are described by Professor Rémy Perrier in his memoir on the Antarctic Holothurians of the Natural History Museum of Paris *. It appears to us, however, to be very doubtful whether these three species can be maintained, and we incline to the belief that they are synonymous respectively with *Cucumaria alba* (Hutton), *Phyllophorus longidentis* (Hutton), and *Caudina coriacea* (Hutton). This question, however, need not be discussed at present.

We may also note in this place that a previously doubtful species of Hutton, *Cucumaria turbinata*, has been re-examined, from the type specimen, by Herdman and Pearson, and has been recorded from Ceylon. Pearson describes and figures the species in his paper on the Ceylon Holothurians †.

In this paper we venture to propose no less than six new species, viz., *Stichopus simulans*, *Phyllophorus dearmatus*, *Pseudocucumis bicolumnatus*, *Chirodota gigas*, *Chirodota geminifera*, and *Rhabdomolgus novæ-zealandiæ*; while *Holothuria difficilis*, Semper, is recorded from Norfolk Island. Of these by far the most remarkable is *Rhabdomolgus novæ-zealandiæ*. A description of this species was actually prepared by one of us in 1896, based on a single specimen, but was not published at the time because it was thought that the absence of spicules, characteristic of the genus *Rhabdomolgus*, might be due in the case of our specimen to the solvent action of the formalin in which the specimen was preserved. An experiment made on the spicules of *Chirodota dunedinensis* showed that the spicules of that species were dissolved in formalin (probably owing to the decomposition of the latter); therefore it was considered unsafe to rely upon formalin material,

* Annales des Sciences Naturelles, Zoologie, 1905, p. 1.

† Herdman's Pearl-Oyster Reports, Supp. No. 5, 1903.

and the manuscript was accordingly withheld from publication. Subsequently, however, one of us found this curious Holothurian in quantity at Kaikoura and was able to study it in the fresh condition, when it became evident that spicules are really absent and that the genus *Rhabdomolgus*, so long discredited by systematists, must be revived. Professor Ludwig * has lately (1905) come to the same conclusion from the study of specimens of Keferstein's original species (*Rhabdomolgus ruber*), rediscovered on the coast of Heligoland.

We cannot conclude this brief introduction without expressing our thanks to several friends in New Zealand for their great kindness in helping to get together the collection, especially Professor W. B. Benham, Professor H. B. Kirk, Mr. A. Hamilton, and Mr. Henry Suter.

STICHOPUS MOLLIS, *Hutton*, sp. (Plate **12.** fig. 12.)

1872. *Holothuria mollis*, Hutton, Cat. Echinoderm. N.Z. p. 15.
1879. *Holothuria (? Stichopus) mollis*, Hutton, Trans. N.Z. Inst. vol. xi. p. 308.
1879. *Holothuria Robsoni*, Hutton, Trans. N.Z. Inst. vol. vi. p. 308.
1885. *Holothuria mollis*, Lampert, Die Seewalzen, p. 93.
1885. *Holothuria Robsoni*, Lampert, Die Seewalzen, p. 93.
1886. *Holothuria mollis*, Théel, Challenger Reports, vol. xiv. p. 239.
1886. *Holothuria robsoni*, Théel, Challenger Reports, vol. xiv. p. 239.
1886. *Stichopus sordidus*, Théel, Challenger Reports, vol. xiv. p 167.
1897. *Stichopus mollis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 46.
1897. *Holothuria Robsoni*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 48.
1897. *Stichopus mollis*, Whitelegge, Rec. Australian Museum, vol. iii. p. 50.
1898. *Stichopus mollis*, Ludwig, Hamburger Magalhaen. Sammelreise, Holothurien, p. 7.
1905. *Stichopus mollis*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 83.

Four specimens from Milford Sound, collected by Mr. D. Sutherland, and one specimen from Otago, collected by Prof. Benham at a depth of 20 fathoms, occur in the collection.

They vary in length from 7·0 cms. up to 13·4 cms. The smallest specimen is very dark brown in colour ; it possesses a much thicker body-wall than the other specimens, probably owing to its being in a state of contraction. Three other specimens are brown in colour, but in addition have irregular, dirty-white markings. The largest example is almost white and has a remarkably thin body-wall, but, as it does not differ from *S. mollis* in any other characters, we consider it merely a variety of this rather variable species.

The general integument of this species contains no other spicules but the characteristic tables. The tube-feet and papillæ, however, contain two or three kinds of spicules.

Each tube-foot is supported at its extremity by a slightly irregular perforated end-plate, round which are arranged a number of perforated bilateral plates.

* Zoologischer Anzeiger, Bd. xxviii. No. 12.

The dorsal papillæ are supported by stout curved rods, with either simple or branching extremities.

We follow Ludwig in including *Holothuria Robsoni*, Hutton, in this species.

STICHOPUS SIMULANS, sp. n. (Plate **11.** fig. 5.)

1897. *Stichopus mollis*, Dendy (*pars*), Journ. Linn. Soc., Zool. vol. xxvi. p. 48.

A single specimen of this species was briefly described by one of us under the heading of *Stichopus mollis*. As we have now obtained another example, possessing the dichotomously foliaceous spicules, from Resolution Island, we feel justified in proposing a new specific name.

In the specimen now before us the body is rounded at both ends and exhibits pronounced dorsal and ventral surfaces, the latter being much narrower than the former. The specimen is 3·5 cms. in length and 1·9 cms. in greatest breadth. The integument is very much contracted and folded. The colour is brown on the dorsal surface and pale brown on the ventral; in addition, pale streaks occur on both lateral surfaces. Four bands of very large papillæ, each terminating in a sucker, run along the dorsal surface, these papillæ reaching as much as 0·7 cm. in diameter in the contracted state.

In its present condition the ventral surface is deeply corrugated transversely. A dirty-white stripe runs down the mid-ventral line, and brown spots are sparingly scattered over the pale brown background of this surface. Tube-feet appear to be quite absent from the ventral surface.

There are twenty bushy tentacles, of approximately equal size, arranged round the ventrally situated mouth. Surrounding the buccal depression, which contains the retracted tentacles, is a complete circle of the large conical papillæ ending in suckers.

The anus, as usual, is a round aperture at the posterior end of the body.

The body-wall is very thick and tough, resembling that of *S. mollis*, and the spicules in it are confined to the outer portion. Of these there are two kinds:—

(i) Large numbers of the characteristic tables, which have the spire supported by four rods, these rods being united by two diagonal cross-bars about halfway up from the base (Pl. **11.** fig. 5 *a*). These are identical both in form and size with those of *S. mollis*.

(ii) Large numbers of the small spicules (about ·03 mm. in length) which have been described as dichotomously foliaceous in form (fig. 5 *b*). These occur most abundantly in the depressions of the surface, where they form an almost continuous layer. They form such a definite character that there can be no doubt about the specific distinctness of this form.

The form of the calcareous ring appears to be identical with that of *Stichopus mollis*.

There are twenty tentacular ampullæ; a large Polian vesicle situated ventrally, and a madreporic canal dorsally.

The other contents of the body-cavity have been ejected; therefore we are unable to add any further observations on the anatomy.

HOLOTHURIA DIFFICILIS, *Semper*. (Plate **13.** figs. 19 *a*–19 *c*.)

1868. *Holothuria difficilis*, Semper, Holothurien, p. 92.
1880. *Mülleria parvula*, Haacke, in Möbius, Meeresfauna d. Inseln Mauritius u. d. Seychellen, p. 46.
1883. *Holothuria difficilis*, Ludwig, Ber. Oberh. Ges. f. Nat.- u. Heilkunde, vol. xxii. p. 173.
1885. *Holothuria difficilis*, Lampert, Die Seewalzen, p. 68.
1898. *Holothuria difficilis*, Bedford, Proc. Zool. Soc. 1898, p. 838.
1901. *Holothuria difficilis*, Sluter, Holothurians of the 'Siboga' Expedition, p. 10.

Three specimens of this Holothurian were obtained by Mr. R. M. Laing off Norfolk Island.

The largest is 3·65 cms. in length and 1·4 cms. in greatest width. All the examples are dark brown in colour, but are somewhat lighter on the ventral surface than on the dorsal.

The tube-feet are almost restricted to the ventral surface, where they are very numerous.

The internal anatomy presents no peculiar features, but it is interesting to note that, although the specimens have been in spirit for at least ten years, the Cuvierian organs have not lost the adhesiveness and elasticity characteristic of them in the fresh condition—a fact which was noticed by Semper in the specimens that he examined.

Three kinds of spicules are found in the integument:—

(i) Tables, resembling those of *S. mollis*, consisting of a base with four columns supporting a spire, and two cross-bars uniting these columns (Pl. **13.** fig. 19 *c*).

(ii) Biscuit-shaped spicules, which are oval plates usually with six perforations arranged in two rows of three each, but there is considerable variation in the number of these perforations, as shown in fig. 19 *b*.

(iii) Irregular perforated plates occurring in the tube-feet (fig. 19 *a*).

CUCUMARIA ALBA, *Hutton*, sp.

1872. *Chirodota* (?) *alba*, Hutton, Cat. Echinoderm. N.Z. p. 17.
1879. *Echinocucumis alba*, Hutton, Trans. N.Z. Inst. vol. xi. p. 307.
1885. *Echinocucumis alba*, Lampert, Die Seewalzen, p. 167.
1886. *Echinocucumis* (?) *alba*, Théel, Chall. Reports, vol. xiv. p. 119.
1897. *Colochirus alba*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 35.
1898. *Cucumaria alba*, Ludwig, Hamburger Magalhaen. Sammelreise, Holothurien, p. 29

1903. *Cucumaria Filholi*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. ix. p. 144.
1904. *Cucumaria alba*, var. *Filholi*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. x. p. 367.
1905. *Cucumaria alba*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 85.
1905. *Cucumaria Filholi*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 88.

Nine examples of this species were obtained by Mr. Henry Suter, in Akaroa Harbour, at a depth of 4–8 fathoms.

The specimens vary in size from 1·2 cms. long and 0·35 cm. broad up to 3·4 cms. long and 0·8 cm. broad.

In all the specimens the two extremities are bent upwards, and, in addition, the posterior end is drawn out into a more or less pronounced caudal appendage. The ambulacral appendages are almost absent from the dorsal surface and are not very numerous on other parts of the body. They are concentrated towards the middle of the body, and here they show very little definite arrangement. Towards the extremities they are almost confined to the radii.

We have examined the calcareous ring in three examples, and find that the anterior processes of the radials have each a very narrow median cleft, giving them a bifid appearance. The same is the case in one of the specimens from Wellington Harbour previously studied by one of us. In none of these specimens, however, are the anterior ends of the inter-radials split.

We include *Cucumaria Filholi* under the heading of *C. alba*, as we do not think that Professor Perrier has adduced sufficient reasons for separating his specimens from the latter species. It is true that he describes the presence of a cleft in the anterior extremities of both radial and inter-radial plates; but we venture to doubt its existence in the latter, especially as a shallow groove runs up the middle of this process and produces an illusion of bifidity. Even if this cleft is present in Professor Perrier's examples, it constitutes but a very slight distinction. The tail is stated to be larger in *C. Filholi*; but our specimens vary so much in this character that we cannot attach any specific importance to it, and it probably depends very much on the state of contraction. Neither can we admit any specific difference in the arrangement of the tube-feet, such as Perrier attempts to demonstrate. The supposed differences in spiculation also appear to be trifling.

Cucumaria brevidentis, *Hutton*, sp.

1872. *Thyone brevidentis*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1886. *Thyone brevidentis*, Théel, Chall. Reports, vol. xiv. p. 141.
1897. *Colochirus calcarea*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 38.
1897. *Colochirus brevidentis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 40.
1898. *Colochirus brevidentis*, Ludwig, Hamburg. Magalhaen. Sammelreise, Holothurien, p. 30.
1898. *Colochirus brevidentis*, Ludwig, Zool. Jahrb., Suppl. iv. Part 2, p. 442.
1905. *Cucumaria brevidentis*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 110.

A large number of specimens of this animal were obtained from many localities. It appears to be by far the most common Holothurian occurring in the New Zealand area. The examples that we possess were obtained from the following localities:—Waitangi, Chatham Islands (collected by Prof. H. B. Kirk); Ouenga, Chatham Islands (collected by one of ourselves); Akaroa Harbour (collected by Mr. Henry Suter); Great Barrier Island (collected by Mr. Chas. Cooper); Stewart Island (collected by Prof. H. B. Kirk).

The examples from Ouenga were found living underneath stones on the beach between tide-marks. They were clinging to the stones with the aid of their tube-feet.

The specimens vary in size from 0·85 cm. by 0·3 cm. up to as much as 2·4 cms. by 1·1 cms. There is a very marked difference in appearance between the large specimens and the small ones, the large possessing a much darker and rougher integument than the small animals. This latter feature is probably due to the fact that the large calcareous nodules, which are common in the integument of the large ones, only occur very sparingly in the small specimens.

This difference is at first sight so marked that it was thought necessary to erect a new species (*C. calcarea*) for the reception of the small specimens; but after subsequent examination we consider that there is not sufficient justification for this course. We therefore concur with Ludwig in including *C. calcarea* under *C. brevidentis*.

We also agree with Perrier in referring this species to the genus *Cucumaria*, though we must admit that the distinction between these two genera, *Cucumaria* and *Colochirus*, appears to us to be not very satisfactorily defined.

This species has also been recorded, by Ludwig, from Juan Fernandez, on the other side of the Pacific Ocean—a very interesting case of agreement between the marine fauna of New Zealand and that of South America.

CUCUMARIA OCNOIDES, *Dendy*, sp.

1897. *Colochirus ocnoides*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 36.
1898. *Cucumaria ocnoides*, Ludwig, Hamburg. Magalhaen. Sammelreise, Holothurien, p. 30.
1901. *Ludwigia ocnoides*, Reiffen, Zeitsch. f. wissench. Zool. vol. lxix. p. 598.
1904. *Cucumaria ocnoides*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. x. p. 13.
1905. *Cucumaria ocnoides*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 96.

There are in the collection six examples of this remarkable Holothurian from New Brighton, near Christchurch. They vary in length from 8·5 cms. up to 14 cms. In the larger specimens the tube-feet are entirely restricted to the three ventral radii, where they are arranged in four somewhat irregular longitudinal rows along each radius. In the specimens before us the dorsal surface exhibits neither tube-feet nor papillæ.

The integument of the middle of the body seems to have the power of attaching foreign particles to itself, for in all our examples it is covered with sand.

The original account of this form given by one of us has been supplemented by both Reiffen and Perrier, so that the anatomy of the species is now very well known.

The species must be extremely abundant off the New Brighton beach, though seldom thrown up on the shore. On one occasion, however, after a storm, innumerable specimens were cast up at high-water mark together with immense quantities of other marine animals, as already described by one of us. "Probably I should be correct in saying that there were millions of this animal lying on the beach ; they lay in heaps and might have been collected with a shovel."* They were associated with large numbers of *Caudina coriacea* and burrowing lamellibranchs, and probably live buried in the sand, out of reach of ordinary tidal influences.

PHYLLOPHORUS LONGIDENTIS, *Hutton*, sp. (Plate **13.** figs. 18 *a*–18 *d*.)

1872. *Thyone longidentis*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1872. *Thyone caudata*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1879. *Pentadactyla longidentis*, Hutton, Trans. N.Z. Inst. vol. xi. p. 307.
1886. *Thyonidium rugosum*, Théel, Chall. Reports, vol. xiv. p. 95.
1886. *Thyone longidentis*, Théel, Chall. Reports, vol. xiv. p. 141.
1886. *Thyonidium caudatum*, Théel, Chall. Reports, vol. xiv. p. 147.
1891. *Phyllophorus caudatus*, Ludwig, Bronn's Klass. u. Ordnung., Holothuroidea, p. 347.
1891. *Phyllophorus rugosus*, Ludwig, Bronn's Klass. u. Ordnung., Holothuroidea, p. 347.
1897. *Phyllophorus longidentis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 42.
1898. *Phyllophorus longidentis*, Ludwig, Hamb. Magal. Sammelreise, Holothurien, p. 49.
1903. *Thyonidium anatinum*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. ix. p. 142.
1905. *Phyllophorus anatinus*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 112.

Two examples of this species were obtained in Akaroa Harbour by Mr. Henry Suter.

Although these two specimens differ somewhat in external appearance, a careful examination has convinced us that they belong to the same species.

In the smaller specimen (length 1·8 cms., breadth 0·7 cm.) the body is curved upwards at both ends, while in addition the tip of the tail is slightly flexed towards the ventral surface. The ambulacral appendages are distributed somewhat sparingly over the surface, but are concentrated along the radii, especially towards the extremities. The small tail is without appendages.

In the larger specimen (length 2·5 cms., breadth 1 cm.) the body is almost straight and the tail is very obscure, apparently retracted. The ambulacral appendages are more numerous and appear irregularly scattered over the body.

* Dendy, "Notes on a Remarkable Collection of Marine Animals lately found on the New Brighton Beach, near Christchurch, New Zealand," Transactions of the New Zealand Institute, vol. xxx. 1897, p. 320.

In both specimens the tail is paler than the remainder of the body, which is brown in alcohol.

As the anatomy of this species has never been fully described, we append the following particulars:—

There are twenty tentacles, five pairs of large alternating with five pairs of small, the latter being internal to the former.

The pharynx is very long and is supported by a large calcareous ring composed of ten plates, each made up of a number of small polygonal pieces. This ring has already been figured in detail by one of us *. A distinction between radials and inter-radials is only obvious in the anterior third of the ring, where the radials are not only separate from the inter-radials, but are distinguished from them by the fact that their anterior ends are bifid and truncate, whilst those of the inter-radials are single and pointed. A median cleft runs up nearly to the anterior extremity of each radial. These clefts almost divide the whole ring into five separate but compound segments. Posteriorly each cleft runs down to the extremity of one of the five posterior prolongations of the ring, which, in the former paper by one of us, have been described as formed by the union of processes of the inter-radials. We can no longer maintain this interpretation, for the processes in question are undoubtedly radial in position, and would therefore be prolongations of the radials. The structure of the ring in *Phyllophorus dearmatus*, sp. n. (Pl. **11.** fig. 8) supports this view.

The water-vascular ring surrounds the œsophagus in contact with the ends of the posterior prolongations of the calcareous ring. There is a single long, thin Polian vesicle placed ventrally; opposite to this is a long, thin madreporic canal ending in a small madreporite.

The alimentary canal resembles that of other species of the genus (e. g. *Phyllophorus dearmatus*, sp. n., described below).

The gonads are very feebly developed in the smaller specimen and are not well developed even in the larger one.

The spicules are perforated plates, each usually bearing a spine on its outer face. This spine is made up of two rods, which unite shortly above their origin (Pl. **13.** fig. 18 *d*). The plates are rather irregular in shape, but are frequently extended into four radiating arms, as already figured by one of us (*loc. cit.*). The dimensions of an average-sized spicule are:—length 0·35 mm., breadth 0·21 mm., height of spire 0·22 mm.; but these dimensions are very variable. The spines are very frequently broken off, especially in the older animals. The development of these plates is shown in Pl. **13.** figs. 18 *a*–18 *c*, and needs no fuller explanation. In a few of the plates spines are not developed at all.

We feel fully justified in including *P. anatinus*, Rémy Perrier, under the

* Dendy, "The Holothurians of New Zealand," Journ. Linn. Soc., Zool. vol. xxvi. fig. 66.

heading of *P. longidentis*, for the characters which Perrier considers peculiar to the former are of very minor importance from a taxonomic point of view. The difference in shape probably depends to a large extent on the state of contraction, and is a very uncertain character. The difference in the arrangement of the tube-feet is very slight and can be explained by the assumption that Perrier's example was a young specimen, and therefore had not developed as many tube-feet as the adult animal.

As to the supposed distinction between two kinds of perforated plates, we cannot find any difference in this respect between our specimens of *P. longidentis* and Perrier's *P. anatinus*, and, moreover, the supposed difference is in itself so slight as to be of no specific importance. In fact differences in the size of perforations of the kind figured by Perrier were also figured by one of us in *P. longidentis* many years ago (*loc. cit.*).

We are no longer able to refer to Hutton's type slide, but in the specimen from the Dunedin Museum, referred to in Dendy's earlier paper, we find several reticulate plates without spines, as figured by Perrier for his *P. anatinus*, and such also occur in both our specimens. Perrier was unable to open his specimen, but as the animal had been cleared in cedar-wood oil he was able to state that the calcareous ring has a complicated structure, very analogous to that of *P. longidentis*.

PHYLLOPHORUS DEARMATUS, sp. n. (Plate **11.** figs. 7, 8; Plate **12.** fig. 15; Plate **13.** fig. 20.)

A single specimen of this species was obtained by Mr. H. Suter in Akaroa Harbour at a depth of six fathoms.

The body of the animal, as preserved in spirit, is roughly cylindrical, tapering at both ends (Pl. **11.** fig. 7). Its length is 6 cms. and its greatest transverse diameter is 2·05 cms. The anterior part of the body forms an introvert which bears the ring of tentacles at its extremity; in the specimen before us it is retracted, with the result that the tentacles are directed backwards and occupy the spacious pharynx.

The body bears numerous small, but well-developed tube-feet, which are abundantly scattered over both radial and inter-radial areas; towards the extremities they are less numerous and their radial arrangement is more obvious. The tube-feet are more abundant on the ventral than on the dorsal surface.

The mouth is a circular aperture situated at the end of the introvert. It is surrounded by a circle of twenty tentacles which are arranged in two series, five pairs of large tentacles externally, alternating with five pairs of small tentacles internal to them. The larger tentacles are arboriform, about 1·65 cms. long, and bear comparatively few branches. On the stem and branches of these larger tentacles are deep red-brown spots, which have retained their colour in spite of the fact that they have been in spirit for more than ten years. These tentacles are arranged inter-radially, one pair to each inter-radius, and between the two which form the dorsal pair is situated the opening of the genital duct.

The inner ring of tentacles, arranged radially, exhibits a slight irregularity, which may be expressed by the accompanying diagram (fig. A).

Fig. A.

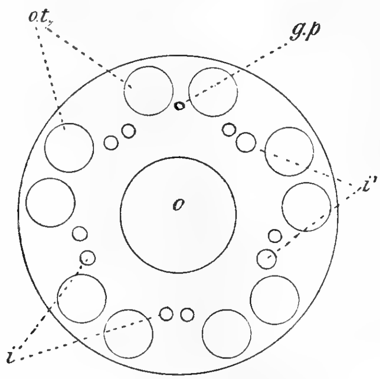


Diagram to show the size and arrangement of the tentacles in *Phyllophorus dearmatus*.— *g.p.* = genital pore; *i* = small tentacles of the inner ring; *i'* = two larger tentacles of the inner ring; *o* = oral aperture, *o.t.* = large tentacles of the outer ring.

It will be seen that on the right side the two tentacles of each inner pair are unequal in size, the lower one enlarged, while ventrally and on the left side they are equal. It is not likely, however, that this arrangement is constant, for in the allied genus *Pseudocucumis* there is considerable individual variation in this respect, as described by Bedford in his description of the Holothurians from Funafuti and Rotuma (P. Z. S. 1898, p. 844).

The eight smaller tentacles of the inner ring are thickly tufted arboriform structures each about 1 mm. in length. The two larger ones are each about 3 mm. long and resemble those of the outer ring in form.

The anus is situated at the base of a small depression at the posterior extremity of the body. It is surrounded by a circle of ten small papillæ which are probably modified tube-feet.

Spicules are absent from the body-wall itself, but are present in the tube-feet, at the end of each of which there is a large end-plate. These are slightly convex perforated plates usually about 0·35 mm. in diameter (Pl. **13.** fig. 20).

The internal anatomy seems quite typical of the genus *Phyllophorus* (Pl. **12.** fig. 15). The buccal cavity leads through the mouth into a spacious pharynx supported by a calcareous ring (Pl. **11.** fig. 8) of ten plates, five radial and five inter radial in position. The radial plates are each about 2 cms. long.

Anteriorly, each is produced into a process which is deeply cleft at its extremity; posteriorly, each is produced into two long and slender processes ending at the level of the circular canal. These two processes are closely approximated at their posterior ends, but in front the space between them widens out into a cleft which continues almost to the anterior end of the plate. The entire radial plate is formed by a number of roughly rectangular pieces, which form a single row down each process and are fairly regularly arranged. The inter-radial plates are somewhat shorter and a little wider than the radials. Each is concave behind and anteriorly produced into a pointed tongue-like process. Each inter-radial plate is composed of a number of small polygonal pieces.

The pharynx leads into a very thick-walled narrow œsophagus (fig. 15, *œ.*) a little more than 1 cm. long. After a slight constriction this widens out into a thin-walled intestine (*i.*) which exhibits the usual **S**-like curvature. The first descending limb is much convoluted, the ascending limb rather less so, and the last descending limb is straight. The first two limbs are kept in position by the dorsal mesentery and the last part by the right mesentery.

The terminal part of the alimentary canal is dilated into a cloaca in the dorsal wall of which open the two large respiratory trees. The cloaca is kept in position by a large number of muscle-fibres, radially arranged, running from its outer surface to the body-wall.

The respiratory trees (fig. 15, *r.t.*) are richly branched and extend almost to the anterior extremity of the body-cavity, the left tree being slightly larger than the right. They unite immediately before opening into the cloaca.

The five longitudinal muscle-bands are well developed. Although single whilst on the body-wall, at the anterior end each becomes double as soon as it passes on to the introvert, and runs along the latter as two very thin strips of muscle. Each strip is attached to the corresponding half of the bifurcate process of one of the radial plates.

The five retractor muscles of the pharynx are very stout bands attached to the radials at one end and to the corresponding longitudinal muscle-bands at the other. Their points of attachment to the radials are remarkably small, considering the thickness of the muscle, and in the specimen before us have all become detached from the corresponding plates.

Arising from the ambulacral ring, by a wide base, is a long thin Polian vesicle extending, in the retracted specimen, almost to the posterior end of the body-cavity (fig. 15, *p.*). The madreporic canal (fig. 15, *m.*) is a slender sinuous tube which ends in a small madreporite, situated on the dorsal mesentery.

Running along the intestine are the usual dorsal and ventral vessels.

The gonads (fig. 15, *g.*) consist of two bundles of slender radiating cæca placed right and left of the dorsal mesentery at about one-third the length of the animal from the anterior end (in the retracted state). As they appear to contain nothing but ova, this species is probably diœcious. A very slender genital duct (*g.d.*) runs forward along the dorsal mesentery and then on the introvert to open by a small aperture situated between the two large tentacles of the mid-dorsal inter-radius.

This species somewhat resembles *Phyllophorus Drummondii* (Thompson), in which also spicules are typically absent from the body-wall. They differ from one another chiefly in the size of the calcareous ring, which is little more than one-tenth the length of the body in *P. Drummondii*, whereas it is one-third the length of the body (in its retracted state) in *P. dearmatus*. In our species again there is only one Polian vesicle, whereas in *P. Drummondii* there are two or three. Finally, the geographical distribution is quite different, *P. Drummondii* having been recorded only from the Northern Hemisphere. Without hesitation, therefore, we consider our specimens to represent a distinct species, and propose the name *dearmatus* in view of the fact that it has lost the spicules of the body-wall.

PSEUDOCUCUMIS BICOLUMNATUS, sp. n. (Plate **11.** figs. 6, 6 *a*; Plate **12.** figs. 13, 14.)

A single example of this species was obtained by Mr. A. Hamilton off Dunedin.

The animal is cucumiform, tapering slightly at both ends, and possesses a short and inconspicuous conical tail (Pl. **11.** fig. 6). The length of the body is 3·5 cms. and the greatest transverse diameter is 1·25 cms. The tentacles are completely retracted within the pharynx.

The tube-feet are entirely restricted to the five radii, thereby giving the animal a very well-marked external radial symmetry. For the greater part of its length they form two double rows along each radius, but towards the anterior and posterior ends they are arranged in two single rows. The tube-feet are more numerous on the ventral than on the dorsal surface, and about the middle of the body may even form six irregnlar rows on each ventral radius. The inter-ambulacra are quite naked.

There are apparently nineteen tentacles, arranged in two circles round the mouth, at the anterior extremity of the body. The outer circle is formed by five pairs of large and richly branched arboriform tentacles, each about 0·7 cm. long. The inner circle is apparently formed by nine smaller tentacles, four pairs and an odd one alternating with the five pairs of large tentacles external to them. Probably there are normally five pairs of smaller tentacles in this species, as, in our specimen, there appears to be the remnant of another by the side of the odd tentacle, and it seems likely that the tentacle has been lost by accident; so that the total number would probably be twenty. The small tentacles are short and thickly branched, and about 1 mm. in length. Surrounding the circle of tentacles is a complete ring of small digitiform papillæ, each about 1 mm. long, forming a very definite circle.

The anus is situated in a small depression at the apex of the conical tail. It is a small circular aperture surrounded by fifteen small papillæ, three in each radius. These papillæ appear to be modified tube-feet.

The body-wall itself is rather thin, but the circular muscles attached to it are remarkably thick and form very conspicuous transverse bands between the radial longitudinal muscles. Whilst on the body-wall the latter are single, but as they run down the introvert each divides into two strips of muscle, and each strip ends on the corresponding process of the bifurcate radial.

The body-wall contains a large number of spicules which are almost entirely in the form of small tables (fig. 13 *a*). These tables have an approximately oval base perforated by eight holes, arranged radially, four large alternating with four small ones. The presence of these eight holes is very constant, for in examining several hundred of the tables the only exception found was the one represented in fig. 13 *b*, which is evidently abnormal. The spire is formed of only two pillars supporting a cross-bar at their distal extremities, and this bar usually bears about six spines. The dimensions of an average-sized table are :—length of oval plate, 0·058 mm. ; breadth, 0·041 mm. ; height of spire, 0·017 mm. The size of these tables is, however, very variable, the plate sometimes reaching 0·07 mm. × 0·049 mm. In a few of them the spire is not developed, with the result that biscuit-shaped forms are produced (fig. 13 *c*). These also have the usual eight perforations.

In addition to these spicules of the body-wall, two more kinds occur in the tube-feet. Each tube-foot is supported at its extremity by a circular convex perforated plate, usually about 0·28 mm. in diameter, and resembling those of *Phyllophorus dearmatus* in form. Round the edge of this end-plate is a complete circle of irregular perforated plates (fig. 13 *d*) which support the rim of the sucker.

The mouth leads into a wide thin-walled pharynx supported at its anterior end only by the calcareous ring (fig. 14), composed of ten simple plates, five radial and five inter-radial (fig. 6 *a*). The radials are oblong plates about three times as long as they are wide and bifurcate at both ends. Each anterior limb is abruptly truncated and exhibits a very slight further bifurcation. Each posterior limb tapers to a pointed extremity attached to the end of the corresponding inter-radial. These latter are Λ-shaped pieces, whose posterior extremities turn outwards and thicken slightly at their ends, where they are attached to the radials, as shown in the figure.

The retractor muscles are attached partly to the anterior limbs of the radials and partly to the pharynx-wall itself. Each runs from its pharyngeal attachment to the corresponding longitudinal muscle, and is inserted somewhat in front of the middle of the body (in its retracted state).

The posterior part of the pharynx narrows rapidly into an intestine (fig. 14, *i.*) which does not vary much in structure throughout its whole length, there being no differentiated œsophagus. It exhibits the usual S-shaped curvature. The first limb, extending to the posterior end of the body-cavity, is slightly convoluted; the middle part is almost straight; and the last limb is quite straight, and is supported by the right ventral mesentery. There is no well-marked dilatation of the terminal part of the intestine to form the cloaca, and there are no radially arranged muscle-fibres in that region; a fact which may doubtless be correlated with the feeble development of the respiratory trees.

The latter extend almost to the anterior extremity of the body, but are very little branched and differ markedly from the respiratory trees of *P. dearmatus*. They unite immediately before opening through the dorsal wall into the posterior end of the intestine.

The water-vascular ring (fig. 14, *a.c.*) surrounds the pharynx immediately before the latter narrows into the intestine. The Polian vesicle (*p.*) is a long thin tube ending in a pear-shaped dilatation, and arises from the ventral side of the ambulacral ring. It is 1·7 cms. in length; the diameter of the narrow portion is 0·5 mm. and of the dilatation 3·5 mm. The madreporic canal (*m.*) is a very slender sinuous tube arising from the dorsal part of the ambulacral ring, and running posteriorly to end in a somewhat large madreporite, attached to the dorsal mesentery.

The gonads (*g.*) consist of two bunches of very long filaments situated right and left of the dorsal mesentery a little behind the middle of the (retracted) body. The left bunch is larger than the right and its branches extend to both ends of the animal and are very numerous *. The genital duct (*g.d.*) runs forward in the dorsal mesentery from the junction of the two bunches of cæca to open to the exterior on the dorsal surface.

The spiculation and the structure of the calcareous ring distinguish this species from all other members of its genus.

The tables differ markedly from those of *P. intercedens*, Lampert, and this is the only other known species of *Pseudocucumis* with only two rods to the spire of the table. *P. bicolumnatus* is also distinguished from this species by the number of the tentacles and the presence of only one Polian vesicle.

CAUDINA CORIACEA, *Hutton*, sp.

1872. *Molpadia coriacea*, Hutton, Cat. Echinoderm. N.Z. p. 17.
1879. *Caudina ? (Echinosoma ?) coriacea*, Hutton, Trans. N.Z. Inst. vol. xi. p. 337.
1883. *Caudina meridionalis*, Bell, Proc. Zool. Soc. Lond. pp. 58–59, pl. 15. fig. 1.
1885. *Molpadia coriacea*, Lampert, Die Seewalzen, pp. 208–209.
1886. *Caudina meridionalis*, Lampert, Die Seewalzen, pp. 210–211.
1886. *Caudina coriacea*, Théel, Chall. Reports, vol. xiv. pp. 47, 54–55, pl. 3. fig. 4.
1897. *Caudina coriacea*, Dendy, Proc. Linn. Soc., Zool. vol. xxvi. pp. 28–32, pl. [3. figs. 9–18.

* Only a few of these branches are shown in fig. 14.

1898. *Caudina coriacea*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. pp. 456–464, pl. 29, figs. 1–13.

1898. *Caudina coriacea*, Ludwig, Hamb. Magalh. Sammelreise, Holothurien, pp. 63–64.

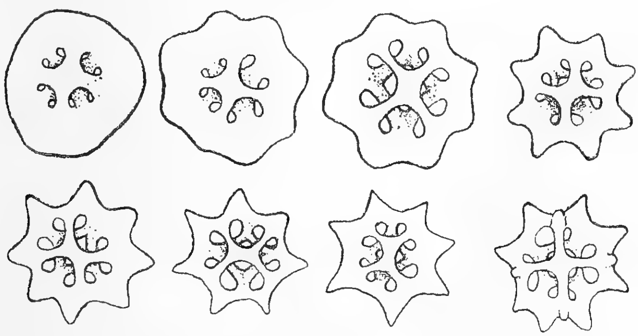
1905. *Caudina pulchella*, Rémy Perrier, Ann. Sc. Nat., Zool. 9e sér. i. 1905, pp. 117–120, pl. 5. figs. 14–17.

1905. *Caudina coriacea*, var. *brevicauda*, Rémy Perrier, Ann. Sc. Nat., Zool. 9e sér. i. 1905, pp. 121–123.

In July 1896, immense numbers of young specimens of this animal were thrown up on the beach at New Brighton, near Christchurch. Thirteen months later it was again cast up in the same locality in large numbers, together with countless millions of other marine animals, such as *Cucumaria ocnoides*, as already described by one of us. "The remarkable Holothurian *Caudina coriacea* was found in enormous numbers, and the specimens were nearly all adult, while on a previous occasion, as already mentioned, large numbers of young specimens were thrown up, and no adults. The American *Caudina arenata* is known to bury itself in the sand with only the tip of the tail projecting, and doubtless the same is true of our species, so that only a considerable disturbance of the sea-bed would cause it to be thrown on shore in such quantities."*

The characters which Perrier considers distinctive of his *Caudina pulchella* and of his variety *brevicauda* appear to us to be too slight for purposes of specific or even varietal distinction. The diameter of the caudal appendage would vary according to its state of contraction, and would always be a very unsafe character to depend upon. For a similar reason the thickness of the integument would also vary. As for the supposed difference in spiculation

Fig. B.



Spicules of *Caudina coriacea* (× 345).—All the spicules in this figure were from the integument of one specimen. (Camera drawing.)

we doubt its existence, for the integument of each example of *C. coriacea* that we have examined contained every variety of spicule shown in the

* Dendy, "Notes on a remarkable Collection of Marine Animals lately found on the New Brighton Beach, near Christchurch," Trans. N.Z. Inst. vol. xxi. p. 323.

accompanying drawing (fig. B) and also gradations between them. It will be seen from this figure that the range of variation is such as to include both varieties which Perrier figures for his *Caudina pulchella*.

On the other hand, the exact agreement of the calcareous ring, spiculation, general form of the body, number of tentacles, and, finally, the fact that Perrier's two specimens also come from New Zealand, convince us that *Caudina pulchella*, Rémy Perrier, is not distinct from *Caudina coriacea*, Hutton.

CHIRODOTA GIGAS, sp. n. (Plate **12.** figs. 9–11.)

The following description is taken from a single individual, collected at the Chatham Islands by Prof. H. B. Kirk. Unfortunately, it had broken into three pieces, and, in addition, ejected most of its gut, before it came into our possession.

The fragments when put together measure as much as 11·3 cms. in length, with a maximum transverse diameter of 1·2 cms. The body tapers posteriorly to a transverse diameter of 0·7 cm. at the extremity. As these measurements were made on a spirit-specimen, the living animal must have been very large for a *Chirodota*.

The body is elongated and cylindrical, attaining the greatest diameter immediately behind the anterior extremity. This region of the body is thickly covered by small round papillæ. The number of these papillæ gradually diminishes posteriorly, while they unite to form somewhat vermiform prominences which are most abundant in the middle of the body and disappear towards the posterior extremity. In this latter region the papillæ are again small and round, resembling those of the anterior part of the body. All these papillæ contain aggregations of the characteristic wheel-shaped spicules.

At the anterior end is a circle of twelve pinnate tentacles, whose digitiform processes are arranged in a single row along each side of a wide stem. These processes increase in length distally, the terminal pair being usually about three times the length of the proximal pair. The number on each tentacle varies from twelve to fourteen (*i. e.*, six or seven pairs). The retracted tentacles are situated in a funnel-shaped depression, at the bottom of which is the mouth.

The body-wall is thickest at the anterior end, and here the aggregations of wheels are very numerous. Posteriorly it becomes thin and semitransparent, and the wheel-bearing prominences are very conspicuous.

There are four kinds of spicules :—

(i.) Small six-rayed wheels (figs. 11 *c*–11 *g*.), which are commonly 0·1 mm. in diameter, but vary from 0·08 mm. up to 0·13 mm. In structure these wheels appear to differ both from those of *C. dunedinensis*, as described by Dendy *, and also from those of *C. pisanii*, as described by Ludwig †.

In *C. pisanii* a plug is developed from the original six-rayed cross, which grows up and fills the round hole left between the spokes on the outer face of the wheel. In *C. dunedinensis* this plug is not developed, and the round hole on the outer face is left open.

In *C. gigas*, on the other hand, the six spokes on the outer face themselves unite completely in the middle, and form a round papilla without any perforation. A plug is not developed and the papilla in the centre of the outer face of the wheel is thus formed quite differently from that of *C. pisanii*. The development of these spicules (figs. 11 *e*, 11 *f*) appears to take place as in *C. dunedinensis*, and the young forms have a round hole in the middle of the outer face, as in that species.

A single four-rayed wheel (fig. 11 *g*) was found ; this is a point of some interest, as the presence of six rays is regarded as a generic character.

The arrangement of the wheels is also of interest. At the anterior end of the body they are confined to the round papillæ, each of which contains on an average about thirty wheels. Towards the middle of the body, where the papillæ seem to run together, the wheels are accordingly collected mainly in larger aggregations of somewhat vermiform shape, and in addition a few wheels occur isolated in the body-wall, thus giving a condition intermediate between *Chirodota* and Ludwig's genus *Trochodota*. Towards the posterior extremity the papillæ (now round again) become more definite and are arranged concentrically around the anus.

(ii.) Short and thick curved rods (fig. 11 *b*) slightly expanded at both ends, which are covered with short spines. The average length of these rods is 0·1 mm., and thickness 0·016 mm., but they vary both in size and shape. Their ends are occasionally bifurcate.

These spicules are concentrated along the radii as five wide bands, one outside each longitudinal muscle, but also occur scattered about the inter-radial areas.

(iii.) Smooth slender curved rods (fig. 11 *h*), frequently with slightly branching ends. The average length is about 0·065 mm., and thickness 0·005 mm. ; but they are very variable both in size and shape. These spicules are confined to the tentacles, where they form two rows in each branch of each tentacle.

(iv.) Short thick rods, with smooth and rounded ends (fig. 11 *a*), sometimes known as miliary granules. A fairly large example of these is 0·035 mm. in length and 0·01 mm. in thickness, but they vary enormously in size. These spicules are restricted to the radii, where they form two bands (each two or

* Dendy, Journ. Linn. Soc., Zool. vol. xxvi. 1897, pp. 49–50, figs. 1–6.

† Ludwig, Zeitschr. f. wiss. Zool. pp. 350–353, pl. 16. figs. 1–9.

three spicules wide), one on either side of each mid-radial line, and thus in the middle of the broad band of larger curved rods.

The two ventral muscle-bands are much closer together than the other three bands.

The calcareous ring (fig. 9) is composed of twelve short nodular pieces, five being radial and seven inter-radial in position (as in *Chirodota fernandensis*). The two extra inter-radial pieces are situated one in each lateral dorsal inter-radius. The inter-radial nodules possess two short posterior processes where they join the radials. The latter are simple ovoid pieces. The figure shows the junction of two inter-radials as well as that of the radials with the inter-radials.

The water-vascular system consists of an ambulacral ring, from which are given off twelve large tentacular canals running up to the tentacles. A large number of Polian vesicles arise from the ventral half of the ring (fig. 10). In our specimen there are nineteen well-defined vesicles (*p.*), and in addition two or three papillæ which may be small ones, but the number is probably indefinite. A tightly-coiled madreporic canal (*m.*) runs forward in the dorsal mesentery and ends in an oval madreporite.

The gonads consist of two bunches of long cæca, extending to the middle of the body, which are arranged right and left of the dorsal mesentery. From their point of union, at about the level of the calcareous ring, the genital duct runs forward in the dorsal mesentery.

The characters detailed above, especially the size and the spiculation, distinctly mark off this animal from all hitherto described species of *Chirodota*. It is distinguished from *C. dunedinensis*, the only other known New Zealand species with wheels, by

(1) The much larger size of the animal.
(2) The presence of twelve instead of ten tentacles.
(3) The structure of the calcareous ring.
(4) The presence of numerous Polian vesicles.
(5) The absence of sigmoid spicules.
(6) The presence of definitely arranged rods and granules.
(7) The much smaller size of the wheels and the closure of the round holes on their outer faces.

The species presents a condition intermediate between that of *Chirodota*, in which the wheels are all aggregated into papillæ, and that of *Trochodota*, in which they are scattered. We therefore consider it undesirable to recognize any generic distinction between these two forms.

CHIRODOTA GEMINIFERA, sp. n. (Plate **14.** fig. 30.)

We propose this name for a single specimen of a remarkable *Chirodota* which was obtained from the New Brighton Beach, near Christchurch, by

Mr. Henry Suter in 1896, at the same time as the original specimen of *Rhabdomolgus novæ-zealandiæ.* The specimen was slightly damaged, about 2·5 cms. in length and about 0·15 cm. in transverse diameter in the middle. When it first came into our hands it was of a very pale pinkish colour, nearly white, and opaque, the opacity being probably due to the alcohol in which it was preserved.

The tentacles are ten in number, pinnately branched, each with about five branches on each side increasing in length towards the distal end of the tentacle. The calcareous ring is feebly developed and composed of numerous small pieces, the arrangement of which could not be satisfactorily made out. The internal anatomy, so far as determinable, is typical.

The integument bears numerous scattered sense-papillæ as in *Rhabdomolgus novæ-zealandiæ.* It contains no wheels but fairly numerous scattered, slender, contort, sigmoid spicules, about 0·05 mm. in length, which as a general rule have sharply and gradually pointed ends (fig. 30 *a*). The spicules appear to be confined to the anterior portion of the body, where they are uniformly scattered over the inter-radii, leaving a narrow band opposite the middle of each longitudinal muscle quite free from them. The most remarkable feature about them is their apparently constant arrangement in pairs (figs. 30 *b*, 30 *c*), the two individuals of each pair lying parallel with one another and so close together as frequently to appear as a single spicule. In each pair the curvature of the two sigmata appears to be identical, and in the case of the larger ones the two components of the pair actually appear to have fused together by concrescence throughout the greater part of their length, remaining separate only at the two extremities (fig. 30 *c*). We believe that this curious arrangement of the sigmata in pairs is unique; but in *Chirodota japonica*, which is perhaps the most closely related species, they are arranged in radiate groups of from three to nine *.

Like *Chirodota japonica*, our species would fall under Studer's proposed genus *Sigmodota*, characterized by the presence of sigmoid spicules without wheels; this genus has, however, been abandoned by recent authors. The reduction of the spiculation in "*Sigmodota*," and especially the absence of spicules from the hinder part of the body of our species, seem to indicate the probability that the species of *Rhabdomolgus* are simply *Chirodotas* which have progressed still further in this direction and completely lost their spicules.

RHABDOMOLGUS NOVÆ-ZEALANDIÆ, sp. n. (Plate **11.** figs. 1–4; Plate **13.** figs. 16–17; Plate **14.** figs. 22–29.)

The history of this species has already been briefly referred to in our introductory remarks. It first became known through the discovery of a

* *Vide* Théel, 'Challenger' Reports, vol. xiv. Holothurioidea, p. 17.

single specimen on the New Brighton Beach (near Christchurch, New Zealand), by Mr. Henry Suter in 1896. This was described by one of us at the time, but as it was preserved in formalin, which frequently has a solvent action on calcareous spicules, it was considered inadvisable to publish. Subsequently however, in December 1898, the species was again found by one of us at Kaikoura, on the east coast of the South Island of New Zealand, where it occurs in large numbers under stones between tide-marks. Again in 1901 a considerable number of specimens were found by one of us living under rocks or in pools on the shore at Ouenga, in the Chatham Islands. It is therefore evidently a common species in the localities where it occurs, but its distribution would appear to be very sporadic.

External characters.—The living animal is of a pale pinkish-brown colour, very transparent. The surface is beset with numerous minute papillæ (sense-papillæ), which give it a finely granulated appearance. These papillæ are especially abundant at the anterior end.

A specimen from Kaikoura in life measured about 5 cms. in length, but after preservation in alcohol only 2·9 cms. The largest specimen in the collection measures (in spirit) 4·75 cms. in length, 0·55 cm. in transverse diameter at the anterior and 0·40 cm. at the posterior end ; so that the living animal may probably attain a length of at least 8 cms.*

In spirit-specimens the body is elongated, cylindrical and vermiform, with a slight spiral twist ; it is slightly expanded at the anterior and tapers towards the posterior end. The surface is slightly wrinkled transversely throughout most of its length, but at the anterior end this wrinkling is very inconspicuous (fig. 1). The integument is very thin and transparent, especially at the anterior end, showing the longitudinal and circular bands of muscle, the latter being very feebly developed in the more thin-walled anterior portion. Tube-feet are entirely absent. The mouth is a circular aperture at the anterior extremity, and is surrounded by a circle of ten outwardly-curving tentacles, of equal size, about 2·3 mm. in length (fig. 17). Each tentacle gives off twelve pinnately arranged branches, which increase gradually in length from 0·3 mm. at the base, up to 1·4 mm. at the apex of the tentacle. Each branch in the present retracted condition is strongly curved towards the posterior end of the body and its concave surface is deeply wrinkled, even slightly lobate, transversely, as shown in fig. 17. The anus is usually conspicuous as a wide pentagonal opening, surrounded by a raised lip, at the posterior extremity. The genital pore is situated between the bases of the two dorsal tentacles and internal to them.

A very noticeable feature of this animal is its tendency to break up into

* Ludwig gives the dimensions of spirit-specimens of *Rhabdomolgus ruber* as only 5 mm. long and 0·6 mm. thick. Keferstein's original specimen was 10 mm. long, presumably in life.

three parts when irritated. Of the spirit-specimens in our possession about half the number exhibit two very well marked constrictions, one about the middle of the body, and the other about midway between this and the posterior end. The constriction in the middle of the body is of very constant occurrence, for out of about thirty specimens only one (fig. 1) was entirely free from it. There does not appear, however, to be any special structural modification in relation to this tendency.

Integument.—The body-wall, as in all known Holothurians, exhibits four layers:—(i.) an epithelial layer (epidermis) ; (ii.) a connective-tissue layer with a nervous layer internally ; (iii.) a muscular layer ; and (iv.) a peritoneal layer.

(i.) *Epidermis.*—A thin structureless cuticle (fig. 4, *cu.*) covers the outside of the epidermis and appears to be continuous over the whole surface of the animal. The epithelial cells (figs. 3, 4, 22, *c.e.*) are elongately columnar and arranged in a single layer; the average size of each is about 15 μ by 3 μ. Each cell possesses a conspicuous deeply-staining nucleus, which is usually situated about the middle of the cell. All the cells taper internally and become more granular.

In addition to the ordinary columnar epithelial cells, gland-cells (fig. 22, *gl.*) occur, especially on the tentacles and on the papillæ of the integument. They are elongated ovoid cells, each possessing very granular protoplasm and a large nucleus. Sense-cells of the usual type also occur in the papillæ ; they will be described later under the head of sense-organs.

(ii.) *Connective-tissue layer* (figs. 3, 4, 22, *c.l.*).—This usually consists of a very loose layer of connective-tissue fibres containing a few nucleated connective-tissue cells scattered about amongst them. It varies considerably in thickness (from 5 μ–50 μ), being especially thick in the sense-papillæ. On the inner face of the connective-tissue layer is a layer of nerve-fibres and nerve-cells (*n.l.*) In the sense-papillæ there is also a thin layer of nerve-fibres (fig. 22, *s.n.*) just beneath the epidermis, which is connected with the deeper nervous layer by a special nerve (*n.p.*) in each papilla. This layer does not seem to occur in other parts of the body.

(iii.) *Muscular layer.*—There is a layer of circular muscles (figs. 3, 4, 22, *c.m.*) immediately beneath the nerve-layer. Its average thickness is about 10 μ. This layer is continuous, not being interrupted by the longitudinal muscle-bands. At short intervals throughout the length of the body it becomes thickened and forms a series of transverse ridges projecting into the body-cavity.

The longitudinal muscles form five stout radially situated bands arising from the calcareous ring and running back to the posterior end (figs. 16, 22, *l.m.*).

(iv.) *Peritoneal layer* (fig. 22, *per.*).—This is a single layer of cubical cells showing indications of cilia in places, each cell with a conspicuous nucleus. As usual, it forms a continuous lining to the body-cavity.

General Structure of Alimentary Canal (fig. 16).—The mouth leads into a wide pharynx supported by the calcareous ring. The pharynx narrows down to a short œsophagus, which gradually increases in size and passes insensibly into the intestine, which is sacculated and slightly convoluted ; but this latter feature may, to some extent, be due to the contraction of the body. It is kept in position by two mesenteries, the anterior one being mid-dorsal in position (*d.m.*), and the posterior one on the right side. As in all Holothurians, the anterior mesentery extends to about the middle of the body of the animal, and is attached to the dorsal side of the alimentary canal and to the body-wall in the mid-dorsal line (*d.m.*). The right mesentery commences immediately behind the dorsal one, and extends between the right side of the alimentary canal and the right longitudinal muscle, to the posterior extremity. Along the intestine run the usual dorsal and ventral vessels.

Histology of Alimentary Canal.—The epidermis of the buccal region within the bases of the tentacles does not differ from that of other parts of the body except in the absence of sense-papillæ and in the presence of large numbers of ciliated depressions, presumably taste-pits, which will be described later on. The buccal region passes gradually into the pharynx, but around the actual mouth is a thicker layer of circular muscle-fibres which probably serves as a sphincter.

The pharynx is thick-walled and exhibits the following layers from without inwards :—(i.) A layer of peritoneal epithelial cells. (ii.) A very thin outer layer of connective tissue. (iii.) A layer of circularly arranged muscle-fibres, which is fairly well developed. (iv.) A layer of longitudinal muscle-fibres. (v.) An inner very thick layer of connective tissue in which the fibres are further apart than in the corresponding layer of the integument. It contains a large number of stellate and bipolar connective-tissue cells and a few apparent amœbocytes. Some of the latter are large with deeply-staining granular protoplasm. In addition to these large amœboid cells, other brown bodies are present which may be either large single cells or aggregates of cells. There is no nervous layer within this layer. (vi.) An inner epithelium lines the pharynx and is composed of elongated columnar cells, tapering peripherally, and covered at their free ends by a hyaline cuticle. Gland-cells occur very commonly between the ordinary columnar cells ; they are much longer than the latter and are rounded off peripherally. They are often arranged around depressions in the epithelium to form simple glands. In the pharynx also occur ciliated depressions (taste-pits) similar to those which are so common in the buccal region. "Sphæruliferous corpuscles" and wandering-cells are found embedded amongst the epithelial cells.

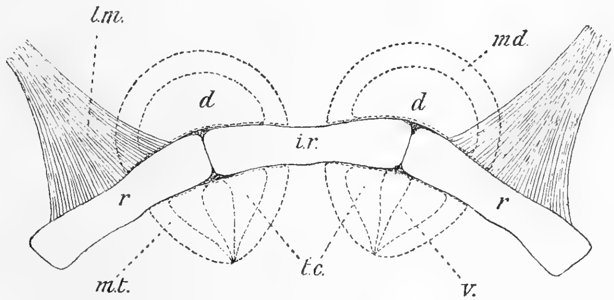
The intestine appears to be uniform in structure throughout its whole length and differs from the pharynx only in the following details:—

(i.) The epithelium is much more glandular and its surface is much more irregular than in the pharynx.

(ii.) There appear to be many more wandering-cells both in the epithelium and in the inner connective-tissue layer.

Calcareous Ring.—The calcareous ring is composed of ten simple, somewhat dumbbell-shaped pieces, five radial and five inter-radial. These pieces are all very similar to one another, and the difference between radials and inter-radials can only be recognized by their position with regard to other structures, especially by the attachment of the longitudinal muscles to the radials. The natural clefts between the pieces are overlapped and almost concealed by the diverticula of the tentacular canals (fig. 17), and at first sight the junctions appear to be in the constricted portions of the ring between the tentacular canals. This appearance, however, is deceptive, and the true relation of the constituent parts of the ring to the radial muscles and tentacular canals is shown diagrammatically in the accompanying text-figure (fig. C).

Fig. C.



Diagrammatic transverse section through the calcareous ring of *Rhabdomolgus novæ-zealandiæ*.—*d* = diverticula of tentacular canals; *i.r.* = inter-radial; *l.m.* = longitudinal muscle-band; *m.d.* = muscular wall of diverticulum; *m.t.* = muscular wall of tentacular canal; *r* = radial; *t.c.* = tentacular canals; *v.* = valve.

Water-vascular System.—The circular canal is a thin-walled tube which encircles the pharynx just behind the calcareous ring (fig. 17, *a.c.*). Its wall is only 12 μ thick, but yet the following layers can be distinguished:—(i.) An outer layer of peritoneal cells; (ii.) a connective-tissue layer; (iii.) a clear zone which does not appear to contain either cells or nuclei; (iv.) a thin layer of circular muscle-fibres; (v.) a lining endothelium composed of cells, probably ciliated, resembling peritoneal cells.

The circular canal gives off a single madreporic canal (*m.*) dorsally, a single Polian vesicle (*p.*) ventrally, and in addition ten adradially situated tentacular canals (*t.c.*) to the tentacles.

The madreporic canal is nearly straight and ends in an inconspicuous madreporite. Its length is about 1·3 mm. and transverse diameter 0·18 mm. Its wall consists of three layers :—(i.) An inner layer of columnar cells which are much longer on the side remote from the dorsal mesentery than on the side to which it is attached (fig. 24); (ii.) a connective-tissue layer, from which calcareous deposits are absent; (iii.) a layer of peritoneal cells.

The Polian vesicle is a comparatively large thin-walled sac of an elongated ellipsoid shape, opening into the circular canal on its ventral side. It is usually about 2·5 mm. long and 0·5 mm. in thickness at its widest part. The wall appears to contain the same layers as the circular canal, but they are thicker owing to the greater development of the muscular and connective-tissue layers.

The ten tentacular canals arise from the anterior side of the circular canal. They run forward on the pharynx internal to the calcareous ring. Opposite the anterior part of the ring they widen considerably, and each canal gives off a blind diverticulum which runs backwards over the outer side of the calcareous ring and is very closely applied to it (fig. 17, *d*, and fig. C, *d*). The calcareous ring therefore appears to be partially enclosed in the tentacular canals, as shown in fig. C and in Pl. **14.** fig. 23, the walls of the tentacular canals themselves and of their backward diverticula being so thin where they touch the ring as to be inconspicuous. From the position of these diverticula it seems possible that they may represent the remnants of tentacular ampullæ, for when present these are also frequently attached to the calcareous ring, for a short distance at least. Near its base, and opposite to the diverticulum on the other side of the calcareous ring, each tentacular canal shows in section a couple of longitudinal septa (fig. C, *v.*) which doubtless represent the valves described by Hamann in *Synapta* *.

The tentacles exhibit five layers in their walls (fig. 4) :—(i.) An external columnar epithelium, the cells of which are very long, tapering internally, and are covered at their outer ends by a thin layer of cuticle. These cells do not differ from those described under the heading of integument, except in being longer (50–60 μ) on the outer side of the tentacle. (ii.) A connective-tissue layer which varies considerably in thickness, but is usually thickest on the outer side of the tentacle. It has the structure of the connective tissue of the integument, containing connective-tissue cells, stellate cells, and scattered fibres, with an internal nervous layer; in addition it contains a great number of peculiar, large and frequently multi-nucleate cells of doubtful nature. (iii.) A very thin layer of circular muscle-fibres. (iv.) A layer of longitudinal muscles supported internally by a basement membrane. This layer is thickest in the stem of the tentacle, gradually diminishing in

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 33.

thickness and finally disappearing at the end of the pinnules. (v.) A layer of peritoneal cells.

Nervous System.—The central nervous system consists of a ring of nervous tissue surrounding the pharynx between the latter and the calcareous ring. The nerve-cells are arranged in definite bands and are thus very conspicuous, as they stain deeply. From the nerve-ring arise five radial nerves (figs. 17, 23, *n.*) which run forwards between the tentacular canals, bend outwards beneath the five longitudinal muscles and then run backwards beneath the latter for a very short distance. They disappear before reaching the level of the calcareous ring, leaving only a cavity, containing some structureless substance which looks as if it were a coagulum (fig. 22, *cav.*). This cavity probably represents both epineural and hyponeural canals from which the nerve has disappeared. It persists to the posterior end of the body, where it ends blindly.

The structure of the radial nerve before it disappears is quite typical (fig. 21). Each is divided into two bands, an inner and an outer, by a very thin septum, which passes across the nerve nearer to the hyponeural than the epineural canal. The nerve-cells are arranged chiefly in two aggregations on the sides of the outer band, as shown in the figure. There is also a tract of nerve-cells on the inner side of the inner nerve-band adjacent to the hyponeural canal. The epineural canal is large and well-defined, the hyponeural less so.

Each radial nerve gives off a pair of nerves shortly after its origin ; each of these nerves supplies the corresponding otocyst.

In addition to the nervous system described above, there is the continuous layer of nerve-fibres and nerve-cells immediately exterior to the circular muscular layer of the integument. This layer supplies nerves to the sense-papillæ and to the " taste-pits," described below.

Sense-Organs.

(i.) *Sensory papillæ* (fig. 22, *p.*).—These are distributed over the whole surface of the body, but are most numerous in the anterior part. Each consists of a core of connective tissue covered by the epidermis, and contains a special ganglionic mass (*g.*), supplied by a nerve (*n.p.*) which comes from the nerve-layer. The ordinary columnar cells of the epidermis in these papillæ are much longer than those of the general surface of the body. The ectoderm also contains gland-cells and sensory-cells similar to those described by Hamann in the sense-papillæ of *Synapta* *. The lower ends of these sensory-cells are connected with the ganglion by means of nerve-fibrils, which form a thin layer beneath the ectoderm-cells, and appear

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 18.

to radiate from the ganglion, which also lies immediately beneath the epidermis.

(ii.) "*Taste-pits*" (fig. 3).—These are common in the epithelium of the buccal region. Each consists of an ectodermal pit which is lined by very regular, concentrically-arranged, columnar cells. As the nuclei of these cells are situated at their bases, the whole organ appears as a conspicuous sub-spheroid body in the ectoderm, with a diameter of 0·031 mm. In the centre of this body is a core of sensory cells (*c.*) bearing short cilia which project into the lumen of the pit. A nerve (*n.*), arising from the nerve-layer of the integument, supplies these sensory cells. From the structure of these cells it is probable that they are gustatory in function, and their restriction to the buccal region also supports this view. The ordinary columnar cells of the pit appear to serve merely as a support for the sensory cells of the core.

These organs resemble the ciliated pits described in *Synapta* by Hamann *.

(iii.) *Otocysts* (fig. 2, fig. 23, *ot*).—There are five pairs of otocysts, each pair being situated on the pharynx right and left of the corresponding radial nerve shortly after its commencement. Each is supplied by a branch from its corresponding nerve. The structure of the otocyst appears to differ somewhat from that of *Synapta*, as figured by Semon †. In transverse sections the sac appears triangular with somewhat convex sides and rounded angles. The length of the otocyst is 0·084 mm. and breadth 0·056 mm. Its wall is formed by a single layer of cells which on the side nearer to the radial nerve are of approximately equal size and cubical in shape. The middle of the wall remote from the radial nerve appears as a thin membrane (fig. 2, *d.*) and is composed of flattened cells. The nerve enters at one corner of the triangle, and here the lining cells of the otocyst are more elongated than in any other part. The nerve appears to separate into fibres which form a layer round the outside of the otocyst. The sac contains numerous rounded otoliths (*ot.*) of varying size.

Reproductive Organs.—The sexes are distinct. In both male and female the gonads (fig. 16, *g.*) consist of two bunches of sparingly-branched cæca, arranged right and left of the dorsal mesentery in the anterior third of the body-cavity. The left bunch is larger than the right. About the level of the ring-canal they unite in a slender genital duct (fig. 17, *g.d.*) running forwards in the dorsal mesentery to open mid-dorsally between, and internal to, the two dorsal tentacles.

"*Ciliated Funnels*" (figs. 25–29).—Peculiar funnel-shaped organs occur commonly on the mesentery and the longitudinal muscle-bands; in the former position they are almost invariably clustered together, in little groups of

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 22.

† Semon, Beiträge zur Naturgeschichte der Synaptiden des Mittelmeeres. 2. Mittheilung. Mittheilungen aus der Zoologischen Station zu Neapel, vol. vii. pl. 15. fig. 8.

about twenty individuals, whereas in the latter position they are usually isolated. The size of the open ciliated funnels from the mesentery is usually about 0·147 mm. in length, and 0·054 mm. in transverse diameter across the widest part.

The form of a ciliated funnel from the mesentery is shown in fig. 25. The entire organ may be regarded as a flat plate with the two sides curved inwards until they meet at the base, but left gaping for the greater part of their length. These ciliated funnels from the mesentery are always situated on the end of a long stalk and all of them appear to be widely open. The centre of the funnel is always filled with a large number of cells which may possibly be cœlomic cells carried into it by the action of the cilia occurring on the inside of the funnel (fig. 27).

The wall of the funnel appears to consist of a single layer of regularly arranged columnar cells bearing cilia on their inner ends. Semon describes the ciliated funnel of *Synapta* as possessing two layers of cells, an outer layer of peritoneal epithelium and an inner layer of columnar cells. We have not yet had an opportunity of examining these organs in *Synapta*, but in our *Rhabdomolgus* we have not been able to detect the external peritoneal covering.

The "funnels" which occur on the longitudinal muscle-bands appear to differ from those occurring on the mesentery. They are apparently not ciliated and present various stages from a mere closed sac-shaped body, at the end of a stalk, to the funnel-shaped body shown in fig. 26. In the earlier stages of their development these organs appear to be quite solid, and ovoid in form, consisting of a central mass of protoplasm containing a few scattered nuclei, surrounded by a more or less definite outer layer of cells as shown in fig. 28. The central mass of protoplasm later on appears to break up into large cells with conspicuous nuclei, which may be seen in figs. 26 & 29. At the same time the whole structure increases in size, becomes funnel-shaped, and finally opens at the distal extremity, apparently to allow the large granular cells of the interior (? ova) to escape (fig. 26).

From a consideration of the above facts, it seems possible that these remarkable funnel-like structures may be parasites. All those occurring on the longitudinal muscles appear to be of the same kind and possibly represent one stage in the life-history of the individual. The cells which escape from these funnels are certainly very different from any other cells occurring in the Holothurian both in size and structure. They may possibly give rise to the "ciliated funnels" of the mesentery or to others of their own kind.

The open ciliated funnels of the mesentery may thus represent another stage in the life-history, or may even be males, while those on the longitudinal muscles are females. A strong argument in favour of the view that these structures are parasites is the fact that they are much less numerous in some individuals than in others and also that they have no definite arrangement, but are scattered haphazard over the peritoneal epithelium. In *Rhabdomolgus ruber* these organs appear to be absent *, a fact which also supports our suggestion as to their nature.

A variety of functions have been assigned to these organs, but none of them seem very probable. Some authors have regarded them as excretory organs; others suppose that they serve to maintain the circulation of cœlomic fluid; whilst one regards them as accessory respiratory organs. Semon † described those of *Synapta* in detail, and came to the conclusion that they are "lymph-stomata." Ludwig discusses the question and also gives references to the literature in his work on the "*Holothuroidea*" in Bronn's 'Klassen und Ordnungen des Thier-reichs.' Although differing considerably in structure, the ciliated urns of the Sipunculidæ may perhaps be cited as a parallel case of structures previously regarded as integral parts of the animal in which they occur and subsequently as parasites.

The genus *Rhabdomolgus* was founded by Keferstein in 1863 for an apparently pelagic Holothurian observed only once, at St. Vaast, and to which he gave the specific name *ruber* ‡. Ludwig has recently re-described the species after an interval of forty-two years (*loc. cit.*).

That the New Zealand species is distinct from that found at St. Vaast can, we think, scarcely be doubted. In the latter the tentacles are "undivided, slightly lobate on the sides," whereas in our species the pinnæ of the tentacles are well developed. An even more striking difference is the enormous size of the New Zealand species as compared with the European one.

The probable relationship of *Rhabdomolgus* to *Chirodota* is discussed under the heading of *Chirodota geminifera*, sp. n.

EXPLANATION OF THE PLATES.

Plate 11.

Figs. 1–4. *Rhabdomolgus novæ-zealandiæ*, sp. n.

Fig. 1. Sketch of the entire animal. (× 2.)
Fig. 2. Transverse section of an otocyst. (× 550.)
c.e. = cubic epithelium; *d.* = thin part of wall; *n.* = nerve supplying otocyst; *ot.* = otoliths.

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* Ludwig, "Ein wiedergefundenes Tier: *Rhabdomolgus ruber*, Keferstein," Zoologischer Anzeiger, Bd. xxviii. (1905) pp. 458–459.

† Semon, Beiträge zur Naturgeschichte der Synaptiden des Mittelmeeres. 2. Mittheilung. Mittheilungen aus der Zoologischen Station zu Neapel, Bd. vii. p. 415, Taf. 15. figs. 9–15.

‡ Keferstein, "Untersuchungen über niedere Seethiere," Zeitschrift für wissenschaftliche Zoologie, Band xii. pp. 34–35, Taf. 11. fig. 30.

Fig. 3. Vertical section of a ciliated depression ("taste-pit") from the buccal region, with the surrounding integument. (× 900.)

c. = central core of sensory cells bearing short cilia; *c.m.* = circular muscle-layer; *c.s.* = supporting columnar cells; *c.e.* = columnar epithelium of body-wall *cu.* = cuticle; *n.* = nerve supplying the taste-pit; *n.l.* = nerve-layer; *c.l.* = connective-tissue layer; *s.l.* = granular wandering-cell.

Fig. 4. Transverse section of a branch of a tentacle. (× 500.)

c.e. = columnar epithelium; *c.l.* = connective-tissue layer; *c.m.* = circular muscle-layer; *cu.* = cuticle; *m.* = thin basement membrane supporting the longitudinal muscles; *l.m.* = longitudinal muscle-layer; *p.* = peritoneal layer.

Figs. 5 *a*–5 *b*. *Stichopus simulans*, sp. n.

Fig. 5 *a*. Table.
Fig. 5 *b*. Dichotomously foliaceous spicules.

Figs. 6–6 *a*. *Pseudocucumis bicolumnatus*, sp. n.

Fig. 6. View of entire animal. (× $1\frac{1}{2}$.)
Fig. 6 *a*. Part of the calcareous ring. (× 9.)
i.r. = inter-radial; *r.* = radial.

Figs. 7–8. *Phyllophorus dearmatus*, sp. n.

Fig. 7. View of entire animal. (× $1\frac{1}{8}$.)
Fig. 8. Part of calcareous ring. (× 3.)
i.r. = inter-radial; *r.* = radial.

Plate 12.

Figs. 9–11 *h*. *Chirodota gigas*, sp. n.

Fig. 9. Sketch of a part of the calcareous ring. (× 10.)
i.r. = inter-radial; *r.* = radial.
Fig. 10. Diagram of the water-vascular ring and its appendages. (× .)
m. = madreporic canal; *p.* = Polian vesicles; *r.* = ring nal.
Fig. 11 *a*. Miliary granules from the radii. (× 250.)
Fig. 11 *b*. Curved rods. (× 250.)
Fig. 11 *c*. Fully developed wheel. (× 250.)
Fig. 11 *d*. Optical vertical section of a wheel. (× 250.)
Figs. 11 *e*, 11 *f*. Developmental stage of the wheel. (× 490.)
11 *e* = inner face of wheel; 11 *f* = outer face.
Fig. 11 *g*. A four-rayed wheel (abnormal). (× 490.)
Fig. 11 *h*. Curved rods from the tentacles. (× 280.)

Fig. 12. *Stichopus mollis*.

Irregular perforated plate from a tube-foot. (× 250.)

Figs. 13–14. *Pseudocucumis bicolumnatus*, sp. n.

Figs. 13 *a*–13 *d*. Spicules of the integument. (× 350.)

Fig. 13 *a*. Three views of characteristic tables.
Fig. 13 *b*. A single table with one column (abnormal).
Fig. 13 *c*. An oval perforated plate.
Fig. 13 *d*. An irregular perforated plate.

Fig. 14. Internal anatomy of the animal seen when opened up along the right ventral inter-radius. (× 2.)

a.c. = ambulacral ring-canal; *c.* = cloaca; *g.* = gonad; *g.d.* = genital duct; *i.* = intestine; *i.r.* = inter-radial; *l.m.* = longitudinal muscle; *m.* = madreporic canal; *p.* = Polian vesicle; *ph.* = pharynx; *r.* = radial; *r.mes.* = right mesentery; *ret.m.* = retractor muscle of the pharynx; *r.t.* = respiratory tree.

Fig. 15. *Phyllophorus dearmatus*, sp. n.

Internal anatomy of the animal seen when opened up along the right lateral inter-radius. (× $1\frac{1}{3}$.)

œ. = œsophagus. (Other lettering as in the preceding figure.)

Plate 13.

Figs. 16–17. *Rhabdomolgus novæ-zealandiæ*, sp. n.

Fig. 16. Sketch of the internal anatomy of the animal seen when opened up along the left dorso-lateral inter-radius. (× 2.)

a.c. = ambulacral ring-canal; *c.r.* = calcareous ring; *d.m.* = dorsal mesentery*; *d.v.* = dorsal vessel; *g.* = gonad; *g.d.* = genital duct; *i.* = intestine; *l.m.* = longitudinal muscle-band; *m.* = madreporic canal; *p.* = Polian vesicle; *t.* = tentacles; *t.c.* = tentacular canals; *t.m.* = transverse ridges formed by the circular muscle-layer; *v.v.* = ventral vessel.

Fig. 17. Semidiagrammatic sketch of the anterior part of the alimentary canal, together with the tentacles &c., viewed laterally. (× 12.)

a.c. = ambulacral ring-canal; *c.r.* = calcareous ring; *d.* = diverticula of tentacular canals; *g.* = gonad; *g.d.* = genital duct; *m.* = madreporic canal; *n.* = radial nerve; *p.* = Polian vesicle; *ph.* = pharynx; *pinn.* = pinnules of a tentacle; *t.* = tentacles; *t.c.* = tentacular canal.

Figs. 18 *a*–18 *d*. *Phyllophorus longidentis.*

Spicules, showing various stages of development. (× 150.)

Fig. 18 *a*. An early stage at which no perforations are complete and the two rods which form the spine are still distinct.

Fig. 18 *b*. A stage at which four perforations have been completed; the two rods of the spine are still distinct.

Fig. 18 *c*. A more advanced stage at which the two rods have fused to form a single spine.

Fig. 18 *d*. Side view of a spinous plate.

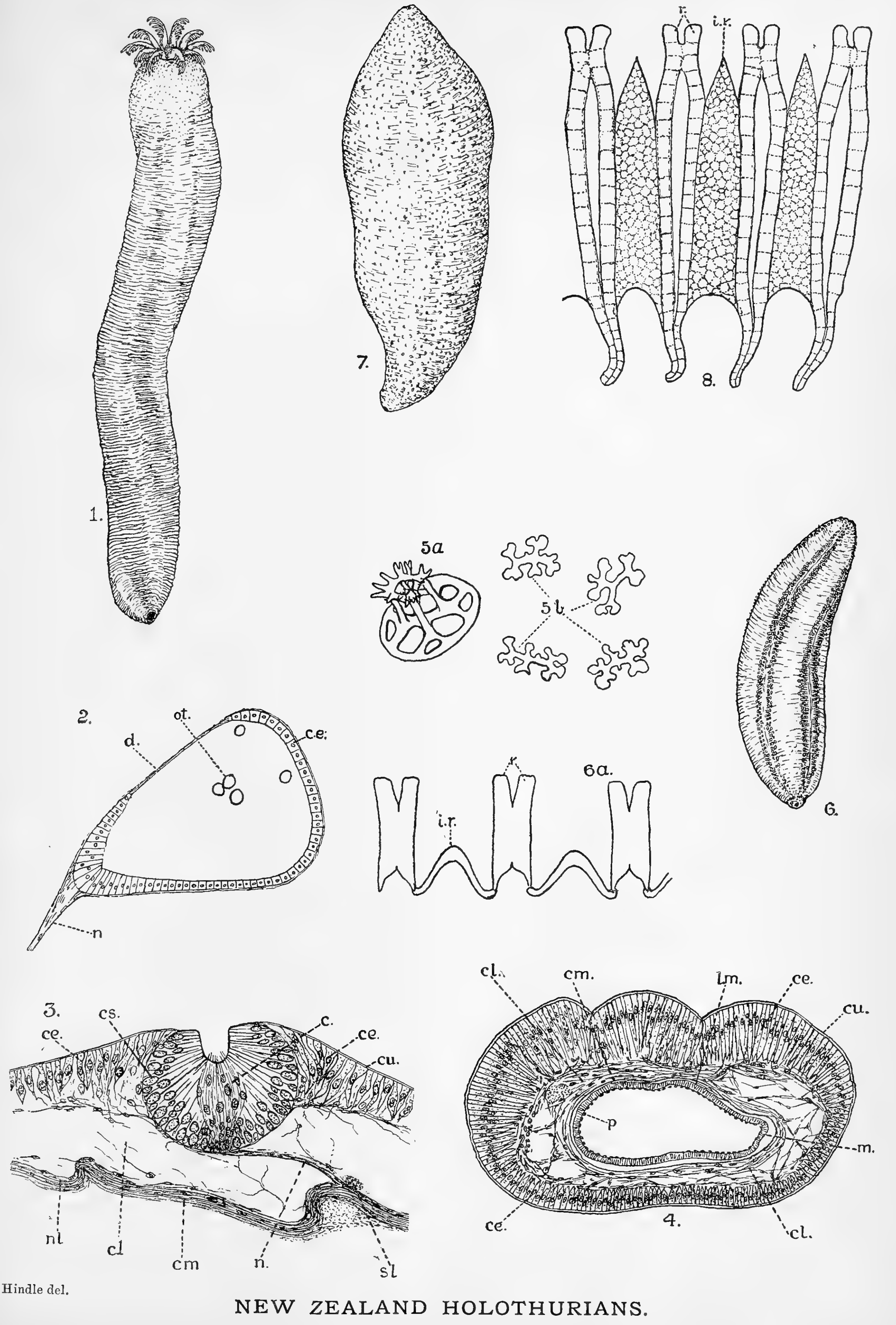
Figs. 19 *a*–19 *c*. *Holothuria difficilis.*

Fig. 19 *a*. A bilateral perforated plate. (× 200.)
Fig. 19 *b*. Various biscuit-shaped spicules. (× 250.)
Fig. 19 *c*. Two views of a table. (× 200.)

Fig. 20. *Phyllophorus dearmatus*, sp. n.

Perforated end-plate from a tube-foot. (× 150.)

* The dotted line should be continued in a little further.



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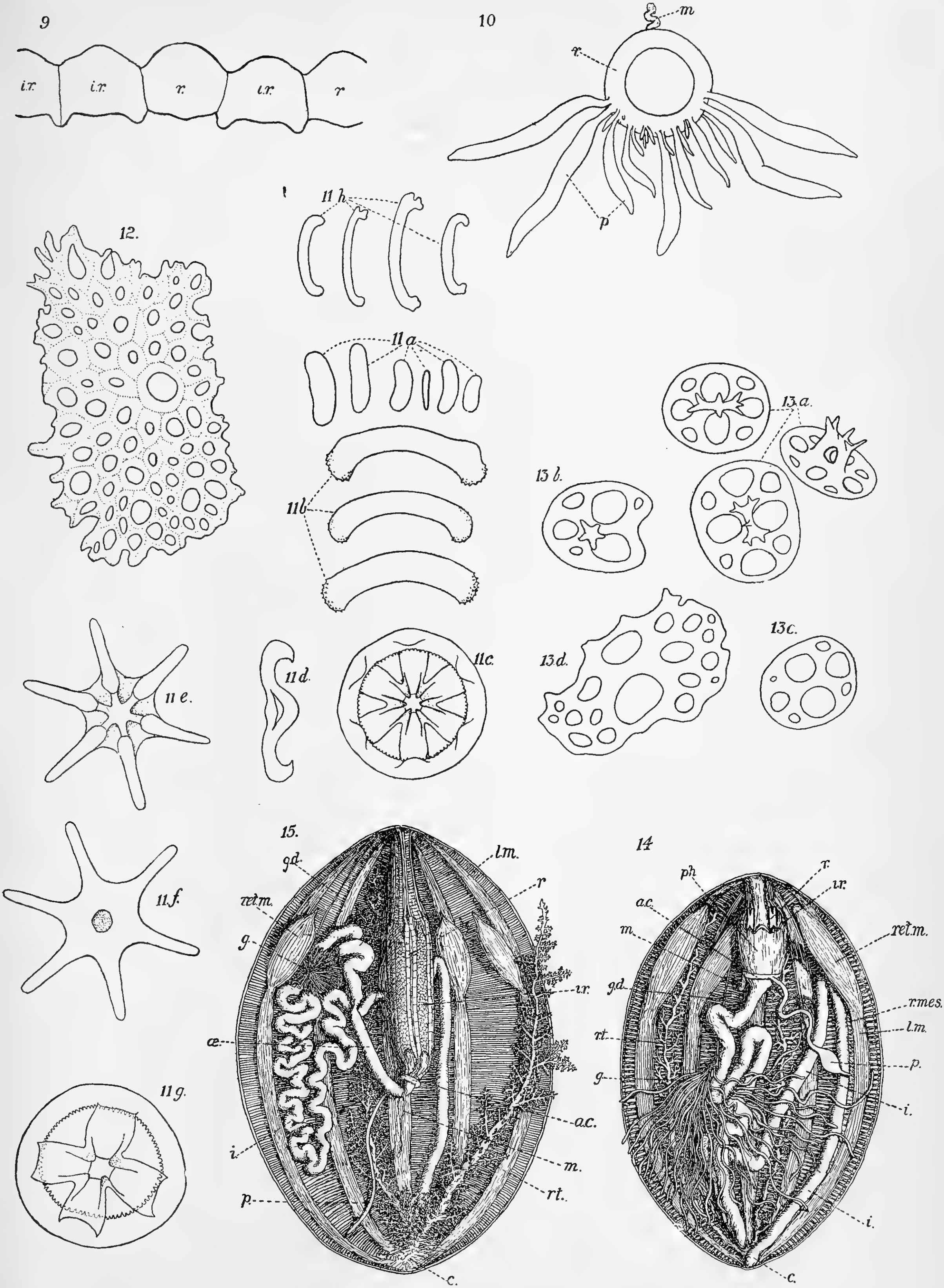
NEW ZEALAND HOLOTHURIANS.



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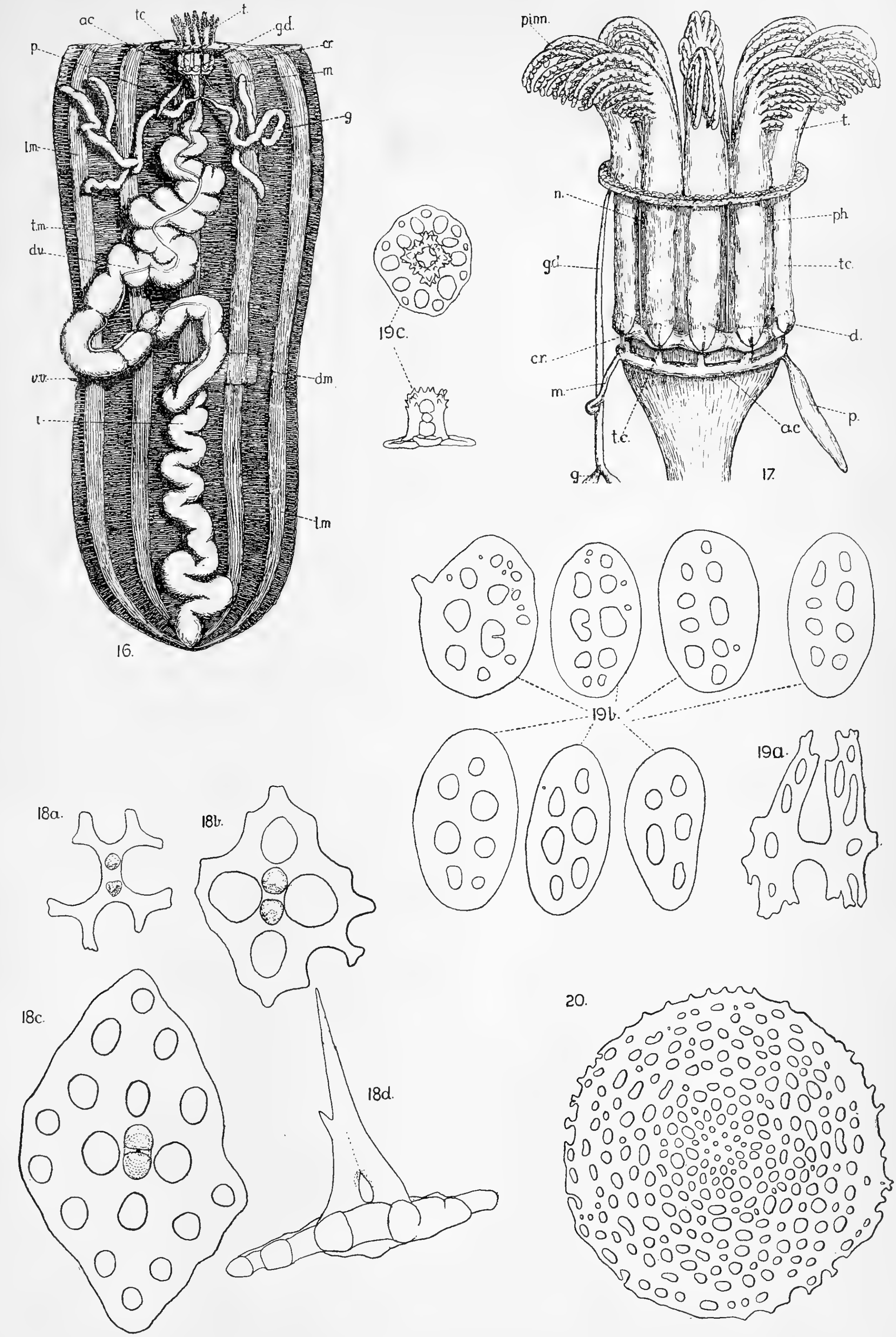

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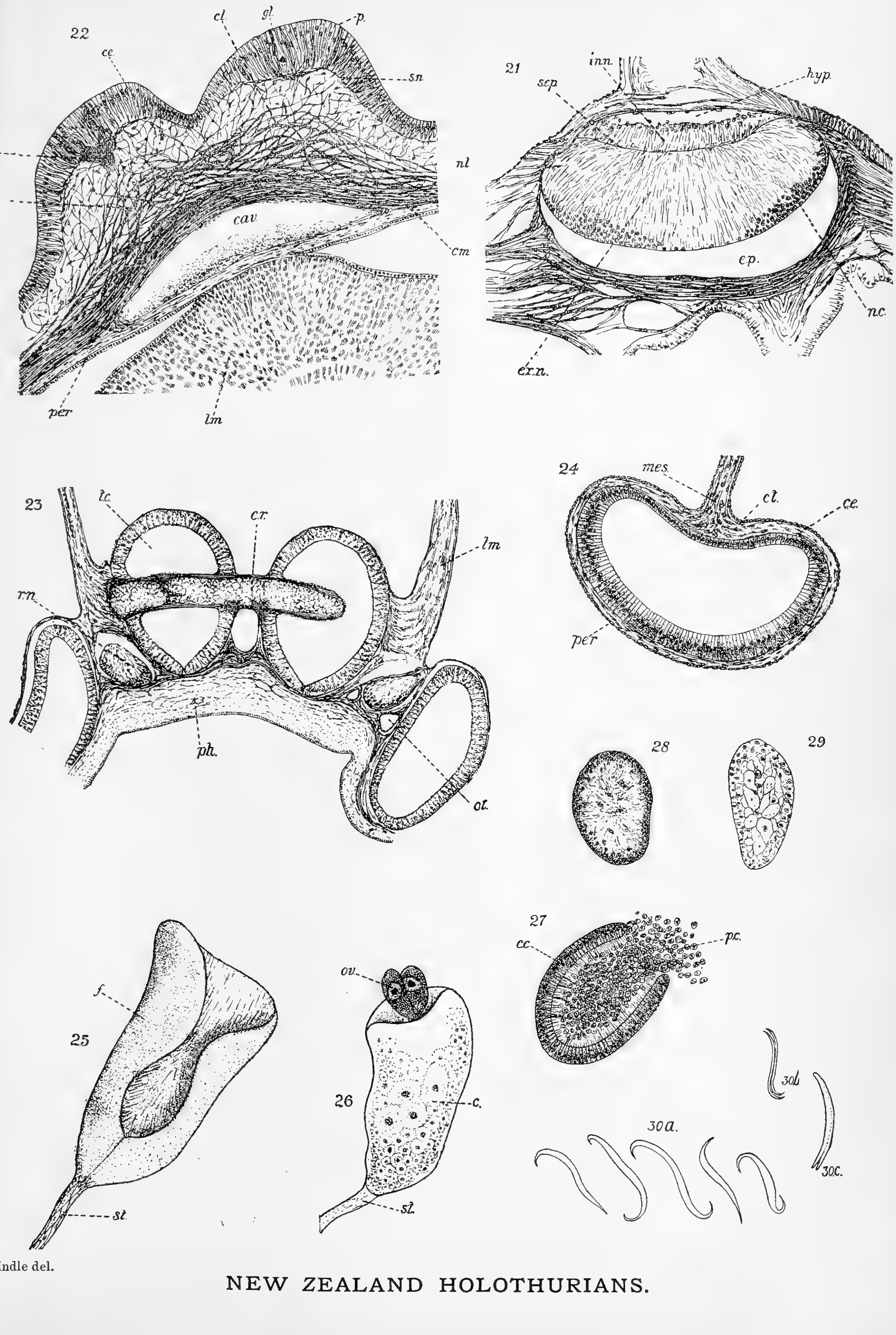

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NEW ZEALAND HOLOTHURIANS.

PLATE 14.

Figs. 21–29. *Rhabdomolgus novæ-zealandiæ.*

Fig. 21. Transverse section of the radial nerve whilst on the pharynx. (× 225.)
ep. = radial epineural space; *ex.n.* = external band of the radial nerve; *hyp.* = radial hyponeural space; *in.n.* = internal band of radial nerve; *n.c.* = nerve-cells; *sep.* = septum of connective tissue between the inner and outer bands of the radial nerve.

Fig. 22. Transverse section of radial region of the body-wall after the disappearance of the radial nerve. (× 225.)
cav. = radial cavity; *c.e.* = columnar epithelium; *c.l.* = connective-tissue layer; *c.m.* = circular muscle-layer; *g.* = ganglion, from which radiate the nerves of the sense-papilla; *gl.* = gland-cell; *l.m.* = longitudinal muscle-band; *n.l.* = nerve-layer*; *n.p.* = nerve supplying the ganglion *g.*; *p.* = sense-papilla; *per.* = peritoneal layer; *s.n.* = superficial layer of nerve-fibres beneath the epithelium.

Fig. 23. Transverse section (somewhat oblique) through the calcareous ring, &c. (× 55.)
c.r. = calcareous ring; *l.m.* = longitudinal muscle-band; *ot.* = otocyst; *ph.* = pharyngeal wall; *r.n.* = radial nerve; *t.c.* = diverticulum of tentacular canal.

Fig. 24. Transverse section of the madreporic canal. (× 250.)
c.e. = endothelium of columnar cells (probably ciliated); *c.t.* = connective-tissue layer; *mes.* = mesentery; *per.* = peritoneal layer.

Fig. 25. Ciliated funnel from the dorsal mesentery. (× 300.)
f. = funnel; *st.* = stalk.

Fig. 26. Funnel from a longitudinal muscle-band showing two large cells (? ova) escaping from the mouth. (× 250.)
c. = large nucleated cells, filling the funnel; *ov.* = large cells escaping from the funnel; *st.* = stalk.

Fig. 27. Transverse section of an open ciliated funnel from the dorsal mesentery. (× 300.)
c.c. = ciliated columnar cells; *p.c.* = cellular contents.

Fig. 28. Transverse section of a closed funnel from a longitudinal muscle-band. (× 300.)

Fig. 29. Transverse section of another funnel from a longitudinal muscle-band. (× 300.)

Figs. 30 *a*–30 *c*. *Chirodota geminifera*, n. sp.

Fig. 30 *a*. Sigmoid spicules showing some variations of shape. (× 280.)
Fig. 30 *b*. A young pair of sigmoid spicules. (× 280.)
Fig. 30 *c*. An older pair of sigmoid spicules, partially fused. (× 280.)

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* The dotted line has been accidentally omitted; the nerve-layer lies just outside the layer of circular muscles, but is not distinctly shown.

Tubucellaria: its Species and Ovicells.

By Arthur Wm. Waters, F.L.S.

(Plates 15 & 16.)

Collections made by Cyril Crossland, Esq., from the Red Sea, Zanzibar, and Cape Verde Islands contain species of *Tubucellaria*, and in one from Zanzibar sections have revealed several interesting points concerning the ovicells, about which nothing has been definitely known. It has therefore seemed advisable to deal with this genus at once, instead of waiting for the description of the collections upon which I am now at work.

The recent species *T. cereoides*, Ell. & Sol., and *T. hirsuta*, Lamx., are well known, and d'Orbigny described without figures another as *T. fusiformis*, to which I am able to add *T. zanzibariensis*, sp. nov. It will thus be seen that it is but a small genus occurring in the northern and southern temperates and the tropics, and also represented by a few species in the tertiaries of Europe and Australia.

There has been some uncertainty with regard to the specific names, but this is dealt with under the different species and it is to be hoped that the position will now be clearer.

It will be best to deal with the ovicell here, as there are various physiological facts of considerable importance to be noticed.

Busk * figured a tubular peristome curved inwards in *Tubucellaria hirsuta*, Lamx., but does not seem to have alluded to it. I † figured it in *T. cereoides* from Australia, and Reuss ‡ mentioned it in fossil *cereoides* from the Austrian Miocene, and, further, one was figured by me § in fossil *Porina papillosa*, Reuss. Levinsen ‖ in a most important paper has called these peristomial prolongations "peristomial oœcia," a name which had occurred to me when I was working on these ovicells, before recalling Levinsen's designation. Although Levinsen recognised their true nature, he gives no further particulars, but indicates that *Porina magnirostris* has similar ovicells. In my specimens of *P. magnirostris*, McG., there is no trace of ovicells, nor does this species seem closely allied to *Tubucellaria* in other particulars.

The ovicell which I figured in the peristome of specimens which I named *Porina coronata*, Reuss, is structurally allied to that of *Tubucellaria*. This, however, may have to be removed from *P. coronata*.

* Quart. Journ. Mic. Sc. vol. iii. p. 320, pl. 3. fig. 5, 1885.

† Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 190, pl. 5. fig. 10, 1887.

‡ "Foss. Bry. des Oest.-ung. Miocäns," Denkschr. math.-naturwissensch. kais. Akad. der Wissensch. vol. xxxiii. p. 147 (7), 1873.

§ Quart. Journ. Geol. Soc. vol. xlvii. p. 25, pl. 3. fig. 19, 1891.

‖ "Studies on Bryozoa," Vidensk. Medd. fra den Nat. Foren. i Kjöbenhavn, 1902.

In *T. cereoides* the end of this curved tube becomes gradually narrower, and the opening is small. The shape of the opening of the ovicell seems to be a specific character, for in *T. zanzibariensis*, sp. nov., the end of the tube is straight.

Many preparations of Mediterranean and other specimens have been made in the hope of finding an explanation of the meaning of these curved tubes, but without success, until it was at last revealed in a specimen from Chuaka, Zanzibar. There is some doubt whether this form should be called *T. cereoides* or should be separated specifically, as the ovicell is smaller than those seen in the Mediterranean specimens ; but at present we can hardly appreciate the value of the ovicellular characters, as so little work has been done in their investigation.

A number of serial sections have revealed most interesting and unexpected facts, but much remains to be made out, and sections are wanted of other species. The polypide (figs. 20, 25) is much modified, being thin and small, the tentacular sheath together with the diaphragm is extended, and passes as a tube through the oral aperture, past the operculum, to the end of the ovicell (figs. 18, 19) ; and near the diaphragm the lining membrane extends nearly across the opening of the ovicell, ending with a solid cover having a thick cuticula, under which there are some muscles ; and this expanded end, which at present I would call a plug, fits into a small notch at the opercular opening of the peristomial ovicell (fig. 18, see also figs. 20, 21, 25).

In order to understand the ovicell we should, before going further, examine the position of the tentacular sheath and diaphragm in the ordinary zoœcia. This diaphragm has been mentioned by Nitsche, Vigelius, Freese, Jullien (as irisoide), Pergens, Harmer (as vestibule), and by Calvet, who has given a *résumé* of the views of these authors. There seem, however, to be various points which have not been fully appreciated, and some of these may be found to be of use in determining the species. Longitudinal sections with the polypide withdrawn show the diaphragm looking somewhat like a contracted sac, which, in *Tubucellaria* and in many species of other genera, is situated at the side of the tentacular sheath as shown in fig. 15 ; in other cases it lies centrally in the tentacular sheath, as in *Myriozoum subgracile*, d'Orb., fig. 17, and here the mechanism is more easily followed, as part of the polypide has to pass through this diaphragm before the tentacles are spread out. The diaphragm or the tentacular sheath is attached on one side to the operculum, and on the other to the zoœcial wall (figs. 15, 16, 17), and this does not appear to have been generally understood—or, at any rate, explained. When the polypide is exserted a part of the tentacular sheath is carried with it, as shown diagrammatically in many text-book figures. It will be necessary to deal with these points in other species in subsequent papers.

In the ovicells of *Tubucellaria* the diaphragm is carried far beyond the opened operculum (*op*), and is attached by a continuation of the tentacular sheath to the operculum (figs. 19, 20, 25). The polypide in the ovicellular zooecia is, as already stated, very small, and is referred to as the diminutive polypide; but although it is so small it is in full vigour, staining throughout and showing no signs of histolysis. The ring-canal, and the *so-called* ganglion, can be distinguished in this small polypide. Fig. 25 shows how it is formed from an ordinary polypide, for in *r* we still have the remains of the rectum, while part of the digestive tube (*dt*), namely the cardiac region, stomach, and cæcum, is separating into three cysts, or we may call them brown bodies, and other sections show the changes from the ordinary polypide to the diminutive in various stages. Fig. 25 is one of the most instructive sections, for we have the larva (*l*) in the ovicell and the ovarium immediately below the diminutive polypide; and this is what we generally find, though in fig. 20 there are no larvæ, as they have probably been shed and another ovum will shortly pass into the ovicell. I have preferred to give fig. 20 as a copy of a section rather than to make it at all diagrammatic, though, in the stage figured, it is rather unusual not to find a larva in the ovicell, and a considerable number of sections show that the existence of the diminutive polypide with a larva in the ovicell and the ovarium immediately below it is no exceptional thing, but the general rule. Young ovaria occur in different places, but very frequently they are found in the neighbourhood of the upper lateral rosette-plate with parenchym-threads extending from the wall as in fig. 24.

In some Ctenostomata small polypides called "auxiliary polypides" * have been described, and these are formed in zooecia which have previously contained an ordinary polypide, though now it has disappeared leaving only a brown body. The only function of these "auxiliary polypides" is said to be to eject the larva, and it is only natural to enquire whether the diminutive polypides of *Tubucellaria* have a similar function, though there is nothing to suggest this. In the first place, it is not a fresh polypide, but the original one modified; then, in the second place, it seems as if the object were to get beyond the larva, for it is connected directly with the aperture of the ovicell. Probably we shall not obtain a full explanation until more species or living ones have been examined. If the object is to obtain direct communication with the exterior medium, could the spermatozoa be thus brought to the growing ova of the ovarium?

In *Adeonella* there is a minute polypide at the distal end of the ovicellular zooecium, and this will be dealt with shortly. The ovicell is rather like a Chinese puzzle, as there is one sac within another, and in the interior one the larva is developed. These calcareous species present great difficulties in study,

* Metschnikof, Bull. de l'Acad. de St. Pétersbourg, vol. xv. p. 507, 1871.

Nitsche, "Betracht. über die Entwicklungsgesch. und Morph. der Bry.," Zeit. für wiss. Zool. vol. xxii. p. 467, 1871.

Joliet, "Bry. des Côtes de France," Arch. de Zool. Exp. et Gén. vol. vi. p. 70, pl. 13. figs. 5-9, 1877.

as so much work is in the dark, for a suitable piece cannot be examined and chosen as in transparent species. However, it is to be hoped that further sections will elucidate some points still uncertain, and that we shall learn whether these polypides must be compared with those of *Tubucellaria.*

A more detailed examination of the ovicells of the Bryozoa is likely to reveal many new points: for instance, I find that the ovicell of *Thalamoporella Rozierii*, Aud., is double, and contains a larva in each division; also, the ovicell of *Idmonea radians* is compound, containing a group of larvæ in each of the four to six divisions.

It seems much the simplest plan to retain the old name "ovicell" as a general term, and then, instead of giving a special name for each kind of ovicell, to distinguish them by saying that the ovicell is a gonocyst, or that it is peristomial, and so forth.

TUBUCELLARIA CEREOIDES (*Ellis & Solander*). (Plate **15**. figs. 8, 9, 15, 16.)

Cellaria cereoides, Ellis & Solander, Zoophytes, p. 26, pl. 5. figs. B, C, D, E, 1786. See Miss Jelly's Catalogue, under *opuntioides*, for synonyms, though *Vincularia fragilis* of Defrance and of Blainville is not *Tubucellaria*, but add:—

Vincularia fragilis, Michelin, Icon. Zooph. p. 175, pl. 46. fig. 21, 1840.

Tubucellaria cereoides & var., MacGillivray, Tert. Polyzoa Victoria, p. 105, pl. 4. fig. 1, 1895.

Tubucellaria opuntioides, Calvet, "Bry. Mar. des Côtes de Corse," Trav. Inst. de Zool. de Montpellier, ser. 2, mém. 12, p. 11, 1902.

After Busk in the 'Challenger' Report had separated *T. cereoides*, Ell. & Sol., and *T. opuntioides*, Pallas, I followed him in using the latter name, although expressing my doubts as to the correctness of this separation. A further study of Busk's and of other specimens in the British Museum has convinced me that he was not right in the separation which he made; and now having another species, *T. fusiformis*, d'Orb., with which Pallas's description agrees much better, we must certainly retain Ellis and Sollander's name, which has so long been in use.

Busk's specimens of *T. opuntioides* are all from the John Adams Bank, N. Atlantic, and at first I thought that there might be differences of sufficient importance for separation, especially in the ridge at the base of the peristome, but having been permitted to make some preparations for the British Museum of the "*opuntioides*," I now consider that, so far as there are available characters, there is no material difference. In *Tubucellaria* the divisional wall is continued under the peristome (figs. 1, 8, 10), and in the John Adams Bank specimens this could hardly be made out until the covering membrane was removed. The specimen is less stout than is usual in the Mediterranean forms, and there are no large open pores round the peristome, though at the same time it is identical with some Mediterranean forms.

We thus have the *Tubucellaria cereoides* in its simplest form, with the peristomial ridge not very prominent, in the Atlantic; it occurs in its most familiar form in the Mediterranean, while we get the variety *chuakensis* with the open spaces round the peristome further east ; but, contrary to Mr. Busk's statements, I do not find any material difference between the opercula of specimens from the Atlantic and of specimens from other localities. The operculum has a thickened bar across, a little above the middle, and that of *T. fusiformis* is similar. In the Naples specimens the bar is rather higher than in the others, and the state of preservation enables the oval opening in the membrane under the operculum to be more clearly distinguished.

There are about 27 tentacles.

It will be noticed in figure 8 that two series of tubular ovicells may occur together, but in the Naples specimens there is more frequently a series of ordinary zoœcia between the ovicells. In all cases the ovicells occur in groups all round the zoarium. In *Cellaria* and other genera the ovicells occur abundantly in parts of the zoarium and are absent from others.

There are a great number of delicate muscles attached to the compensation sac.

Loc. St. Paul's Rocks, N. Atlantic (*Chall.*) ; John Adams Bank ; Cape Verde Island ; Madeira ; Mediterranean ; Shubuk, Red Sea (24), collected by Crossland; Manaar; Loyalty Isles; Torres Straits; Queensland; New South Wales ; Victoria ; South Australia ; Tasmania.

Fossil. Eocene, Miocene, Pliocene of Europe ; Victoria, Australia.

TUBUCELLARIA CEREOIDES, var. CHUAKENSIS nov. (Plate **15.** figs. 10–13, 18, 19 ; Plate **16.** figs. 20–25.)

Tubucellaria fusiformis, Busk (non d'Orb.), Zool. Chall. Exp. vol. x. p. 100, 1884.

It is with doubt that this is separated as a variety from *cereoides,* merely on account of the smaller beak-like ovicell, while there are no other characters of sufficient importance upon which separation can be based. However, as very few specimens with ovicells have been seen, and as it is important to record which form my sections refer to, I have called it a variety. There are large open pores or spaces round the peristome, and the ridge separating the peristome is very distinct; but in Mediterranean specimens these characters are found, though they are not generally so well marked. There are about 27 tentacles. The ovicells and larva have already been referred to.

In specimens from Grahamstown the ovicells are larger than those from Chuaka, but not so large as those from Naples, indicating that, unless additional characters are found, any separation of the *T. cereoides* group based largely on the size of the ovicell may not be ultimately retained.

Loc. Torres Straits (*Busk*), Brit. Mus. specimen 82.2.23.410 ; Grahamstown, South Africa ; Chuaka, Zanzibar, 3 fath., Mar. 29th, 1901 (512, 524), and Wasin, Brit. East Africa, 10 fath. (501), collected by Crossland.

TUBUCELLARIA FUSIFORMIS, *d'Orbigny.* (Plate **15.** figs. 1, 2, 3, 14.)

Tubucellaria fusiformis, d'Orb. Paléont. Franç. vol. v. p. 337.

Zoarium about 1 mm. in diameter, and at the end of each branch three fresh branches are given off attached by two or three corneous tubes. Occasionally there are also branches growing from the side of a branch. The divisional lines of the zoœcia can only be distinguished with difficulty even when the outer membrane is removed by eau de Javelle, or by other methods.

The zoœcia end in long peristomes, round the base of which there is a divisional line, and the surface of the peristome is ribbed, having one or two rows of pores between the ribs. The surface of the zoœcia is pitted all over and the peristomial pore is in a slightly projecting tube.

This form corresponds more nearly with Pallas's description of *Cellularia opuntioides* than any of the species recently thought to be *opuntioides.*

The specimen from Torres Straits to which Busk referred as *T. fusiformis,* d'Orb., in his 'Challenger' Report, p. 100, is a much stouter species with larger pores. To this I allude on p. 130. Harmer says that there is a *Tubucellaria* found by the 'Siboga' Expedition which is probably *T. fusiformis,* d'Orb. When passing through Paris I took the opportunity of examining d'Orbigny's specimen, which is only the basal portion of a lateral branch, and is only about the length of two zoœcia; an examination of this fragment, however, leaves me in no doubt as to the correctness of my determination. D'Orbigny described it as having "cellules sur quatre faces opposées"; which is correct for the basal zoœcia of the branches of *T. fusiformis,* but in the rest of the zoarium there are six zoœcia to a complete series.

Loc. Straits of Malacca (*d'Orb.*). There is a specimen unnamed in the British Museum (82.10.15.5.10) from Marie Louise, Amirante Is., Indian Ocean, 17 fath., collected by the 'Alert.' Chuaka, Zanzibar, 3 fath. (518); Wasin, Brit. East Africa, 10 fath. (520), collected by Crossland.

TUBUCELLARIA ZANZIBARIENSIS, sp. nov. (Plate **15.** figs. 4–7.)

Zoarium delicate, about 0·5–0·8 mm. diameter. It cannot be said that there are divisional lines, though the boundary of the zoœcia can often be traced in suitable preparations, and in the same way there is usually no line separating the peristome. There is a distinct suboral pore in a slightly raised tube, and the surface of the zoœcium is covered with elongated pits. The operculum is straight below, with a double chitinous wall on the distal border, covering a third of the operculum. There are 22–24 tentacles.

In a few nodes the peristomial ovicell is seen on most of the zoœcia; the ovicells are curved below, but with the terminal tubular portion straight, and the opening circular and as wide as the zoœcium; differing in these respects entirely from the peristomial ovicells of *T. cereoides* and *T. hirsuta,* Lamx.

The central branch is thicker than the lateral ones, which, however, are long and do not give off many branches; from the central one numerous long branches grow on all sides. There are only four zoœcia in a complete series, whereas in *T. cereoides* and *T. fusiformis* there are six.

The specimens were not in good condition for study, and no larvæ have been found in the peristomial ovicells.

Loc. Wasin, Brit. East Africa, 10 fath. (501); Ras Osowamembe, Zanzibar Channel, 10 fath. (504, 514); Prison Island, Zanzibar Channel (505); Chuaka Bay, Zanzibar, tow-net: all collected by Crossland.

Busk in his 'Challenger' Report, p. 99, refers to a species as *T. cæca*, but no description is given, and from examination of the British Museum specimens in the Busk collection I do not consider that it belongs to *Tubucellaria*.

D'Orbigny describes *T. clavata* from the Faluns bleu, but no figure is given and the description is insufficient.

Tubucellaria farnesinæ *, Neviani, also probably belongs to another genus.

T. marginata, MacG.†, fossil, looks like an erect form of his *Anarthropora* (*Lagenipora*) *tuberculata*, which I believe is the *A. horrida* of Kirkpatrick.

Onchopora ventricosa, *immersa*, and *granulosa* of Haswell ‡ all have a wide sinus without projecting peristome, and do not belong to *Tubucellaria*.

EXPLANATION OF THE PLATES.

PLATE 15.

Fig. 1. *Tubucellaria fusiformis*, d'Orb. From Chuaka, Zanzibar. × 12.
2. Do. Natural size.
3. Do. Operculum. × 85.
4. *Tubucellaria zanzibariensis*, sp. nov. × 12. From Ras Osowamembe, Zanzibar Channel (504). The upper part shows the peristomial ovicells, while in the lower part there are only ordinary zoœcia.
5. Do. Natural size.
6. Do. Operculum. × 85.
7. Do. Transverse section. × 25.
8. *Tubucellaria cereoides*, Ell. & Sol. × 12. From Naples, showing the peristomial ovicells.
9. Do. Operculum. × 25.
10. *Tubucellaria cereoides*, var. *chuakensis*. × 12. From Chuaka. Piece treated with eau de Javelle shows the peristomial ovicell on the left.
11. Do. Peristome. × 50.
12. Do. Operculum. × 85.
13. Do. Transverse section showing compensation-chamber. × 25.

* "Bry. foss. delle Farnesina," Paleont. Ital. vol. i. p. 125, pl. 6. fig. 34, 1895.

† Tert. Polyzoa of Victoria, p. 105, pl. 4. figs. 2, 3.

‡ Polyzoa from the Queensland Coast, p. 36 (Linn. Soc. N. S. Wales, 1881).

Fig. 14. *Tubucellaria fusiformis*, d'Orb. Transverse section. × 25.

15. *Tubucellaria cereoides* (Ell. & Sol.). From Naples. Section showing the diaphragm (*d*) retracted; *op*, operculum; *ts*, tentacular sheath; *rs*, position of the rosette plate; *p*, polypide folded in the zoœcium. × 85.

16. Do. Section showing the diaphragm attached at one side to the operculum and at the other to the wall of the peristome. × 150.

17. *Myriozoum subgracile*, d'Orb. Section showing the diaphragm (*d*) with the polypide withdrawn. × 85.

18. *Tubucellaria cereoides*, var. *chuakensis*, var. nov. Section showing the peristomial ovicell containing a larva (*l*); also the diminutive polypide with the diaphragm (*d*) and the plug (*pl*) closing the ovicell. × 25.

19. Do. Section of the end of the diminutive polypide in the peristomial ovicell, showing the operculum (*op*) thrown back; further on the diaphragm (*d*), beyond which there is a growth, at the end of which the plug will ultimately be formed. × 250.

Plate 16.

Fig. 20. *Tubucellaria cereoides*, var. *chuakensis*, var. nov. Section through two ordinary polypides and two peristomial ovicells. This is an absolute copy of one section, though in two or three cases where the operculum had not been well cut through that detail had to be taken from the following section. In the peristomial ovicell the plug is seen withdrawn from the opening, but this may only be the result of decalcification and preparation, as changes are sure to take place when the calcareous support is removed. The operculum (*op*) has opened the peristomial ovicell for the passage of the diminutive polypide, and the position of the tentacular sheath (*ts*) and diaphragm (*d*) can be followed. In this case there is no larva in the ovicell, but apparently there has been one and the ovaria (*ov*) would probably soon furnish others. The parenchym passing through the rosette-plates is seen at *rp*. × 85.

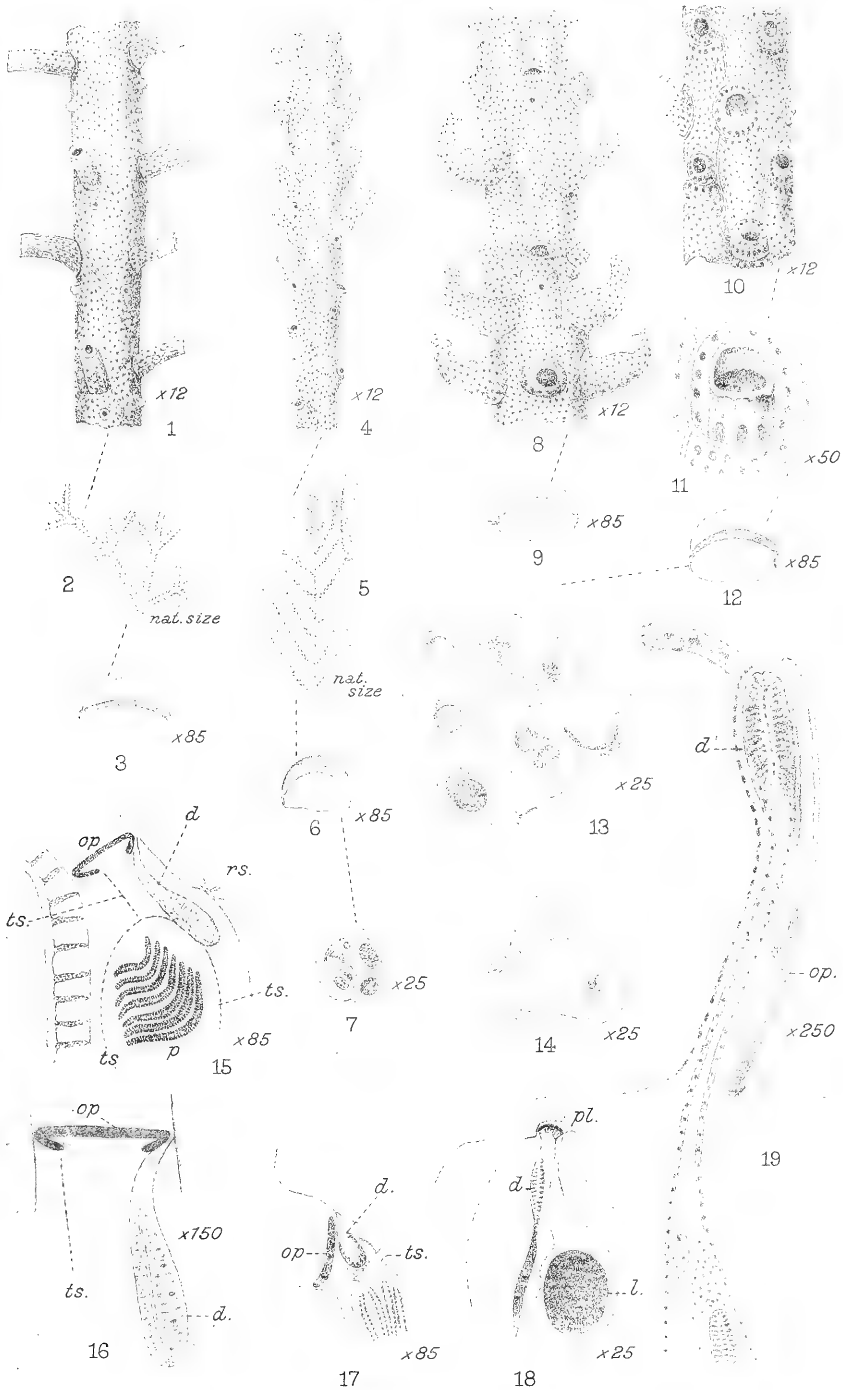
21. Do. Section of plug with diaphragm by the side. × 250.

22. Do. Section of larva. × 250.

23. Do. Section of the polypide-wall just past the operculum. In the lower zoœcia of fig. 20 these cogwheel cells are seen. × 250.

24. Do. Section of ovarium in the neighbourhood of a rosette-plate showing the protoplasmic network attached to the ovarium. × 150.

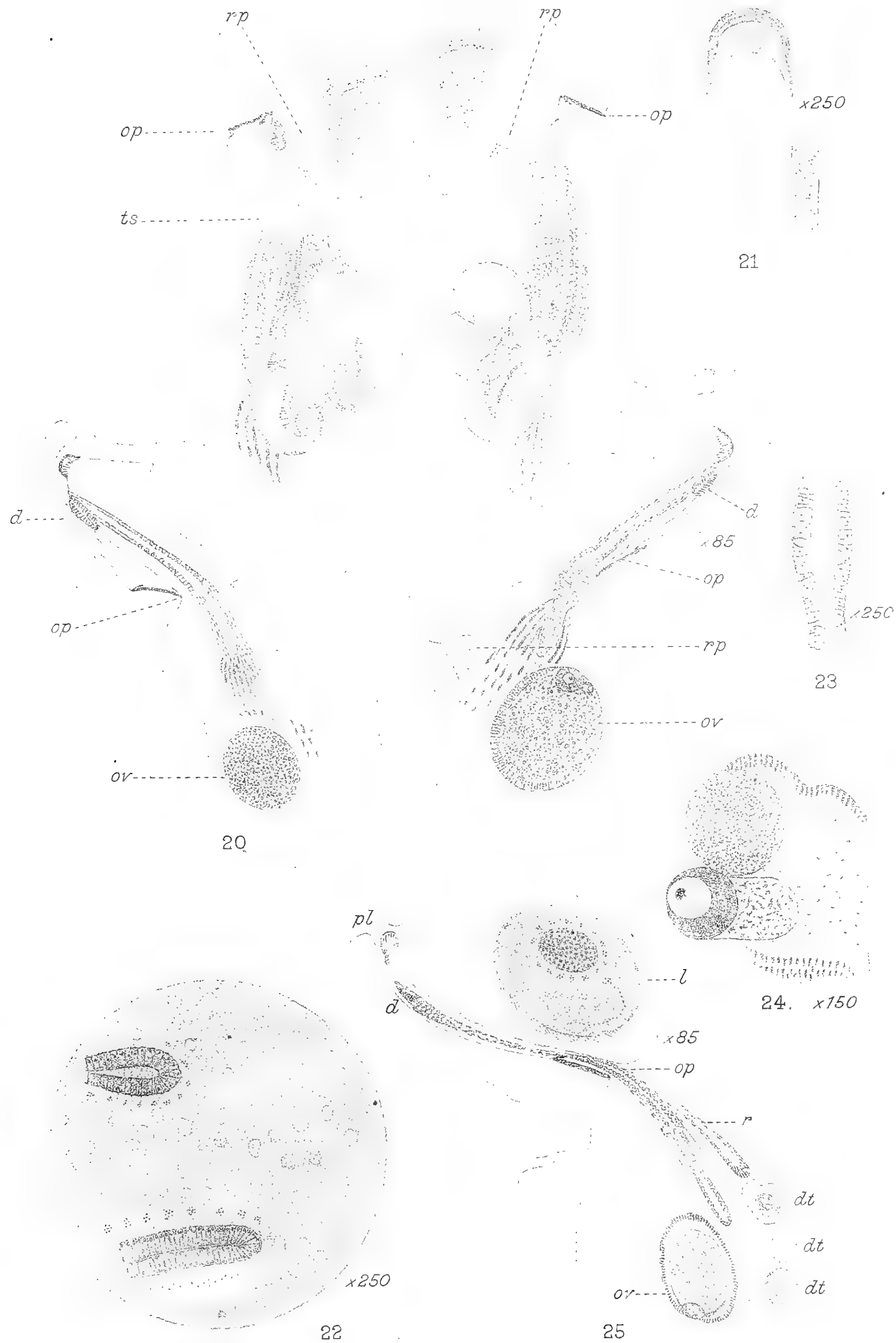
25. Do. Section of peristomial ovicell containing a larva. The diminutive polypide is shown and the plug (*pl*) to close the opening, also the remains of the rectum (*r*) and the incysting portions of the digestive tube (*dt*) are cut through. The ovarium (*ov*) is immediately below the diminutive polypide, and there are parenchym-threads from it to one of the cysts. This apparently shows an earlier stage than fig. 20, as we still have the indications of the complete polypide. × 85.



A.W. Waters del.
A.R. Hammond lith.

West, Newman imp.

TUBUCELLARIA.



A. W. Waters del.
A. R. Hammond lith.

West, Newman imp.

TUBUCELLARIA.

Treasurer's Account for the Year ending April 30th, 1907.

(Presented at the Anniversary Meeting, May 24th, 1907.)

Receipts and Payments from May 1st, 1906, to April 30th, 1907.

Receipts.

Receipts.				£	s.	d.
Balance at Bankers on 1st May, 1906				361	3	4
Interest on Investments				212	19	9
Admission Fees				180	0	0
Annual Contributions				1548	5	0
Compositions				—	—	—
Sales of Publications:—						
Transactions	£59	3	8			
Journals	69	14	1			
Proceedings and Catalogues	2	2	3			
				131	0	0
Miscellaneous Receipts				105	8	11
Sale of Consols				3855	1	5
" " Westwood Bequest				219	4	8
				£6613	3	1

Payments.

Payments.				£	s.	d.
Taxes and Insurance				10	18	9
Repairs and Furniture				56	4	2
Coals and Gas				44	3	8
Salaries				798	11	8
Library:—						
Books	£222	9	10			
Binding	91	14	5			
				314	4	3
Expenses of Publications:—						
Printing	£391	18	4			
Illustrations	211	14	8			
Distribution	29	5	0			
				632	18	0
Miscellaneous Printing and Stationery				85	4	10
Petty Expenses (including Tea and Postage)				122	5	0
Re-investment of Cash realised by Sale of Consols				4074	6	1
Investment on April 20th, 1907				30	17	10
Balance at Bankers, 30th April, 1907				443	8	10
				£6613	3	1

Investments on April 30th, 1907.

	£	s.	d.		£	s.	d.
Metropolitan $3\frac{1}{2}$ per cent.	1079	11	3	@ 99	1068	15	3
Great Indian Peninsula Railway, Annuity Class B	42	1	5	@ $21\frac{1}{4}$	894	0	0
Forth Bridge Railway 4 per cent. Stock	450	0	0	@ 114	513	0	0
Metropolitan 3 per cent.	1000	0	0	@ 88	880	0	0
India 3 per cent	500	0	0	@ 89	445	0	0
Eastern Bengal Railway 4 per cent. Debenture Stock	1000	0	0	@ $116\frac{1}{2}$	1165	0	0
Great Western Railway 4 per cent. "	1000	0	0	@ 119	1190	0	0
Metropolitan Water Board 3 per cent. Stock "B" (Westwood Bequest)	232	5	0	@ 89	206	14	0
					£6362	9	3

HORACE W. MONCKTON, *Treasurer.*

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30th April, 1907, and found them correct.

ALFRED B. RENDLE,
HORACE T. BROWN,
HERBERT DRUCE,

B. DAYDON JACKSON,
JOHN HOPKINSON,
Auditors.

W. B. KEEN, *Chartered Accountant.*

RULES FOR BORROWING BOOKS FROM THE LIBRARY.

1. No more than Six volumes shall be lent to one person at the same time without the special leave of the Council or one of the Secretaries.

2. All books shall be returned before the expiration of Six weeks from the time of their being taken out, but if not required by any other Fellow, they may, *on application,* be kept for a further period of Six weeks.

3. All books lent shall be regularly entered by the Librarian in a book appropriated for that purpose.

4. No work forming part of Linnæus's own Library shall be lent out of the Library under any circumstances.

NOTE.—*Certain other works are included in this prohibition, such as costly illustrated works, and volumes belonging to sets which could not be replaced if lost.*

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A CATALOGUE of the LIBRARY may be had on application. Price to Fellows, 5*s.*; to the Public, 10*s.*

MARCH 31. *Price* 11*s.*

THE JOURNAL

OF

THE LINNEAN SOCIETY.

VOL. XXX. **ZOOLOGY.** No. 197.

CONTENTS.

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1908

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B. Daydon Jackson, Ph.D.	Prof. Frederick Ernest Weiss, D.Sc.
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A. W. Kappel.	P. F. Visick.

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The Committee meets as required during the Session. The Members for 1906-1907, in addition to the Officers, are:—

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Antony Gepp, M.A.	F. N. Williams, Esq.
Dr. G. Henderson.	Dr. A. Smith Woodward, F.R.S.
Dr. Otto Stapf.	

Fig. 14. *Tubucellaria fusiformis*, d'Orb. Transverse section. × 25.

15. *Tubucellaria cereoides* (Ell. & Sol.). From Naples. Section showing the diaphragm (*d*) retracted; *op*, operculum; *ts*, tentacular sheath; *rs*, position of the rosette-plate; *p*, polypide folded in the zooecium. × 85.
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Unrecorded Acari from New Zealand.

By A. D. Michael, F.L.S., F.Z.S., F.R.M.S., &c.

(Plates 17–21.)

[Read 7th November, 1907.]

My friend the late Edwin Bostock, of Tixal near Stafford, at his death, left a considerable collection of Acari, chiefly Oribatidæ, both British and foreign. The British collection has already been fully dealt with, but there has not hitherto been any attempt made to describe or illustrate the foreign species. The most important portion of these preparations consists of specimens from New Zealand; they are wholly Oribatidæ with the exception of two specimens of Gamasidæ, both most remarkable creatures. Failing health and other causes prevented Mr. Bostock from attempting to publish any account of the novelties contained in this collection during his life, but he bequeathed the collection to me. Unfortunately, other engagements and difficulties have delayed my giving them up to the present time the attention which they deserved.

Mr. Bostock was an admirable collector and preserver of Acari, and I have often had occasion to thank him for assistance in my former work; he also had a remarkable power of interesting others in his pursuits, and obtaining their help at times when and in places where he could not personally carry on his collecting. The present gathering was made partly by Mr. Bostock himself during visits to New Zealand, and partly by Mr. J. W. Baker and other residents in that country, whose assistance in collecting Mr. Bostock secured. The collection is decidedly the finest of extra-European Oribatidæ which I have yet seen. Of course a large portion of it consists of species which do not depart in any marked manner from their nearest European allies: this is only what might be expected looking at the very wide distribution of Acarine species and genera, either identical or very closely allied; but amongst them are seven or eight very remarkable species which are well worth recording, and I think that, looking at my own age and other engagements, it is most prudent to do so in the present paper rather than to wait until every specimen, whether of special interest or not, can be fully worked out.

I have often remarked in former papers that the few species of Oribatidæ with which we are at present acquainted from tropical countries are usually of smaller size and less striking appearance than those which are found in more temperate parts of the world. The collection which forms the subject of this paper is a very good example of this: the analogy of the climate of New Zealand to that of Great Britain has often been remarked upon, and it is from thence that we now receive this collection containing species whose large size and apparent vigour would indicate at once, to a specialist acquainted with the group, their probable temperate origin ; what he would also notice is that the temperate characteristics seem exaggerated, as if they had run wild, giving many of the species a very singular appearance.

I have not thought it necessary to create any new genera; probably many systematists would have done so. The creature which I propose calling *Oribata Bostocki* is a very remarkable one. The most uncommon feature of this species is that the pteromorphæ (chitinous wing-like expansions of the abdomen) are confined to the anterior margin of the abdomen and point forward, instead of running along the lateral margin of the abdomen and projecting at the sides : this is so rare that the only instance which I am acquainted with is *O. gilvipes*, C. L. Koch, a species the capture of which is seldom recorded. Some authors would probably think that a genus, or subgenus, should be founded on this character, making *O. Bostocki* the type ; personally I do not think a separate generic or subgeneric name necessary, particularly as *O. Bostocki* and *O. gilvipes* are very different in other respects, *O. gilvipes* having the appearance of a typical *Oribata*, while *O. Bostocki* shows certain analogies to *Tegeocranus* and *Carabodes*.

The *Trachynotus* which I propose calling *T. sclerophyllus* is in many respects a very remarkable creature, but especially so in the chitinized leaf-shaped appendages which spring from the edge of the abdomen. It is quite common in the Acarina that some of the principal hairs on the body are placed in this situation, and these hairs are usually good specific distinctions, being practically always similar in number, position, and character in all specimens of the same species and sex ; but they vary greatly in different species. It is not by any means unusual for these hairs to have assumed a flattened, leaf-like form, and to consist of a central rhachis, with branched nervures, between which is stretched a transparent flexible membrane ; but for these nervures and the membrane to have become an opaque sheet of brown, rigid chitin, while retaining its leaf-like form and hair-like mode of attachment to the body, is a very exceptional development.

The species which I propose calling *Nothrus cophinarius* is an extreme form of that genus, and is another example of the curious and varied modes in which some adult Oribatidæ carry portions of the cast skins of the nymph ; and that which I am calling *Notaspis spinulosa* has the serrated hairs on the notogaster carried to a development greatly in excess of anything hitherto known in the family.

I am not able to give as much detail of parts dissected off as I usually like to do in drawings of new species, but the specimens I have are all mounted in balsam, and those in preservative liquid which Mr. Bostock had provided for dissection were unfortunately destroyed in a fire which occurred after his death.

ORIBATIDÆ.

ORIBATA BOSTOCKI *, sp. n. (Pl. 17. figs. 1–3.)

Average length	. . . .	about	·9	mm.
„ breadth	. . . .	„	·6	„
„ length of legs, 1st pair	. . .	„	·45	„
„ „ „ 2nd „	. . .	„	·36	„
„ „ „ 3rd „	. . .	„	·40	„
„ „ „ 4th „	. . .	„	·55	„

Colour dark chestnut-brown.

Texture rough and dull. The roughness is upon the epiostracum, which is easily detachable in parts, and is consequently apt to rub off partially.

Cephalothorax large, rather more than half the length of the abdomen, broadly conical. Rostrum rounded at the tip. Rostral hairs short and curved inward. *Lamellæ extremely large and almost horizontal*, joined anteriorly by a translamella, also horizontal, which is continuous with the lamellæ, and not distinctly demarcated from them; both are formed of light translucent chitin; the whole together cover the larger portion of the cephalothorax. Cusps of the lamellæ very large, projecting nearly as far as the tip of the rostrum; very broad, and deeply excavated anteriorly for the insertion of the lamellar hair, which is thick, long, and curved inward; those from the two sides generally cross. The lobe of the cusp outside the hair is generally rounded, the inner lobe pointed, but the chitin of which they are formed is thin and brittle, and the inner lobe, as well as the outer, is often rounded in captured specimens; the outer lobe may possibly also be pointed when the creature emerges, but this cannot probably be ascertained without rearing the creature. Pseudo-stigmata large, of thick rough chitin, almost hidden between the lamellæ and the wing-like projection from the abdomen. Pseudo-stigmatic organs rather long, moderately recurved, with slightly fusiform heads upon thin peduncles. Inter-lamellar hairs rod-like, slightly curved, not conspicuous; each is mounted upon an almost circular chitinous ridge. Tectopedia large and conspicuous from the dorsal aspect.

Legs of moderate length; the fourth pair pass the hind margin of the abdomen by about half the length of the tarsi. The femora of the first pair have slender peduncles to suit the deep cleft in which they are inserted; the other femora are without peduncles. The coxæ of the fourth pair of legs are pyriform, flattened, curved backward, and drawn out to a long curved point outside the lateral edges of the femora; the whole coxa thus assumes the form of a comma, or of one of the ornaments known as "pines" in Indian embroidery. Claws large and *monodactyle*. The tarsi bear numerous fine hairs, and there are a few similar hairs on most of the other joints.

* Named in honour of the memory of the discoverer.

Abdomen not longer than its width ; it has a squarish effect, but all its sides are more or less rounded, the hind margin being the most so. The principal feature of the species is a pair of large and remarkable sheets of thin translucent chitin (the pteromorphæ) which form *wing-like projections* from the *anterior margin* of the abdomen near the lateral corners. These chitinous projections are one-third the length of the whole body of the creature, and are nearly three times as long as their own greatest width; where they start from the abdomen each projection has a width about equal to one-third of that of the abdomen ; they, however, suddenly narrow and then widen again, and eventually narrow again almost to a point ; they also curve forward and downward ; their edges are somewhat turned upward, and the whole projection is slightly twisted, like half a turn of a screw ; the form thus produced is complicated and will be best understood from the drawing. They cross above the femora and genuals of the second pair of legs and project between that pair and the first *. In the centre of the hind-margins are two small, chitinous, conical projections close together ; each bears a short hair curved inward. There is a row of about twelve thick, slightly-curved, rod-like hairs rather nearer the periphery than the centre of the notogaster.

Ventral surface. The tectopedia are large, conspicuous, and complicated. There is a large, chitinous, tooth-like projection between the first and second legs, and a smaller one on the ventral side below the second femur. The third and fourth coxæ are sunk in depressions of the ventral plate. The genital plates are placed far forward and are trapezoidal, narrowest posteriorly; the anal plates much larger, and of an unequal diamond-shape with curved sides.

Habitat. Several specimens from Fielding (J. W. Baker's collection).

NOTASPIS SPINULOSA †, sp. n. (Pl. 18. figs. 5–10.)

Average length	. . . .	about	·75	mm.
,, breadth	. . . .	,,	·45	,,
,, length of legs, 1st pair	. . .	,,	·50	,,
,, ,, ,, 2nd ,,	. . .	,,	·45	,,
,, ,, ,, 3rd ,,	. . .	,,	·48	,,
,, ,, ,, 4th ,,	. . .	,,	·50	,,

Colour chestnut-brown of medium depth.

Texture polished, but not very highly so for the genus.

Cephalothorax of medium size, not much more than a third of the length of

* This form of the pteromorpha, confined entirely to the anterior margin of the abdomen, is extremely rare; indeed, the only instance at all approaching the present species in this respect which I know of is *O. gilvipes*, C. L. Koch. The two species might possibly form a subgenus.

† *Spinulosus*, covered with little spines (Modern Latin).

the abdomen; broadly conical. Rostrum somewhat rounded at the tip. Rostral hairs inserted far back, finely pectinated, rather long. Lamellæ low, rough, slightly curved, irregular ridges without cusps; they are short, considerably less than half the length of the cephalothorax; they are about twice as far apart at the base, next the abdomen, as at their anterior ends, from which the lamellar hairs arise. These hairs are stout and long, passing the tip of the rostrum by about half their length; they are strongly pectinated, or spinulated. Inter-lamellar hairs similar, but a trifle longer. Pseudostigmata small, and placed partly under the edge of the abdomen. Pseudostigmatic organs with rather long peduncles and small pyriform heads; they stand forward and upward.

Legs of about average length for the genus; the first pair pass the tip of the rostrum by about the length of the tibia and tarsus, the fourth pair pass the posterior margin by that of the tarsus only. The tibiæ are the longest joints, and in the first pair of legs have a small projection in the centre of the anterior margin, which projection bears the tactile hair. The femora, genuals, and tibiæ each carry a pair of stout, curved, spinulated hairs, and the coxæ of the third and fourth legs one similar hair. The tarsi bear several very caducent, finely pectinated or plumose hairs. The claws are tridactyle, and strong, the central claw of the three is the shortest but the thickest.

Abdomen about a tenth longer than its width, it is not round in effect but is somewhat diminished in width anteriorly, the sides there sloping in an almost straight line, and there is a tendency to a median anterior point. There are not any markings on the notogaster, but it bears a large number of extremely large, conspicuously spinulated hairs; these hairs constitute the great feature of the species; they are the most striking and remarkable hairs that are found on any *Notaspis* that I am acquainted with; some of them are as long as, and look longer than, the whole body of the creature, and the spinulation makes them look even thicker and stronger than they are. The spinules of these, and the other spinulated hairs on the Acarid, are placed at regular intervals and are not jointed to the principal rhachis of the hair but are prolongations of it; they are placed in alternate pairs, first a pair opposite each other springing from the sides of the rhachis, then a similar pair springing from the upper and under surfaces of the rhachis, and so on alternately. Each spinule points toward the tip of the hair and a little outward (Pl. **18.** figs. 8–10); just the tip of the hair is without spinules (Pl. **18.** fig. 9). There are about 60 of these spinulated hairs on the notogaster; four are arranged in a transverse curved row near the cephalothorax; seven, of which one is central, in a similar row a little further back; then two rows of eight each; and there are several, less regularly placed, on the posterior part of the notogaster; the remainder are round the periphery.

Ventral surface without markings; the epimera are small and do not nearly reach the median line, those of the second pair of legs are the longest; there are not any to the fourth pair, they are all separate. There is not any sternum. Genital plates small and squarish, but curved anteriorly, placed between the coxæ of the fourth pair of legs; anal plates larger, more diamond-shaped, and near the posterior margin. There is a transverse row of six moderate-sized, finely pectinated hairs behind them.

Habitat. Four specimens from Mr. J. W. Baker's collection, New Zealand.

NOTASPIS CAUDATA*, sp. n. (Pl. **19.** figs. 11 & 12.)

Average length	. . . .	about	·65 mm.
,, breadth	. . . .	,,	·45 ,,
,, length of legs, 1st pair	. . .	,,	·35 ,,
,, ,, ,, 2nd ,,	. . .	,,	·30 ,,
,, ,, ,, 3rd ,,	. . .	,,	·42 ,,
,, ,, ,, 4th ,,	. . .	,,	·50 ,,

Colour lightish chestnut-brown.

Texture highly polished.

Cephalothorax roughly conical; broad in consequence of the width of the chitinized shelf which bears the two anterior pairs of legs; it is however slightly narrowed on the ventral surface where it joins the abdomen. Rostrum rounded at the tip; it bears two pairs of rostral hairs, the upper of which are the thicker and rather the longer. Lamellæ narrow, straight blades on edge, about half the length of the cephalothorax; not much nearer together at their anterior than at their posterior ends. No cusps. Translamella a mere thickened line, except at the ends, where it adjoins the lamellæ and where the chitin is thicker and darker. Lamellar hairs long and fine, passing the tip of the rostrum by nearly half their length; inter-lamellar hairs very similar, but standing upright. Pseudo-stigmatic organs minute globes on very short peduncles, so short that no part of the organ reaches the dorsal level.

Legs of moderate length; the first pair pass the tip of the rostrum by about the length of their three distal joints, the fourth pair pass the tip of the caudal projection of the abdomen by about half the length of the tarsi; the tibiæ are the longest joints, but in the fourth pair of legs the tarsi are nearly as long. Claws tridactyle, almost, but not quite, homodactyle.

Abdomen about a third longer than its width; it is slightly truncated anteriorly, but posteriorly is prolonged so as to form a short, conical, tail-like, central projection which is the principal characteristic of the species; it is very unusual in the Orobatidæ; it arises solely from the dorsal plate, the ventral plate is not prolonged. The abdomen is strongly curved laterally and is arched on the dorsal surface, but not so strongly as in many species of the genus. It has not any hairs or markings on the notogaster. The

* *Caudatus,* tailed.

female when distended with eggs is rounder and more arched than is shown in the drawing.

Ventral surface without hairs or markings ; the epimera of the first pair of legs do not nearly reach the median line ; those of the second pair are joined to the thickened margin of the genital opening, which is broader than long, somewhat curved anteriorly, and with almost square posterior angles ; it is placed between the third and fourth pairs of legs. The anal opening almost reaches the posterior margin of the ventral plate ; it is longer than the genital opening, curved anteriorly, and has curved lateral margins meeting in a rounded point posteriorly.

Habitat. Six specimens from Mr. Steele's and Mr. Baker's collections.

HERMANNIA PHYLLOPHORA *, sp. n. (Pl. **20.** figs. 17–23.)

Length	about	·97	mm.
Breadth	,,	·63	,,
Length of legs, 1st pair	,,	·56	,,
,, ,, 2nd ,, ...	,,	·48	,,
,, ,, 3rd ,, ...	,,	·57	,,
,, ,, 4th ,, ...	,,	·72	,,

I regret to say that I have been forced to describe and draw this remarkable species from a single specimen, which I am always unwilling to do ; but I had only one, and the creature seemed to me too interesting to be omitted. My specimen is a female.

Colour dark chitinous brown.

Texture smooth, but not polished.

Cephalothorax large, both in length and breadth ; it is slightly bent down, which makes it look shorter than it is, as in the drawing ; it is a good deal arched, especially the central portion of the posterior third which forms a semi-lunar elevation the antero-lateral edge of which is bordered on each side by a short curved ridge springing from the outer anterior edge of the pseudo-stigma. The pseudo-stigma itself is oval, with a sharpish point at the place nearest to the median line of the body. Pseudo-stigmatic organs long, filiform, curving slightly forward toward their distal ends. Rostrum rather small, rounded ; rostral hairs short, fine, curved. No lamellar or inter-lamellar hairs visible in my specimen ; but with a single specimen, although I can say that all the hairs and details described or drawn are present, yet I cannot be equally sure that there may not be others which my specimen has lost.

Legs rather long for the genus, the first pair pass the tip of the rostrum by more than the length of the three distal joints ; the fourth pair pass the

* φύλλον, a leaf ; φορέω, I carry.

posterior margin by a little more than the length of their tarsi only. The femora and tarsi are the longest joints, each about as long as the two intermediate joints. The femora, genuals, and tibiæ are broad and flattened ; the femora of the two anterior pairs of legs have irregular, rough, narrow blades on their inner edges ; those of the third and fourth pairs are without blades and have a flattened surface fitting against the side of the abdomen but are rounded exteriorly. All the femora are finely and irregularly reticulated in parts, particularly on the under side. The genuals of the same legs have rough blades on their inner edges. The tarsi are not flattened, and are much narrower than the other joints; the coxæ of the first and second legs are wholly sunk in the body, those of the third and fourth legs are conspicuous, and are approximately like a quarter of a globe in form, but are rough ; like the femora of all the legs, they are inserted by comparatively narrow short peduncles turned at an angle to the joint itself. Claws large and monodactyle. The legs bear a number of large and small, semi-transparent leaf-like hairs or scales on their edges, viz., two on the outer edge of each femur and one on the inner edge of each of those of the first two pairs, one on the outer edge of each genual and tibia except the first pair. There are fine hairs on the tarsi and the usual tactile hair on each tibia of the first two pairs, and a few other fine and filamentous hairs.

The second leg, on each side, is inserted into the posterior part of a chitinous lateral projection of the cephalothorax which is bi-dentate on its anterior edge; the third into an indistinct flattened projection, and the fourth into the posterior edge of a large chitinous projection from the side of the abdomen ; this projection has a rounded indentation in the centre of its outward edge, into which indentation the inner posterior corner of the coxa of the third leg falls.

Abdomen oval, rounded both on its anterior and posterior margins and considerably arched on the notogaster ; which does not bear any markings, but there are on it, in my specimen, five pairs of minute dots from which very small hairs, probably leaf-like, have apparently fallen ; I am also inclined to think there has been a pair of small leaf-like hairs on the anterior margin. From the central portion of the hind margin of the abdomen springs a broad, but very shallow, chitinous projection which bears three small, transparent, fan-shaped scales, or hairs, close together, they project over the posterior margin ; there is also another pair of these hairs or scales on the notogaster itself overhanging the outer scales of the three above described.

Ventral surface without markings ; mouth-opening small and contracted by the pinching inward of the hood of the rostrum ; maxillary lip pointed anteriorly. Sternum present but rather vague in outline, it being difficult to say where it ceases. The epimera of the first and second legs are joined to the sternum, those of the third and fourth legs are joined to one another by a cross-piece, and to those of the second and the end of the sternum by another cross-piece. There is a vague, elevated, transverse ridge almost entirely across the ventral plate anterior to the genital opening; which is large, nearly square, and placed between the coxæ of the fourth pair of legs. The genital plates bear double rows of small fine hairs on their inner edges. Anal opening almost touching the genital and also almost reaching the posterior margin; much longer than broad, the sides curved.

Habitat. A single specimen from moss on the Ruahine Range, New Zealand (J. W. Baker's collection).

NOTHRUS COPHINARIUS *, sp. n. (Pl. **19.** figs. 13–16.)

Average length	. . . .	about	1·15	mm.
,,	breadth	,,	·50	,,
,,	breadth of notogaster only . .	,,	·45	,,
,,	length of legs, 1st pair	,,	·85	,,
,,	,, ,, 2nd ,, . . .	,,	·55	,,
,,	,, ,, 3rd ,, . . .	,,	·60	,,
,,	,, ,, 4th ,, . . .	,,	·85	,,

Colour yellow-brown of medium depth.

Texture dull; slightly, but not conspicuously, rough; chitin thin and slightly translucent.

Cephalothorax about one-third of the length of the abdomen. Rostrum truncated at the tip, but rather narrow. Rostral hairs short and small, but rather thick; inserted nearly at the antero-lateral angle of the rostrum. A large, chitinous, cylindrical apophysis, nearly, but not quite, half as long as the cephalothorax, springs from the edge just behind the rostrum; it is thickest where it springs, and bears a long hair at its distal end; this hair is thick where it arises, but gradually diminishes; it curves strongly inward, the hairs from the two sides of the body cross. The two apophyses are joined by a thickened ridge. The cephalothorax is deeply indented at the side for the insertion of the first and second legs, which come almost to the dorsal surface. The insertions, especially of the first leg, are protected by curved knife-like ridges arising from the body and overlapping the coxæ. The pseudo-stigmata are circular openings on the dorsal surface surrounded by a slight rough ridge. Pseudo-stigmatic organs small and globular, *entirely sunk inside the pseudo-stigmata,* so that no peduncle is seen. The two pseudo-stigmata are joined posteriorly by a slight, irregular, rough, curved ridge.

Legs flattened, longish; the fourth pair pass the hind margin by about two-thirds of the length of the tarsi; the femora and tarsi are the two longest joints; the genuals and tibiæ of about equal length; the tarsus is as long as, or longer than, the genual and tibia together. All the legs are bordered on the

* *Cophinarius,* a basket maker (from the form of the interlacing spines near the posterior end).

outer edge by a series of chitinous tubercles similar to those on the cephalothorax above described, but very much smaller ; they bear hairs at their distal ends, like those of the cephalothorax, but much shorter and smaller. These tubercles and hairs are on the outer edges of all the joints except the coxæ of the 1st, 2nd, and 4th legs and the tarsi of the 3rd and 4th legs ; they also are found, very small in size, on the inner edges of the femora, genuals, and tibiæ ; they vary very much in number on the different joints, thus there are five on the outer edge of the femur of the second leg and only one on that of the genual of the same leg ; they also vary very much in size, the largest are on the outside of the coxa of the third leg. Each leg is terminated by a very small and weak triple claw, about ·035 mm. in length. The third and fourth legs spring from projections of the underside of the abdomen; that supporting the third leg bears a large apophysis.

Abdomen not quite twice as long as its greatest width ; its anterior edge straight except a shallow, rectangular, median indentation. The width gradually increases from the anterior margin backward for about two-thirds of its length, in this part the lateral margins are slightly convex ; then it rapidly narrows to the posterior margin, the lateral margins of this portion are concave. The hind margin is strongly concave. The notogaster is rather narrow and is partly embraced by the chitinous plates of the side of the abdomen; these bulge out below the notogaster so that the abdomen is wider midway between the dorsal and ventral surfaces than it is on the actual dorsal surface. At each postero-lateral angle of the notogaster is a large apophysis, similar to those on the cephalothorax, but larger ; it turns slightly outward near its distal end, which bears a thick hair not quite as long as the apophysis and a little curved (Pl. **19**. fig. 16). On the lateral margin, on each side of the body, and almost touching the last-mentioned apophysis, is another apophysis, similar but only about a third of the length, and there is another a little further forward on the lateral margin. These three apophyses are usually within small membranous-looking sacs which are really the cast skins of the similarly-placed apophyses of the fully-grown nymph ; each bears the terminal hair of the corresponding apophysis of the nymph. As the nymphal apophyses and hairs are much larger than those of the adult each of these apophyses of the adult appears to be in a pointed, or nearly pointed, semi-transparent sac, which bears a hair much larger, thicker, and more curved than that of the adult ; these hairs are directed backward, but are strongly curved ; each hair crosses those posterior to itself, and thus forms the singular structure depicted in Pl. **19**. figs. 13–14, which is drawn from a creature carrying the cast skins. There is a fourth apophysis further forward and a fifth immediately below that at the postero-lateral corner, and hidden by it when seen from the dorsal side.

Ventral surface. Maxillary lip practically covering the whole mouth-opening. Epimera not reaching the median line but nearer together where they approach closest to it than at the lateral margin. Genital opening large and almost round, but truncated at the posterior end; its anterior end is opposite about the centres of the coxæ of the fourth pair of legs. Anal opening large, only divided from the genital by a thick chitinous ridge; it is almost triangular, but has curved sides, convex outward. The anal plates are long and narrow, and there is a second pair of chitinous sclerites resembling them nearer the lateral edge of, but still within, the anal opening. There is a division of, or split in the chitin of, the ventral surface running from the coxa of the fourth leg to the antero-lateral corner of the anal opening on each side of the body.

Nymph. This stage would easily be recognized from the adult; it is of course far less chitinized and has monodactyle claws. It has the apophyses on the edge of the notogaster much lighter and less chitinized, but also much larger and longer than those of the adult, and the hairs which they bear are much longer; there are also three additional pairs of these apophyses and hairs along the anterior part of the lateral edges of the notogaster, which make the nymph somewhat resemble the European species *Nothrus spiniger*.

Habitat. Several specimens from the Ruahine Range, Fielding, and Maunga Karetu.

NOTHRUS UNGUIFERA *, sp. n.

Average length	. . . .	about	1·35 mm.
,, breadth	. . . .	,,	·75 ,,
,, breadth of notogaster only	.	,,	·45 ,,
,, length of legs, 1st pair	. .	,,	1·15 ,,
,, ,, ,, 2nd ,,	. .	,,	1·0 ,,
,, ,, ,, 3rd ,,	. .	,,	1·5 ,,
,, ,, ,, 4th ,,	. .	,,	1·4 ,,

This species so closely resembles *N. cophinarius* that it may easily be mistaken for it, and it seems unnecessary to fully describe it; the principal differences from *N. cophinarius* are:—

1. The greater length of the body.

2. The smaller *comparative* breadth of the notogaster only, and the greater bulging of the side of the abdomen.

3. The fact that the posterior part of the lateral edge of the abdomen is convex, not concave.

4. That the notogaster is divided into three longitudinal strips of which the median is as wide as the two lateral and is plain, while the two lateral are strongly dotted or granular.

5. That the apophysis at the postero-lateral angle of the notogaster is much smaller and is slightly bulbous at the distal end, and that the adjoining one is attached to it, and that there are not any other apophyses on the notogaster.

* *Unguis*, a claw; *fero*, I bear.

6. That the tridactyle, homodactyle claws are twice the size, ·075 mm. instead of ·035 mm. (whence the name).

7. The greater lengths of the legs, especially the tarsi.

Habitat. Three specimens from Maunga Karetu and Fielding.

GAMASIDÆ.

TRACHYNOTUS SCLEROPHYLLUS *, sp. n. (Pl. **21**. fig. 25 & Pl. **17**. fig. 4.)

Length	·93 mm.
Breadth	·58 „
Length of legs, 1st and 2nd pairs . . .	·70 „
„ „ 3rd pair	·62 „
„ „ 4th „	·78 „

These measurements, and the following description and the figures are unfortunately taken from a single specimen, a female, which is the only one I possess.

Colour. Dull chitinous brown of medium depth.

Texture. Rough and unpolished.

Body almost pentagonal in general outline, but not equal-sided; the sides and base are curved, the sides more so than the base. No demarcation between cephalothorax and abdomen. Rostrum (capitulum) small, about one-seventh of the whole body, flattened, pentagonal, equilateral but not equal-sided, the base forms the posterior margin and is nearly straight; the two sides comparatively long and very slightly concave, the two anterior faces short, approaching rapidly, and meeting in a point. Palpi with the two distal joints passing the tip of the rostrum. Mandibles with very small chelæ (but I have not got those of the ♂). The greater part of the dorsal surface is covered by two strongly reticulated, probably perforated, chitinous plates, which in character resemble those of *Tingis* (Hemiptera). The anterior of these plates is much the larger, occupying over four-sevenths of the entire length and about two-thirds of the width of the creature; it has a raised central portion commencing about opposite the insertions of the third pair of legs, and extending backward in the median line until about one-eighth of the length of the plate from the posterior margin of the plate; the raised part becomes broader and more raised as it extends backward, and ends suddenly with a convex posterior edge; the median portion of this raised part is marked off by an irregular, wavy, chitinous rib, like those forming the reticulations; within this rib the surface is smooth and dull, without reticulations; the part outside the rib is reticulated like the remainder of the plate. Outside the raised central part, both laterally and posteriorly, is a somewhat depressed area; then the lateral and posterior margins of the plate

* σκληρός, hard; φύλλον, a leaf.

curve upward again and have a raised edge. The reticulations vary in size and shape; a certain amount of bi-lateral symmetry may be traced in the larger reticulations, the smaller are wholly irregular. The smaller plate is posterior to the larger and is only divided from it by a narrow line; it measures less than one-eighth of what the larger does in an antero-posterior direction, but is nearly as wide anteriorly as the posterior margin of the larger plate; it narrows considerably towards its posterior margin; the reticulations of this plate do not vary much in size or form; they are round, or nearly round holes, but are irregularly placed.

Beyond the plates, both laterally and posteriorly, is a broad band of flexible cuticle not strongly chitinized, but striated with very fine and close, wavy, irregular wrinkles.

Along the lateral edges of the body, commencing about over the insertions of the third pair of legs and extending to the posterior margin, is a series of processes which form the most striking feature of the species: they are evidently modifications of the expanded, leaf-like hairs, or scales, which are found upon so many of the more remarkable Acarina; but instead of being transparent and flexible, like the wing of a Bee, in the present species they are strongly chitinized, stiff, and almost opaque. There are about ten of these modified scales along each side of the body. There is bilateral symmetry between the corresponding scales on the two sides of the body, but there is great variety between the various pairs of scales; they have a tendency to be larger as they get further back on the body; but the posterior pair, which are at the corners of the posterior margin, are much the largest, and are fully one-third the length of the entire creature; they face laterally and are strongly convex outward, indeed very few of the scales are flat. Four much narrower and more spine-like hairs, but still of a similar character, are placed some way within the posterior margin, very near the edge of the posterior reticulated plate.

Ventral surface. Legs set very close together longitudinally, their coxæ nearly touching at their insertions into the body. Genital aperture of ♀ large, placed between the coxæ of the three posterior pairs of legs, almost elliptical, but slightly narrower anteriorly than posteriorly; there is a thin band-like projection of the anterior edge of the epigynum extending nearly its whole width. The anus is placed on a hemispherical projection of the ventral surface. The space between the coxæ is smooth, that posterior to the fourth coxæ is reticulated; the reticulations run into lines which diverge round the anus. On each side of the anus, but some little distance from it, is a pair of rather long-shaped chitinized scales, like some of those at the edge of the body.

Legs of moderate length, inserted near the edge of the body; the first pair pass the tip of the rostrum by about the length of their four distal joints; this pair are wholly tactile, and have the tarsi very thin and terminated by a long tactile hair without any claw. The various joints of the legs, except the tarsi, are rough and irregular in form, with numerous strong chitinous knobs and projections, and a tendency to thick, rough, irregular blades on their outer edges; these are carried to the greatest extent on the third and fourth joints of the first pair of legs. There are short, stout, chitinous spines on most of the joints except the tarsi, and a few fine hairs on the tarsi.

Habitat. A single specimen from the Ruahine Range.

TRACHYNOTUS FIMBRIATIPES *, sp. n. (Pl. **21.** figs. 26–28 & Pl. **20.** fig. 24.)

Length	about	·75	mm.
Breadth	,,	·45	,,
Length of legs, 1st pair	,,	·46	,,
,, ,, 2nd ,,	,,	·35	,,
,, ,, 3rd ,,	,,	·28	,,

These measurements, and the following description and the figures, are unfortunately taken from a single specimen, a female, which is the only one I possess.

Colour lightish brown, almost bay.

Texture unpolished, mostly rough.

Body approaching a long elliptical form, but very irregular; the anterior margin formed of two bisymmetrical, very shallow concavities meeting in a slight central point and having their lateral points somewhat projecting. No demarcation between cephalothorax and abdomen. Rostrum almost entirely hidden, from above, by the projecting dorsal plate and the fimbriated margins of the front pair of legs; but about the four distal joints of the palpi show from the dorsal aspect, and a small central portion of the epistome also shows when the rostrum is held horizontally. Mandibles (of ♀) very slender. A broad irregular band of smooth, but not polished, chitin occupies the whole median part of the dorsum from the anterior margin until within one-tenth of its length from the posterior margin. This smooth band is composed of thin chitin, and is slightly sunk as compared with the remainder of the dorsum, but is itself a little convex; at about one-tenth of the length of the dorsum from the anterior margin this smooth band sends off a short spoon-shaped branch directed backward and laterally at an angle of about 45°. The band itself is somewhat widened near its anterior and posterior ends. There is also a narrow smooth space round the lateral and posterior margins, commencing just behind the second pair of legs; the irregular form of this space is best seen from the drawing. The posterior margin of this space bears six bisymmetrical pairs of thick curved hairs on its outer edge, each hair mounted on a small papilla, and there are two pairs of smaller, but otherwise similar, hairs a little distance from the edge. The whole of the remainder of the dorsal surface is covered with a chitinous plate so closely and irregularly pierced with holes of from about ·009 mm. to about ·015 mm.

* *Fimbriatus*, bordered; *pes*, a foot, or leg.

that the ridges left between the holes seem to form a fine network over the inner cuticle; the ridges are really narrower in proportion to the holes than can be shown in a drawing the size of fig. 26. The chitinous plate bears one pair of thick curved hairs just where the plate is narrowest, about one-fifth of the length of the dorsum from its posterior end.

Ventral surface. Legs inserted rather nearer the median line than the lateral edge of the ventral surface; their coxæ, on each side, nearly touch longitudinally; the space between the two lines of coxæ as far as the posterior edge of the third pair, and the median portion posterior to this point, is smooth, like the median part of the dorsum, but the smooth part is wider than on the dorsum and is irregular in form. The lateral and posterior parts behind the third coxæ are covered with irregular bands and curved surfaces coarsely striated transversely. The genital opening of the ♀ is placed between the coxæ of the third and fourth legs, it is large and occupies almost the whole space; the genital plate (epigynum) which covers it is spade-shaped, straight on its posterior edge, which is the shortest, slightly increasing in width toward its anterior (distal) edge, which, as well as the lateral edges, are somewhat curved.

Legs. Of moderate length, the first pair set far forward, all joints except the coxæ passing the tip of the rostrum; the fourth pair scarcely passing the hind margin. The three posterior pairs of legs are normal; the first pair form the principal characteristic of the species, their coxæ and second joints are normal, but the other joints are extremely thin; all these thin joints, except the tarsi, are bordered, on each side, by a broad, flat, transversely striated, chitinous expansion, about twice as wide as the joints; the most distal of these expansions is the narrowest. Each tarsus of the first pair of legs is terminated by a long tactile hair, and there are a few fine hairs on the other tarsi.

Habitat. A single specimen from the Ruahine Range.

EXPLANATION OF THE PLATES.

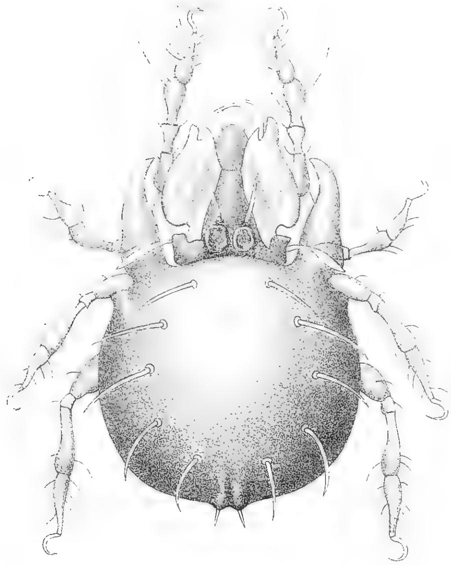
PLATE 17.

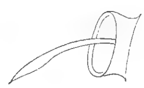
Fig. 1. *Oribata Bostocki*, sp. n. Dorsal aspect, × 55.
2. „ „ Ventral aspect, × 55.
3. „ „ Pseudo-stigmatic organ, × 100.
4. *Trachynotus sclerophyllus*, sp. n. Ventral aspect, × 50.

PLATE 18.

Fig. 5. *Notaspis spinulosa*, sp. n. Dorsal aspect, × 55.
6. „ „ Pseudo-stigmatic organ, × 200.
7. „ „ Claw, × 200.
Figs. 8, 9, 10. „ „ Portions of the notogastral hairs (there are about 30 whorls of spines on each hair), × 250.

1.





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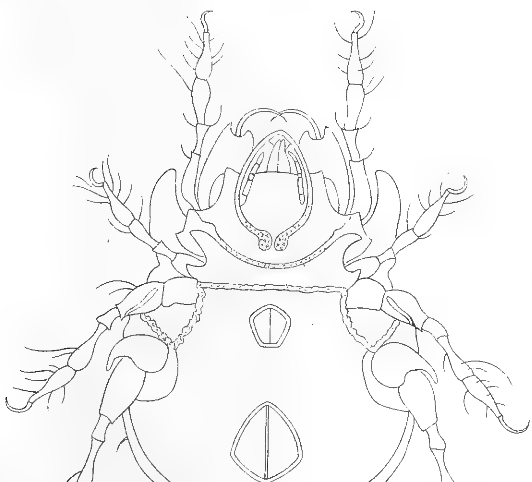

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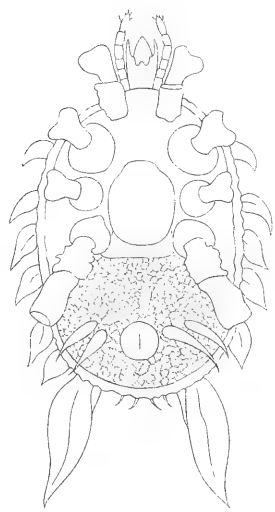


4.

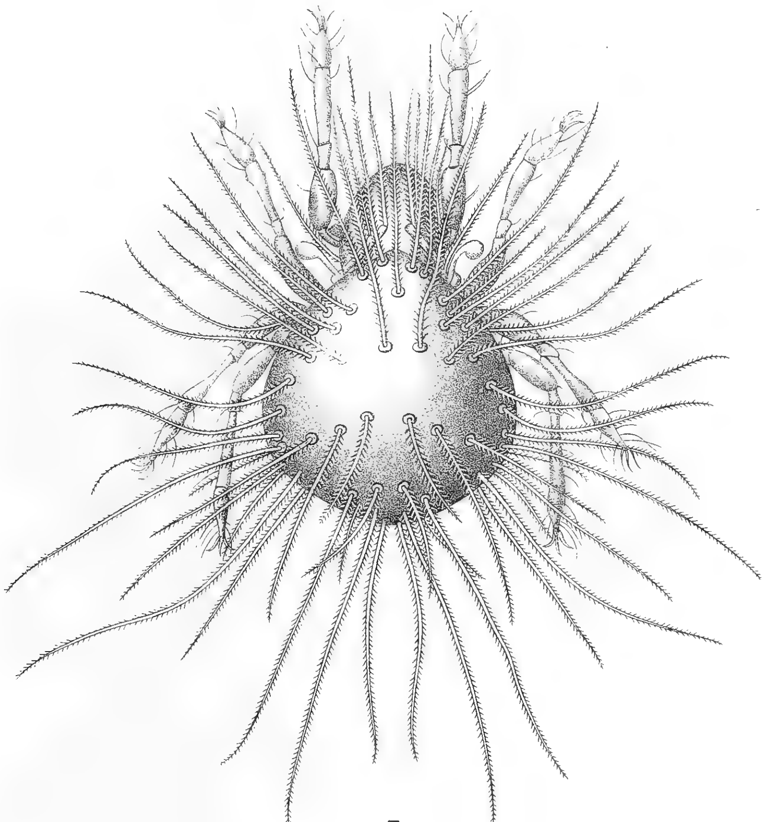
A.D.M. delt. E. Wilson, lith. & imp.

NEW ZEALAND ACARI.

6.

8.

7.



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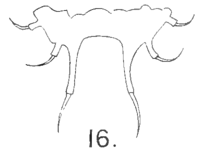
10.

A.D.M. delt. E. Wilson, lith. & imp.

NEW ZEALAND ACARI.



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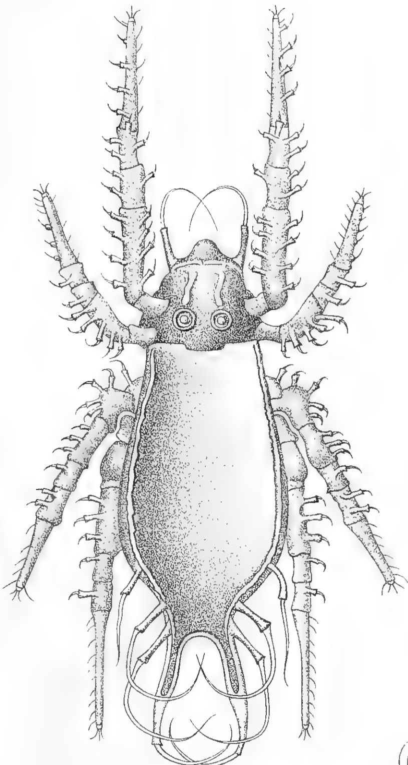

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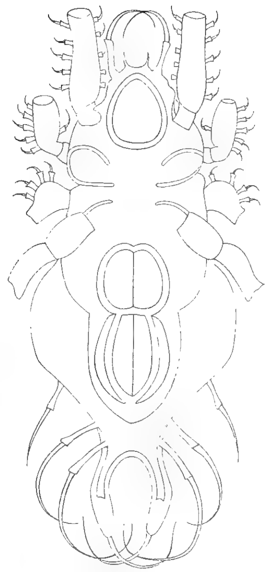

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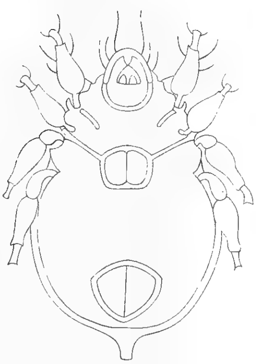

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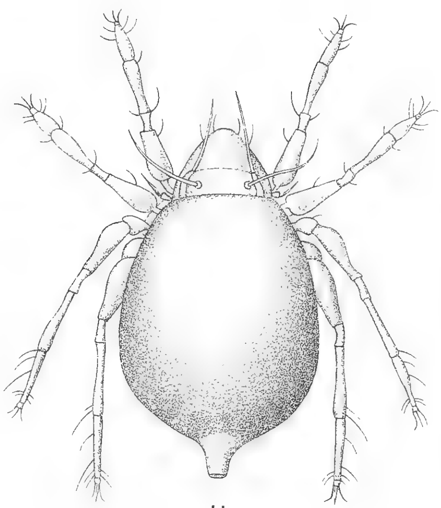
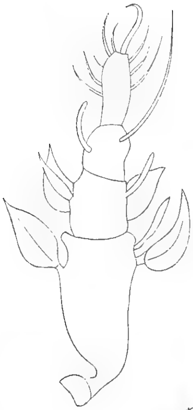


11.

A.D.M. delt. E. Wilson, lith. & imp.

NEW ZEALAND ACARI.



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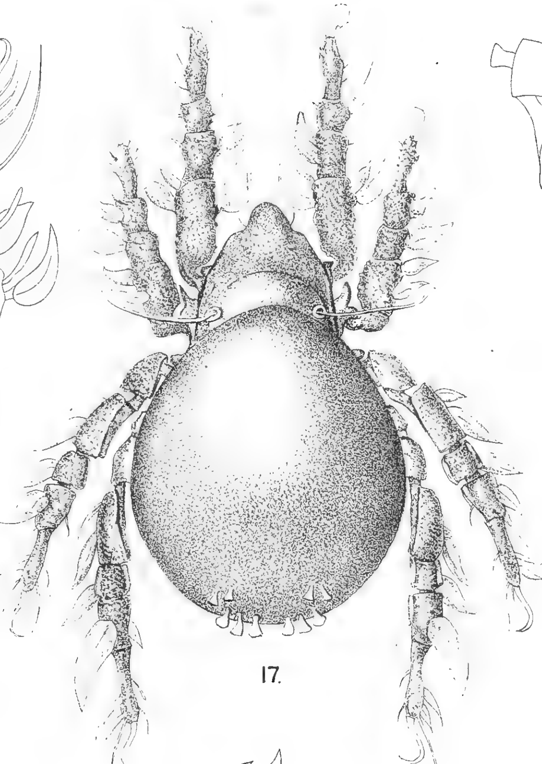
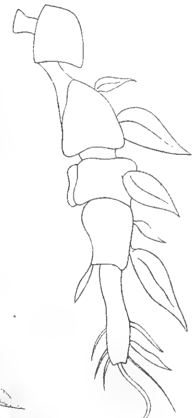
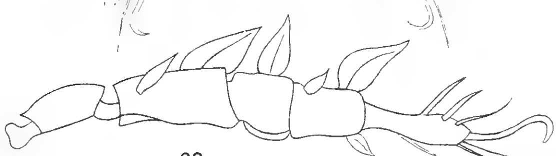


17.



22.



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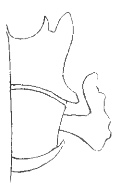

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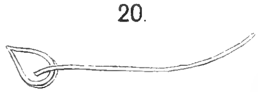
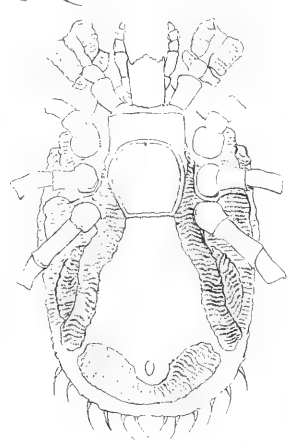


19.

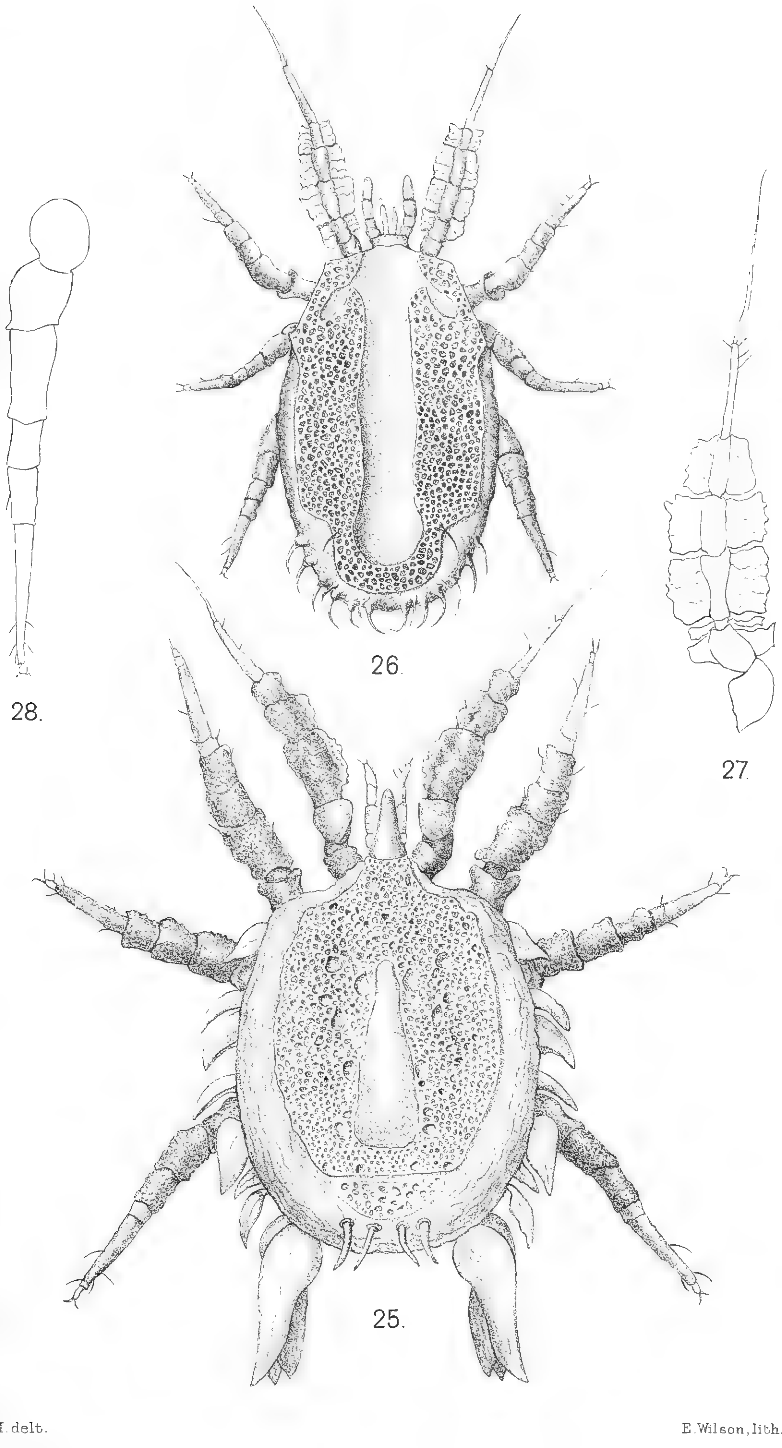
18.



24.

A.D.M. delt. E. Wilson, lith. & imp.

NEW ZEALAND ACARI.



A.D.M. delt. E. Wilson, lith. & imp.

NEW ZEALAND ACARI.

Plate 19.

Fig. 11. *Notaspis caudata*, sp. n. Dorsal aspect, × 65.
12. „ „ Ventral aspect, × 60.
13. *Nothrus cophinarius*, sp. n. Dorsal aspect, × 45.
14. „ „ Ventral aspect, × 45.
15. „ „ Pseudo-stigmatic organ, × 100.
16. „ „ Posterior end of abdomen, dorsal aspect, with cast skin of Nymph removed, × 45.

Plate 20.

Fig. 17. *Hermannia phyllophora*, sp. n. Dorsal aspect, × 57.
18. „ „ Ventral aspect, × 45.
19. „ „ Pseudo-stigmatic organ, × 125.
20 „ „ Chitinous lateral projections between first and second and second and third legs showing the insertion of the coxa of the second leg (right side) between the projections, × 125.
21. „ „ First right leg, from above, × 90.
22. „ „ Third right leg, from above, × 90.
23. „ „ Fourth right leg, from above, × 90.
24. *Trachynotus fimbriatipes*, sp. n. Ventral aspect, × 60.

Plate 21.

Fig. 25. *Trachynotus sclerophyllus*, sp. n. Dorsal aspect, × 65.
26. *Trachynotus fimbriatipes*, sp. n. Dorsal aspect, × 60.
27. „ „ First left leg, from below, × 100.
28. „ „ Fourth right leg, from above, × 125.

Ænigmatistes africanus, a new Genus and Species of Diptera.

By R. Shelford, M.A., F.L.S.

(Plate 22.)

[Read 7th November, 1907.]

Quite recently, Professor E. L. Bouvier of the Muséum d'Histoire Naturelle, Paris, entrusted to me for examination a minute insect from British East Africa, bearing a superficial resemblance to a cockroach. The unique specimen was gummed on to a piece of card, so that little could be made out of its external anatomy when examined with a simple pocket-lens; however, when the specimen had been soaked off the card and placed under a microscope, it was at once seen that it had no affinities with the Orthoptera. I am indebted to Dr. H. J. Hansen of Copenhagen, whom I was fortunate enough to meet in London, for giving me a clue to the real nature of the insect. There can be little doubt that the insect's nearest known ally is *Ænigmatias blattoides*, an aberrant Phorid fly described by Meinert from Denmark [**1***] in 1890; but the relationship, as might be expected from the very different localities of the two insects, is not at all close, in fact the differences between them are almost as striking as the resemblances. The following is a description of the new genus:—

Ænigmatistes †, gen. nov.

Head prominent, subpyramidal; the morphologically anterior part lies in a plane almost at right angles to the plane of the posterior part and the middle region of the frons is produced and sharply ridged, making the angulation more pronounced. The head when viewed from above is concave and the vertex projects above the level of the pronotum. The frons immediately below the ridge is slightly concave, but then becomes strongly convex. On either side of the head is situated a deep depression in which lies the antenna.

The *eyes* have few facets, are somewhat pyriform in outline, and are placed laterally at the postero-ventral angles of the head (Pl. **22.** fig. 3). A stout seta, upwardly curved, springs from a point just below each eye. *Ocelli* absent.

The *antennæ* (Pl. **22.** fig. 4) are composed of 7 visible joints. The first is large, swollen and trapezoidal, the third is large and globular; the second is a connecting joint between the first and third and in surface view appears to be short and slender, in optical section it appears to expand within the

* These numbers refer to the Bibliography at the end of this paper.

† αἰνιγματιστής, one that propounds riddles.

third joint. The remaining joints form a slender flagellum, the last joint being very long and lash-like.

The *mouth-parts* are much reduced and consist of (1) a trapezoidal and strongly deflexed labrum; (2) a pair of two-jointed maxillary palpi, the first joint minute, membranous, the second elliptical, hirsute; (3) a minute, membranous hypopharynx with a bifid apex directed inwards and overlying the entrance to the pharynx (Pl. **22.** fig. 5). There is no *labium.*

Thorax of three segments: the pronotum large and crescentic; the mesonotum lenticular in outline; the metanotum with the anterior margin concave, the posterior margin straight. The mesonotum is enclosed between the pro- and metanotum and fails to reach the lateral margins of the thorax; the lateral borders of the other thoracic tergites overlap on to the ventral surface. Ventrally the cuticle is thin and membranous and only shows faint traces of sternal sclerites; a fine suture runs down the middle line of the ventral surface. An inwardly-directed seta springs from the antero-lateral margin of the pronotum.

Abdomen of four segments; the first three tergites transverse and shorter than the last which is subtriangular; the lateral borders of the first three overlap on to the ventral surface, which is covered with a thin, membranous cuticle showing no signs of segmentation.

Legs.—*1st pair.* Coxæ elongate, broad, flattened, the coxal cavities small, circular and widely separated; femora flattened, about equal in length to the coxæ but narrower; tibiæ almost cylindrical, about $\frac{3}{5}$ length of femora, with one spine at the apex; tarsi 5-jointed, the last joint with two claws, no pulvilli.

2nd pair. Coxæ trapezoidal, excavate and flanged on the outer aspect; femora longer and broader than those of the first pair, their lower margin sinuate towards apex; tibiæ cylindrical, equal in length to the femora, with three spines at the apex; tarsi similar to the first pair but more spinose.

3rd pair. Coxæ narrower and more elongate than the preceding pair; femora broader; tibiæ tapering from apex to base, with six spines at the apex; [tarsi missing].

Æ. AFRICANUS, sp. nov. (Pl. **22.** figs. 1 & 2.)

Depressed, convex above. Piceous above, pale testaceous below; antennæ pale testaceous. Minutely punctate above and with a fine recumbent pubescence which extends also on to the legs.

Total length 2·5 mm.

Hab. Kisumu, Victoria Nyanza, Brit. Central Africa (*Ch. Alluaud,* 1904). Type in the Paris Museum.

I cannot be certain of the sex of the specimen, but suppose it to be a female; the unique specimen of *Ænigmatias blattoides* is considered by Meinert to be a female, though Coquillett [5] throws doubt on this and regards a specimen of another species, *Æ. Schwarzii*, taken recently in Arizona, as a male. Until sufficient material for dissection is obtained it is not possible to settle the question of the sexes of these aberrant Diptera with any degree of certainty. It has been suggested that *Platyphora Lubbocki*, Verrall, is the male of *Ænigmatias blattoides*, but this is open to very considerable doubt.

Attention may be drawn here to some other remarkable Diptera which Brues [9], a leading authority on the Phoridæ, considers ought to be retained in that family; he promises in the near future a paper treating of the relations of these aberrant forms to more normal types.

In 1897 Dahl [2] described from the Bismarck Archipelago a wingless fly, found on carrion and also on an Aroid, with an offensive odour, of the genus *Amorphophallus*. This insect, on account of a very superficial resemblance to a flea, was regarded as intermediate between the fleas and true flies, was named *Puliciphora lucifera*, and was made the type of a new family Puliciphoridæ. Wandolleck [3] subsequently re-examined Dahl's specimen, and described in some detail its anatomy together with that of another species from the Bismarck Archipelago—*Chonocephalus dorsalis*—and of a third from Liberia, a form parasitic on land-molluscs of the genus *Achatina*. The last species, though described, was not named by Wandolleck, but has since been named *Wandolleckia Cooki*. Wandolleck, in his memoir on these three species, heaps scorn on Dahl's view of their affinities, re-christens *Puliciphora lucifera* as *Stethopathus ocellatus* and the Puliciphoridæ as Stethopathidæ. Though there cannot be the slightest doubt that these Diptera have no real affinity with *Pulex*, the rules of priority in nomenclature forbid the supplanting of a valid name, however great the absurdity that is so commemorated; *Stethopathus ocellatus*, Wand., must consequently sink as a synonym of *Puliciphora lucifera*, Dahl. Breddin and Börner [6] described in 1904, under the name of *Thaumatoxena Wasmanni*, a remarkable insect found in a termite's nest in Natal; this they consider to be not only the type of a new family Thaumatoxenidæ, but also the type of a new sub-order of Rhynchota, the Conorrhyncha. Börner later [7] discussed the relation of this insect to the other orders of Hexapoda. Silvestri [8] in 1905 published an account of another species of the same genus, *Th. Andreinii*, and came to the conclusion that the genus is referable to the family Puliciphoridæ (= Stethopathidæ of Wandolleck). The insect is very remarkable in appearance, the abdomen being covered above and below with a single large scutum, three minute telescope-like segments alone projecting from the ventral surface towards its apex; but the antennæ are typically Phorid in character, and the mouth-parts, judging from figures, are sufficiently like those of *Puliciphora*, *Chonocephalus*, and *Wandolleckia* to warrant a belief that *Thaumatoxena* is merely an extreme modification of the Phorid type, brought about perhaps by its termitophilous habits. Brues in his latest monograph on the Phoridæ [9] does not include *Thaumatoxena*, but it is possible that he did not receive Silvestri's paper in time to draw his attention to the fact that the position of *Thaumatoxena* in the order Rhynchota was a very precarious one. Wasmann [4] has described some other termitophilous genera, *Termitoxenia* and *Termitomyia*, which he would include in yet another family, the Termitoxenidæ; they appear to have some features in common with *Thaumatoxena*; Brues includes them in the Phoridæ. Their development is very remarkable, since they undergo no metamorphosis, and *Termitomyia* is also viviparous.

Except in the shape of the head, which resembles the head of *Chonocephalus*, and in the form of the antennæ, which is characteristically Phorid in appearance, *Ænigmatistes* is very unlike all the foregoing genera. *Thaumatoxena* is a form apart, the most outlying member of all. The "Puliciphoridæ" are characterized by the small thorax, swollen abdomen with thin cuticle and isolated scutes, and the long legs. Moreover, in all the genera enumerated above, the rostrum is prominent and is composed of easily recognizable and separate elements. In *Ænigmatias* the rostrum has not been properly demonstrated, but if it exists it is certainly minute and rudimentary. Both in *Ænigmatias* and *Ænigmatistes* the head fits closely to the thorax, and in the latter genus, at any rate, it is incapable of much movement owing to its projection above the level of the pronotum; the labrum is deflexed and covers the entry to the mouth quite completely. In an attempt to raise the labrum of my specimen and examine the mouth-parts *in situ*, the head broke away from the thorax so that the position of the trophi was considerably disturbed. I am, however, confident that no portion of the mouth-parts was lost, and so can affirm with certitude that the proboscis or rostrum of *Ænigmatistes* is represented by a minute membranous hypopharynx which is quite invisible until the labrum, covering it, is removed. This reduction of the mouth-parts alone is sufficient to remove *Ænigmatistes* and *Ænigmatias* from the neighbourhood of the other aberrant genera of Phoridæ described above. It is difficult to see how the insect can feed, since it is provided merely with a pair of maxillary palpi and a rudimentary hypopharynx, and the same may be said of *Ænigmatias blattoides*. *Æ. blattoides* was found in company with ants, and it has been suggested to me that it is fed by the ants thrusting their jaws into the mouth of their guest and regurgitating some liquid nourishment from their crops, very much as the Staphylinid beetle *Atemeles marginata*, Gravenh., is fed by ants. The suggestion was sufficiently ingenious to lead me to examine the mouth-parts of the Staphylinid in question, in the hopes of discovering at least some reduction thereof to lend support to this view, but I was doomed to disappointment, for the mouth-parts in this species are perfectly well-formed. Moreover, I cannot find an instance of the reduction of mouth-parts in any other myrmecophilous or termitophilous insects; and the fact that *Ænigmatias Schwarzii* was not taken in the company of ants almost disposes of the suggestion that these species have to be fed by attendant hosts. Unfortunately, nothing is known of the habits of *Ænigmatistes*; the unique specimen was found in a miscellaneous collection of insects sent to the Paris Museum by M. Ch. Alluaud.

The following are the characters in which *Ænigmatistes* resembles *Ænigmatias*:—

Cockroach-like appearance.
Strongly chitinized head and tergites.
Form of antennæ.
Form of maxillary palpi.
Division of thorax into three visible segments.
Abdomen beneath covered with an unsegmented membranous cuticle.
Form of legs.
Absence of tarsal pulvilli.

The following are the characters wherein *Ænigmatistes* differs from *Ænigmatias*:—

Shape of the head.
Position of the eyes.
Absence of ocelli.
Large size of the pronotum.
Form of the mesonotum and metanotum.
Four visible abdominal segments only.

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EXPLANATION OF PLATE 22.

Ænigmatistes africanus, gen. et sp. nov.

Fig. 1. Dorsal view. × 45.
Fig. 2. Ventral view. × 45. *a*, Antenna; *b*, maxillary palp.
Fig. 3. Head in side view. × 85. *b*, Maxillary palp; *c*, eye; *d*, seta; *e*, lateral edge of pronotum.
Fig. 4. Antenna. × 250. *f*, First joint; *g*, second joint.
Fig. 5. Labrum, maxillary palpi, and hypopharynx. The parts have been separated and the left palpus is shown from the inner aspect. × 85. *ph*, Entrance to pharynx.

The Preservation of Specimens in Australian Museums.

By J. G. Otto Tepper, F.L.S.

[Read 21st November, 1907.]

After reading the—for me—very interesting paper "Contribution to the Physiology of the Museum Beetle, &c.," by Dr. J. Ewart, F.L.S. &c., in No. 195 of the Journal (and the last to hand), I have thought it might not prove amiss if I communicated to you some notes on my experiences relating to the same subject, of which you may make any use you may think it worth while.

For about 24 years I have had the insect collections of the South Australian Museum under my care officially, while at home a considerable botanical collection (mostly Australian) claims my attention privately. Part of the original insect cases (Mrs. Kräusler and Mr. Odewahn, 1850 odd to 1876) were of a rough loose type; the others, though well-made cedar glass cases, were however by no means air-tight, and all were more or less infested with *Anthrenus* and Tineid larvæ, when handed over to me. I cleared them effectively by moistening the specimens with benzol with a camel-hair brush, the youngest larvæ being killed, the others made to quit their lurking places hastily and thus permitting their extermination. After repeated treatments the lepidopterous larvæ, mites, and mould were got rid of for good, while those of the *Anthrenus* only reappeared sparingly and sporadically. However, without some permanent deterrent this method entailed frequent time absorbing inspections, without adequate security against inroads, therefore various substances were successively tried. Camphor proved to be a more or less deceptive expedient, without injuring the depredating larvæ which had gained ingress. Naphthalene, however, was much more effective; although the *Anthrenus* larvæ were sometimes found concealed under it and as vigorous as possible, yet all other agents were killed out.

In respect of the preventive and preservative effect of naphthalene, I found that a great deal depends upon (*a*) the form and (*b*) the quantity applied. Solid lumps and balls proved more or less useless after a few days according to circumstances, the surface becoming dense and smooth, minimising volatilisation. The *scaly* state proved the most effective, the next being the crushed, powdery one, which however soon "cakes" and thus becomes less volatile. The quantity applied and found most satisfactory was from one to two tablespoonsful per case of 24 in. × 18 in. × $3\frac{1}{4}$ in., according to the greater or lesser hermetic fitting or necessity of frequency of opening. Smaller cases require comparatively little, but too much is preferable to too little. One or two applications per annum has been found quite efficient during several years.

The Tinea moths and several coleoptera, like the *Sitotroga*, &c., complete their life cycles within closed vessels, cases, &c., as long as the food-supply lasts; not so the *Anthrenus*, as the adult beetle can only live by feeding on and among flowers. I have often found them numerously on those of *Eucalyptus*, *Leptospermum*, *Bursaria*, in the woods, and on Roses, *Pyrethrum*, &c., in my own garden. Therefore every generation requires fresh infection from without, and this takes place through the oviposition among the dust in the angles and crevices of protected portions of the floor of the room or cabinets and chests of drawers, or on the back and sides of the cases. From these positions the very active and minute larvæ find their way more or less easily into the interior and the specimens long before their presence is suspected. A moderately liberal application of pyrethrum powder in the *loci* indicated, and occasional rubbing over the sides and backs of cases with a duster, I found quite efficient.

Dr. Ewart rightly draws attention to the fact that the larvæ must have some supply of moisture from external sources, although that be imperceptible to the senses. In fact, I found that if this moisture be so abundant as to become perceptible, mould (*Penicillium*) soon affects the specimens and the live larvæ alike, and fatally in time. The supply is provided by warm air more or less saturated with moisture coming in contact with the specimens, when they had become much colder previously, the condensed deposit being gradually absorbed by the internal substance, and accumulated. This I have prevented by keeping the store-room moderately warm from the end of autumn to early summer or latter part of spring, thus removing the conditions permitting the condensation of such moisture quite satisfactorily. A paper of mine, which perhaps was forgotten to be sent to the Society, will be likewise forwarded, in which this aspect of the matter is treated more fully.

Life-Histories and Larval Habits of the Tiger Beetles (*Cicindelidæ*).

By VICTOR ERNEST SHELFORD, S.B., Ph.D. (Chicago). (Communicated by the Rev. Canon FOWLER, M.A., F.L.S.)

(PLATES 23–26.)

[Read 20th February, 1908.]

I. INTRODUCTION.

DURING the past quarter century, the consideration of life-histories and habits as a basis for experimental work and for the study of distribution, variation and other evolutionary topics has been far too much neglected. In the study of variation, investigators have too often collected large numbers of specimens, arranged them in classes, calculated indices, constructed curves, and drawn conclusions regarding the direction of evolution without knowing the life-history of the form and without determining whether the characters studied are easily modified by varying conditions during development, or whether they change during the life of the individual.

Recent studies of the variation of the potato beetle from generation to generation, by Tower, and of seasonal changes in the number of ray flowers of certain *Compositæ*, by Tower, Shull and others, have called attention to the great liability to error in investigations conducted in this manner.

An analysis of the environmental conditions of an organism during development cannot be made until the complete life-cycle is known. The responses and habits of the adult Tiger Beetles at the time of laying, as we shall note later, and of the larvæ, especially at the time of preparation for pupation, determine in many cases the conditions under which later stages must be passed. In the pupal and prepupal stages at least, these organisms are sensitive to external stimuli.

It is my purpose to present in this paper the general outlines of those activities and reactions connected with reproduction, which have a special bearing on the more general papers to follow. The succeeding papers will deal with the following topics :—distribution, variation, the effects of varying environmental conditions during development, an analysis of the colour patterns, a discussion of race tendencies of the genus *Cicindela*, and the bearing of the whole on the problem of evolution. The data on the selection of habitat and on colour-changes herein mentioned, will be presented in detail in another connection.

II. PREVIOUS ACCOUNTS OF LARVÆ AND LIFE-HISTORIES.

The larva and larval habits of a European species, *Cicindela campestris*, Linn., were described by the early writers on natural history and are better known than those of any other member of the group. Geoffroy gave a general account in 1762, to which details were added by Desmarest in 1804 and Westwood in 1838. Blisson described the pupa and the last part of the life-history in 1848, and Enock completed the account in 1903. The latter contributed a description of the eggs, the open burrows in which they are laid, and a detailed account of the burrowing habits of the larvæ. Several other larvæ, pupæ, etc., chiefly European, have been described. Ponselle gave an account of the egg and egg-laying habits of *C. flexuosa*, Fabr., but stated that he was unable to secure any larvæ from eggs removed from the soil, because of fungus attacks.

Larvæ.

The notable characters of the larvæ are the head and prothorax, which close the burrow when the animal is waiting for prey, and the hooks and spines of the fifth abdominal segment which enable it to move up and down in the burrow and prevent large prey from dragging it out. Descriptions of the structures of these larvæ are easily accessible in text-books of entomology, &c. Enock's account of their habits and movements is detailed, accurate, and in a general way applies to the whole group.

Burrows—Soil Inhabiting Forms.

The burrows are not so well known as the larvæ. They differ more in different species than the larvæ themselves. They are usually cylindrical and have a circular opening at the surface. The edge of the opening is slightly rounded and perfectly smooth. Surrounding it is a circular area which extends outward, from the edge of the opening for a distance a little less than the equivalent of the diameter of the burrow itself. This area the animal keeps smooth and clean by removing all loose earth and packing the particles of soil with its mandibles. This smooth area and rounded edge almost always serve to distinguish the burrows of *Cicindelidæ* from those of other animals. Tiger-beetle burrows occur in horizontal or vertical surfaces, or surfaces sloping at any angle between these two extremes. The general direction of the burrows is vertical or at right angles to the surface, all apparently depending upon the habit of the particular species. Those of some species are curved, as for example *C. hybrida* Linn. (Lesne), or straight like those of *C. campestris*. The depth varies from a little more than the equivalent of the length of the animal's body, in the case of larvæ found in hard soil, to 1·25 metres in the case of larvæ mentioned by Criddle as occurring at Aweme, Manitoba ; it is related to the character of the soil, temperature, the distance to ground-water, and possibly other factors.

Arboreal Forms.

There are several genera of tree dwellers. Their young stages are unknown except in *Collyris*. R. Shelford has recently described one of these in detail. The larva has its burrow in the stems of the coffee plant and is an agricultural pest in the East Indies. Its method of food-taking is like that of the larvæ of *Cicindela*.

III. Methods of rearing Larvæ.

Cicindelidæ have always been regarded as very difficult to rear. I have had no success outside of a well ventilated glass-roofed vivarium. The adults of a given species were put in a cage containing the soil which they frequent, or better, that which their larvæ inhabit. Most of the species here considered can be induced to lay without difficulty.

For rearing larvæ in large numbers from the last stage to maturity, a screen bottomed box containing sand (or sandy soil) can be placed over other moist soil which will maintain any desired degree of moisture. If well cared for, even the species that leave their holes when conditions are not favourable, can be reared in numbers by this method without great mortality. It is well to tack strips of tin on the edge of such a box, allowing them to project 3 to 5 cm. over the inside ; this will prevent the larvæ from escaping.

For the study of larval habits, cages were made of glass plates separated by glass tubing of a diameter corresponding to the width of the prothorax of the species to be studied, and cemented together with paraffin of a high melting-point. Bottoms were made of cloth saturated with paraffin (by first wetting in xylol or turpentine) to prevent decay, and fastened in place with hard paraffin. Straight cylindrical Welsbach lamp chimneys were also used for this purpose. The soil, if well packed, will stay in these and the moisture may be maintained by capillarity, through additions from below.

Pupæ were often kept in Syracuse watch-glasses lined with moist filter-paper, through the greater part of the pupal life, with a relatively low mortality. The filter-paper should be moistened with 3 per cent. hydrogen peroxide from time to time ; this may be dropped directly on the bodies of the pupæ and will help to keep down the fungi which are the chief cause of trouble in all these studies.

All larvæ and adults were fed with small pieces of lean meat which were placed in the burrows or cages every day.

IV. Life-Histories of the Species occurring near Chicago.

Twelve races have been studied ; all but one have been reared to at least the second larval stage. Extensive field observations connected with the collecting and rearing of three to four thousand individuals from the last larval stage to maturity, have served to verify and complete the accounts. The races and species considered are :—**purpurea*, Oliv.; *purpurea*, Oliv. sub-species *limbalis*, Klg.; *formosa*, Say, sub-species *generosa*, Dj.; *duodecimguttata*, Dj.; *duodecimguttata*, Dj. sub-species *repanda*, Dj.; *tranquebarica*, Herbst; *scutellaris*, Say, aber. *Lecontei*, Hald.; *hirticollis*, Say; *sexguttata*, Fab.; *punctulata*, Oliv.; *lepida*, Lec.; and *cuprascens*, Lec.

For convenience I shall discuss in detail the life-history and larval habits of *C. purpurea*. The accounts of the remaining species will be comparative, and the points in which they differ from that of *purpurea* will be especially noted. Unless otherwise stated, it is to be understood that the length of the various stages is approximately the same as in *purpurea*:—Period of incubation, 2 weeks; first larval stage, 4 to 5 weeks; second larval stage, 5 to 7 weeks; pupal and prepupal stages, each 2 to 3 weeks.

Cicindela purpurea.

The Ovipositor.—The ovipositor (Pl. **23**. figs. 1, 2 & 3) of *Cicindela purpurea* is made up of abdominal segments 8, 9 and 10 and their appendages. The posterior part of the seventh and anterior part of the eighth segment are soft and pliable, serving to permit the entire posterior end of the abdomen to be withdrawn into the segments in front, as is the case in many Coleoptera. The posterior half of the eighth segment possesses on its dorsal and ventral sides respectively, a chitinized plate. These two plates are separated by a soft portion representing the pleuron, which makes it possible for them to approach each other very closely. The ventral plate is prolonged backward in the form of a pair of pointed projections, representing the gonapophyses of the eighth segment. On the ventral side of the ninth segment is borne a pair of movable, strongly chitinized gonapophyses, which are used in digging into the soil for egg-laying (Pl. **23**. figs. 1, 2 & 3). Also arising from this segment (9th), as can be followed in a series of pupæ, are to be found an outer pair of appendages. In the adult, these lie dorsal and somewhat separated from the others, at the sides of the tenth segment which is without appendages. The outer gonapophyses of the ninth segment and the tenth segment are covered with hairs, which are in all probability sensory. In the pupa, the outgrowths which are to form the movable gonapophyses are present at the moulting of the larval skin and stand out as well differentiated parts.

Mating and Egg-laying.—The mating and egg-laying habits were observed in animals in captivity in the latter part of April, 1904, 1905, and 1906. Specimens captured at Lyons, Ill., April 22, 1904, were carefully studied.

* The nomenclature used in this paper is to be found in Horn's "Systematischer Index der Cicindeliden," Deutsch. Ent. Zeit., Feb. 1905, Supplement. *C. scutellaris*, Say, however, stands in that publication as *obscura*, Say, the corresponding change having been made by the same author in a later publication.

They copulated some time during three or four days following their capture and the first eggs were found April 26th. There appear to be no special courting movements ; a male quickly seizes a female by the thorax with his heavy mandibles and rests with the ventral side of his body against the dorsal side of the female, his legs extended freely at the sides. He may remain in position for a long time and finally succeed in copulating with the female. If, because of being disturbed, he leaves her, he has been known to return to the same one to the exclusion of other females that were present. Some days after fertilization (the length of time is difficult to determine because of the continued copulation or attempts at copulation on the part of the male) the female seeks a place to lay her eggs. She holds the anterior part of the body as high as possible and, extending the posterior part of the abdomen (ovipositor), she digs a vertical hole with the gonapophyses of the abdomen, from 7 to 9 mm. in depth. She tries the soil by making holes without laying any eggs. About fifty eggs are laid, singly and large end uppermost (Pl. **23.** fig. 4), in such uncovered holes by one female. Whether or not more than one lot of eggs is laid by one female has not been definitely determined, but it is quite improbable from all evidence at hand.

The method of egg-laying is essentially like that found in *C. campestris* by Enock and in *C. flexuosa* by Ponselle.

The Egg.—The egg is shaped like a hen's egg but somewhat more elongated; 2 mm. long, 1 mm. in diameter at the small end and $1\frac{1}{5}$ mm. at the large end. It is of a clear, translucent cream-colour and slightly shiny ; the chorion is very easily ruptured (Pl. **23.** figs. 5 & 6).

About two weeks after the eggs were laid, small larvæ appeared (May 8, 9 and 10 in 1904). Those in the dryer parts of the soil appeared only after the soil had been moistened.

First Larval Stage.—The larva at hatching is much like the later stages (Pl. **23.** fig. 7). The abdomen is much wrinkled between the more strongly chitinized plates, bringing them into close contact. The width of the prothorax is $1\frac{1}{4}$ mm. Soon after hatching, the larva makes its way to the surface, packing the soil so as to form a cylindrical burrow with a diameter a little greater than that of its prothorax. This burrow corresponds in position to the hole made by the ovipositor and at first is no deeper. The larva soon digs to a depth of 10 to 15 cm.

After feeding for three to four weeks (fig. 8), the larva closes the mouth of the burrow with soil and goes to the bottom and moults, returning again to the surface at the end of from five to seven days.

Second Larval Stage.—The head, prothorax, appendages and strongly chitinized plates are larger (fig. 9) ; the size of the abdomen is essentially the same as just before moulting but the cuticula is again wrinkled. The larva makes its way to the surface probably by removing the soil from above, thus enlarging the hole and allowing the loosened earth to fall to the bottom.

Under favourable conditions this stage lasts about five weeks. The time is doubtless modified by temperature and food conditions, as some individuals require longer. The activities connected with the second larval moult are the same as those connected with the first.

Last Larval Stage.—The changes are essentially the same as in the first moult; the diameter of the prothorax is $3\frac{1}{2}$ to 4 mm. (Pl. **23**. figs. 10 & 11).

During the latter part of August and the month of September the larvæ disappear, closing the outer end of their burrows and going to the bottom to remain until spring. (In captivity they were kept as nearly as possible under normal conditions and the survivors were found with their holes opened in the early part of April.) They feed until the middle of June, when they fill the upper part of the burrows. Each then constructs an ovoid cavity (fig. 13) near the bottom of its burrow. Having carefully packed and smoothed the soil forming the wall of this cell with its mandibles and the ventral side of its head, each larva remains at rest with the body leaning against one of the sides of the pupal cavity. The head is uppermost and the animal gradually becomes less and less active as time goes on. At the end of two or three weeks it is almost incapable of moving the legs. The abdomen gradually thickens and becomes a clear, characteristic, cream colour, due to internal changes. The tubercles of the first five abdominal segments of the pupa (fig. 12) can be seen through the larval skin. They are folded toward the centre of the back.

Pupal Ecdysis.—A few days after the conditions just mentioned have become apparent, the pupa emerges from the larval skin. The cuticula splits in the mid-dorsal line of the thoracic segments and the head; the split on the head bifurcates, following the suture at the posterior side of the clypeus.

The process of shedding the skin requires only a few minutes and has been seen in the variety *limbalis.* It is accomplished by contractions of the ventral body-muscles which tend to elongate the dorsal side and bring the old skin under tension. The thoracic portions of the body are the first to emerge; the skin meanwhile slips backward on the abdomen and the head is gradually withdrawn, usually becoming free before the abdomen. The abdomen is freed by its later movements. The pupa possesses very few bristles that could assist in the removal of the exuvium. The only ones are a few on the margins of the pronotum and several long ones on each abdominal tubercle. The bristles of the tubercles together with the tubercles themselves obviously assist in working the exuvium from the abdomen. An exuvial fluid is apparently present, and this together with the great expansion of the wings and appendages is sufficient to insure safe emergence.

The Pupa.—At the time of emergence the pupa is only a little shorter than the larva, but it soon contracts and assumes the form shown in fig. 12. As has been noted by former workers, the dorsal tubercles serve to hold the body away from the substratum on which it rests.

At emergence, the eyes are pale brown and gradually become darker by the development of the iris and retinal pigment, until the end of about ten days when the process appears to be complete. Differentiation of the appendages of the adult begins at their distal ends. Cuticular pigment develops only when the cuticula is mature. The appearance of pigment is coincident with final hardening. At the end of twelve days pigment has appeared on the tips of the mandibles and a little later on the tips of the mandibular teeth. It proceeds from these toward the proximal portions, and by the 13th or 14th day the process is complete. On or about the 13th day the tarsal claws are pigmented, and a day or two later the proximal portion of the tibia shows pigment which moves toward the more distal portions. Coincident with the development on the tibia, pigment appears on the outer border of the trochanters and later develops at the attachment of the principal muscles and tendons of the leg (Pl. 24. fig. 14).

The Last Ecdysis.—The first movement possible in the pupa is that of the tarsal claws. The legs, early in the process of moulting, are moved outward from the body and slightly straightened. For this the trochanter muscles and the muscles of the femur are used. Their attachments are hardened and pigmented and movement is accordingly possible. By vigorous movements, especially of the legs and mandibles, the pupal skin is ruptured and the continuation of the movement frees the imago.

The bristles of the adult assist in the removal of the exuvium. Their arrangement is well illustrated in the legs (Pl. 24. fig. 14) and other appendages, where they occupy much space inside the pupal skin. This function of the bristles was suggested by Miall and Denny in their work on the Cockroach.

The Imago.—After emergence, the imago remains in the cell for several days, the pigment of the body meanwhile developing. The only specimen of *purpurea* that was brought to maturity emerged on August 11th and about eighteen hours afterwards had apparently reached an adult colour. It lived for ten days longer, during which time it underwent a series of colour-changes that will be described elsewhere.

In nature, adults appear in the latter part of each August. They feed during the early fall, and in early October dig holes in some little bare bank in a meadow or go into the hole of some other insect for hibernation. They have been dug, in late October, from such situations, being apparently helpless from the cold. Specimens hibernating in captivity appeared in the latter part of March. They reach sexual maturity late in April, lay eggs and die.

Summary and Comparison.—The life-history of *Cicindela purpurea* may be summarized as follows:—The eggs are laid in May; larvæ reach the last stage in August, hibernate, begin to feed again in April and pupate in July; the adults emerge in August, feed for a time, hibernate and come out in the second spring still sexually immature, reach maturity in the first warm days of April and lay eggs and die. The larval life lasts from twelve to thirteen months and the adult life ten months—two years between generations.

The essential features of Enock's account of the life-history of *C. campestris* are as follows:—The larvæ live through two winters, deepening their holes each autumn and appearing again in the spring. An oblique pupal cavity is made in August. The adults emerge in autumn, remain through the third winter in the pupal cell in an inactive state and come out in the spring of the third year.

He does not state the number of larval stages nor did he breed any of the insects. The larvæ of a number of North American species live over only one winter and the last larval stages of two generations overlap, so that one finds very young larvæ and mature larvæ of this stage in July. From field observations alone one might conclude that the larvæ live over two winters.

CICINDELA PURPUREA, subsp. LIMBALIS.

The adults appear later in the spring than those of *purpurea* and the egg-laying takes place in June. The female, after fertilization, selects a place to deposit eggs (they are laid in clay) by first trying the soil as I have described for *purpurea*. In my cages the larvæ were not carried further than the second stage, but they have been observed in nature in a habitat where only this species occurs; from this locality, about six hundred larvæ have been collected and reared to maturity.

In the early part of September, only larvæ of the first and second stages can be found, and later in the autumn the first stage becomes very scarce. They pass the winter chiefly in the second stage and appear in the latter part of May or the first of June when they enter the last stage. The larval burrows enter nearly at right angles to the surface of the steep clay bank in which the larvæ live, and curve into a nearly horizontal position at the inner end; the depth is from 7·5 to 10 cm. A chimney-like structure about 6 mm. in height is usually built up at the mouth of the hole with clay removed from the bottom. The pupal cell is made by enlarging and shifting the inner end of the burrow (Pl. **24**. fig. 18). They enter the prepupal stage during the first two weeks of July.

Some of the adults appear in the early part of August in some years and undergo a series of colour-changes. The stragglers of the former generation may be present in small numbers in the early part of August and continue mixed with the young ones as late as September. The adults hibernate and appear in the spring, reaching sexual maturity in June, about a month later than does the true *purpurea*.

Weather Conditions and Time of Appearance.—The latter part of July, 1905, was very wet and warm at Chicago and I found fresh *limbalis* in numbers at Glencoe on August 3rd. July, 1906, on the contrary, was very dry and I was unable to get any until September 5th, at which time they were very much scattered. The specimens reared from larvæ brought into the vivarium emerged as in former years. These insects are unable to dig their way out until the soil is thoroughly wet. Leng has observed a similar variation in the time of appearance of another variety.

CICINDELA FORMOSA, subsp. GENEROSA.

This species lays its eggs in May and June, in fresh sand. Eggs are difficult to secure and have not been studied. In my cages larvæ appeared June 24th. The head and prothorax are much larger than those of any of the other species here considered and possess a colour pattern (Pl. **24.** fig. 16). The burrow is entirely different from those described above.

The Burrow.—The main part of the burrow is from 30 to 50 cm. deep and vertical throughout the greater part of its course. At a distance from the opening equal to two-thirds of the length of the animal's body (Pl. **25.** figs. 22–24), it curves sharply to a horizontal position like a stove-pipe elbow and opens into the side of a pit. The edge of the pit usually overhangs the mouth of the burrow in such a manner as to make it almost invisible. The head and prothorax of a larva of the first stage are almost as large as those of the last stage of some other species (1·75 mm.). The larvæ are always to be found in sand that is slightly shifting. The great size of the hole would cause it to fill up with the sand moved about by the wind and thus make the animal a great amount of labour. Each larva cements the sand-grains slightly with saliva. Accordingly its hole and pit near the opening are quite firm and the wind does not ordinarily disturb them. The pit may fill and be almost obliterated by the action of either wind or rain; the burrow, however, remains undisturbed, except possibly when the rain is very heavy. This type of burrow possesses advantages in securing prey; the pit acts as a pitfall for small animals. It is more elaborate than that of *C. hybrida* (a European species), described by Lesne, in which the pit and curvature of the burrow are relatively imperfect (Pl. **24.** fig. 17).

In my cages, the larvæ reached the third stage in the latter part of August. They all disappear in the field by the first of October and reappear again in the spring. In the latter part of June and the first half of July, they go into the prepupal stage, each in an oblique side cavity about 10 cm. below the surface (Pl. **25.** fig. 24): the upper part and much of the lower part of the hole is filled with the sand that is taken from this elliptical cavity. The adults of a given generation are not found so abundantly in the fall and summer as in the spring, and it is probable that many remain over winter in the pupal cavities. Those that come to the surface in autumn go into hibernation somewhat earlier than some of the other species and come out somewhat later. They appear in the latter part of April or early May, reach sexual maturity in about a month, lay eggs and die.

CICINDELA DUODECIMGUTTATA, subsp. REPANDA.

The life-history of *C. duodecimguttata* sub-species *repanda* differs from that of *C. purpurea* in that the adults reach sexual maturity later in the spring and the egg-laying is distributed over a longer period.

The eggs are a bright yellow, 2 mm. long, $\frac{9}{10}$ mm. in diameter at the narrow end and 1 mm. at the broad end. They are laid in May and June in sloping ground; sand is preferred. The larval holes are about 10 cm. deep, and their general direction is at right angles when in sloping surfaces and oblique when in horizontal surfaces.

This species is exceedingly difficult to rear. If conditions become a little unsatisfactory to the animals they leave their holes. All of a very large brood, reared to the second and third stages, were lost by their escaping from the box in which they were kept. Screen was tacked on the edge of the box and allowed to project inwards, but the larvæ were seen to crawl around this, clinging by their feet, their abdomens dangling in the air—a very interesting piece of gymnastics in view of the fact that Geo. Horn asserted in 1878 that the larvæ of the *Cicindelidæ* could not assume the straight horizontal position in which they are commonly figured. Many individuals upon leaving the burrows, were devoured by those still in their holes. Schaupp worked with this species and enlarged upon the necessity of having separate dishes to prevent the larvæ from devouring each other.

C. DUODECIMGUTTATA.

With the exception of the rearing of larvæ from the last larval stage to maturity, this species has not been studied in the laboratory. The life-history is shown by field observations to be like that of *repanda*; larvæ are usually found in humus or clay. A complete life-history, with the exception of the egg, has been taken in early August, from 10 square decimeters of ground.

C. TRANQUEBARICA.

The life-history is essentially the same as that of *C. purpurea.*

The eggs are laid in a variety of moist situations. The larvæ go to a depth of from 22 to 50 cm. The sides and anterior corners of the pronotum are not pigmented in larvæ of the third stage.

The imagoes undergo a series of colour-changes.

C. SCUTELLARIS aber. LECONTEI.

The life-history differs from that of *C. purpurea* but slightly. The eggs are laid in dry sand which contains a little humus. The adults do not appear as early in the spring and continue later in the summer. About seven per cent of the larvæ are parasitized by the larvæ of *Spogostylum anale*, Say, one of the

Bombyliidæ (Diptera). The holes of this species vary from 25 to 45 cm. in depth.

The imagoes undergo a series of colour-changes continuing to death.

Cicindela hirticollis.

This species reaches sexual maturity in July and deposits eggs in the level, white, wet sand of the beach of Lake Michigan. The third larval stage is reached by most individuals in the latter part of August and the early part of September. The larvæ live in straight, vertical burrows, 15 to 20 cm. in depth. They disappear very late in the fall (being found as late as the middle of October) and reappear in April. After storms they have been found crawling on the beach and after heavy rains have been found on the tops of sand dunes. This is due to the fact that they leave their burrows with every deviation from the optimum conditions. This makes them difficult to rear. They go into the prepupal stage from the first of June to the latter part of July, or even later.

The colour of the imagoes undergoes a series of changes; the insects come out of the soil before the changes are ended and the chitin hardened. This appearance begins in the second week of July while the hibernated ndividuals are still present; the beach then swarms with them. The old individuals gradually disappear as the number of new ones increases, so that the presence of the new brood cannot be noted by numbers.

The number continues about the same during the month of July, after which it gradually decreases. Individuals that can be recognized as fresh by the condition of their cuticula have been repeatedly brought into the vivarium. They soon go into the ground and do not come out. Repeated examination of the females at this time of the year has never shown a single one to contain eggs, nor have I seen any cases of copulation. While I have not succeeded in bringing any of these individuals through the winter, there is little doubt from these observations that the adults go into hibernation in two or three weeks after their emergence and remain there until the following June.

C. sexguttata.

The female lays the eggs (June or early July) in shaded sand or clay containing humus, more rarely in pure humus. The eggs are of a bright cream-yellow, 1·8 mm. long and 1 mm. in diameter. Most of the larvæ pass the winter in the last stage, a small number in the second stage. The only specimens that were reared went into the prepupal stage before the 15th of June (one year after the eggs were laid) and one was observed to pupate July 29th, six weeks after, and emerge August 7th. All that were observed went into the prepupal stage from June 11th to the 17th and all emerged between August 4th and 8th. None of them dug their way out, but were removed for examination.

C. sexguttata rarely appears in northern localities in the autumn and it is probable that it remains in the pupal burrows until spring, as does *C. campestris.* The species is reported as appearing both autumn and spring in some southern localities. At Chicago the adults appear during April and May, while in the western part of the geographic range of the species, they do not appear until late in June—after the heavy spring rains which soften the soil so that the imagoes can dig to the surface.

Cicindela punctulata.

The eggs are laid in relatively hard dry soil, usually humus, in the latter part of July. They are hatched in two weeks; the first larval stage lasting three weeks, and the second three weeks; the third being reached by the majority in September. After hibernation the larvæ feed from the middle of April until early June.

The larval burrows during the feeding season are 30 to 40 cm. deep. They are shallower in the summer just before the animals go into the prepupal stage. In many cases the larva is overtaken by the condition of helplessness which precedes pupation and pupates in the upper part of the burrow, the pupa standing on end; more often a pupal cavity is constructed (Pl. **24.** fig. 20). The prepupal and pupal stages are each from ten days to two weeks in length. The imagoes emerge after a few days, and if the ground is sufficiently soft, dig their way out and reach sexual maturity by the end of about three weeks. The adults do not hibernate.

C. lepida.

The animals sometimes copulate in the small burrows which they dig in the sand. The eggs are laid in the latter part of July. My only observation of the eggs or egg-laying was one case in which the female, on a warm morning, stood on a board in one of the cages and deposited an egg from the end of the partially extended ovipositor, letting it fall on the board; the egg was accidentally destroyed. It was of a deep cream-yellow and a little smaller than that of *repanda.*

The second stage is reached in the autumn, by almost all of a given population. This stage lasts until the following June or July, after the full-grown larvæ have gone into the prepupal stage. The larvæ feed in this stage (third) until late in the autumn and then hibernate, coming out about the first of May. Their burrows are from 60 to 90 cm. deep and are very small in all of the stages. A natural funnel is frequently formed at the mouth of the burrows due to the action of gravity on the dry sand (fig. 19). The holes of the last stages, which live for nearly a year, are closed and partially filled with sand for much of the time and the larvæ never appear well fed. The adults are small.

The pupal cells are long and curved and are shaped much like the burrow of *C. limbalis* (fig. 19). The larvæ enter the prepupal stage in the last half of May, emerge as adults in the latter part of June and reach the surface during the first few days of July. They reach sexual maturity in about two or three weeks ; the life cycle occupies two years.

Cicindela cuprascens.

After much labour and many fruitless trials, I have succeeded in rearing a few larvæ of this species to the second stage. They have never been found in the field, due no doubt to the fact that they make burrows that are ragged at the edge and are like those of many other animals.

In my cages the female after making very many holes in the sand, laid a few eggs (July). The first larval stage lasted about one month and individuals in the second lived until the last of October without change. The life-history is thus far entirely parallel with that of *C. lepida,* to which this species is regarded as being more nearly related than to any other species hitherto mentioned. The adults appear at the same time as those of *C. lepida.*

V. Taxonomy.

Larvæ belonging to several genera of the *Cicindelidæ* have been described, but our knowledge of their characters is at present too meagre to make a key practicable. The following characterizations of the described forms may, however, prove helpful.

Manticliora has the first antennal segment thick and the others very slender (Kolbe), while in all of the remaining described genera the antennal segments taper gradually distalward. In *Amblychila* the second segment is as long as the others taken together (Geo. Horn). *Eucallia* and some species of *Collyris* (R. Shelford) have two ocelli on each side, *Amblychila* has one, and the remaining described forms four. McGillivray made no place in his key to the families of Coleopterous larvæ for larval *Cicindelidæ* with less than four ocelli on each side, and Kolbe does not state the number in *Mantichora* but implies that there are four. *Omus* and *Collyris* have three pairs of spines on the dorsum of the fifth abdominal segment. All are about of a length in *Collyris* ; the middle one is much the longest in *Omus. Amblychila, Megacephala,* and *Cicindela* never have more than two. In *Amblychila* the inner one is the longer, while in all of the others the outer one is the longer ; the inner may be absent.

The larvæ of the different species of *Cicindela* are difficult to distinguish. The habitat, the form of the burrow, and the size and colour of the head and the prothorax are good taxonomic criteria, but these do not suffice. The distribution and number of bristles on the dorsal side of the head and the prothorax of the larvæ of a given species are very constant. These, taken with the other criteria just mentioned, leave little chance of error in identifying the larvæ of the species considered in this paper. Plate **26**, figs. 25–58 shows the distribution of bristles on the head and prothorax of these species. The position of bristles that are sometimes absent is indicated by a ×.

The first larval stage of *C. purpurea* (fig. 25) shows the usual type of pilosity pattern of the first stage of the species here considered. The second stage (fig. 26) possesses more bristles than the first and the arrangement is here again very typical. The third stage (fig. 27) differs less from the second than the second does from the first. The pilosity pattern of the larvæ of *C. purpurea limbalis* does not differ in any essential particulars from that of *purpurea*. In the discussion of the succeeding species, attention will be directed chiefly to the prothorax, the head presenting less interesting differences in the different species.

The distribution of bristles in the first stage of *C. sexguttata* (fig. 28) is like that in the first stage of *C. purpurea*. The second stage may be distinguished from that of *C. purpurea* by the presence of the bristles Y and Z; the third by bristle Z alone. Leng placed *C. purpurea* and *C. sexguttata* in the same group; his contention is borne out by these larval characters. The first larval stage of *C. punctulata* (fig. 31) differs from the corresponding stage of the preceding species by the absence of bristle W (see fig. 28). This structure is present in the second stage (fig. 32) in which the bristles U and V are sometimes present also. The third stage (fig. 33) is subject to considerable variation, but in case the pilosity pattern duplicates that of the preceding species, the larva can always be distinguished by the size of its head (Table III.).

The first stage of the larva of *C. repanda* (fig. 34) lacks bristle W (see fig. 28), but possesses bristles T and V (see fig. 32). Bristles V and Z (see fig. 29) are usually present in the second and third stages (figs. 35 and 36). The distribution in *C. 12-guttata* (figs. 37–39) does not differ in any essential way from that in *C. repanda*. The bristles are usually larger and occasionally bristle S (fig. 39) is present.

The first stage of *C. generosa* (fig. 40) is like that of *C. repanda* (fig. 34). The second stage (fig. 41) lacks the bristle V. The third stage (fig. 42) is in some cases without those indicated by the ×. The first stage of *C. tranquebarica* (fig. 43) is like that of *C. repanda*. The second stage (fig. 44) possesses in addition to the bristles present in the second stage of *C. repanda* (fig. 35) bristle Y (see fig. 29). The third stage often (fig. 45) does not possess bristle Y.

The distribution in the first stage of *C. scutellaris* (fig. 46) is like that of the four preceding races. The second stage (fig. 47) differs from the second stage of *C. repanda* only in having bristle Y (see fig. 29). The third stage (fig. 48) possesses a number of bristles on each side of the median line of the prothorax.

The first stage of *C. lepida* (fig. 49) is like that of *C. repanda* except for the bristles on the anterior side of the head which may be weak or absent. The second and third stages (figs. 50 and 51) possess many bristles that have not been noted in any of the preceding species and races. These fall into longitudinal and cross lines of more or less definiteness which will be discussed in a succeeding paragraph.

The first larval stage of *C. cuprascens* (fig. 55) is like that of *C. lepida* (fig. 52), but the second stage is more like that of the last stage of *C. tranquebarica* (fig. 45).

In addition to the species herein treated, these characters have been examined in the larval stages of *Tetracha Carolina*, Linn., larvæ evidently belonging to African and Australian *Megacephalidæ*, in the British Museum, and of the following species kindly sent to me by Dr. Walter Horn, of Berlin :—*C. campestris*, Linn., *C. hybrida*, Linn., *C. maritima*, Dej. (?), and *C. biramosa*, Fabr. (Ceylon). The larger and more constant bristles of the American species of *Cicindela* are present in all these. *Tetracha Carolina*, Linn., has a pattern strictly comparable to that of *C. purpurea*, 12-*guttata*, etc. The pattern of some of the European species is identical with that of *purpurea*. The study of the distribution of these bristles is difficult and their development and relation to other morphological structures have not been studied. Any interpretation of their arrangement must accordingly be purely tentative and for convenience in further study.

The bristles fall with greater or less precision into several transverse and longitudinal rows. There are four pairs of longitudinal rows on the prothorax (A, B, C, and D of fig. 57) and two on the head (E and F of fig. 58). The principal transverse rows are 1, 2, 3, 4, 5, and 6 on the prothorax and 7, 8, 9, and 10 on the head. The positions of the principal bristles are indicated by the point of crossing of the lines. The positions of the more constant bristles are starred.

At the present time it is impossible to make a key as so few larvæ are known and, in the case of the described ones, no figures or descriptions of the arrangement of bristles have been presented. Accordingly, the distinguishing characters of the different stages and species are presented in the Tables below. For the arrangement of the bristles the reader is referred to the figures just described.

No generally practicable way of distinguishing the pupæ has been found. Excepting an occasional rudiment of some of the large and constant ones, the bristles are lost in the pupæ.

TABLE I.—Showing the characters of the first larval stages.

Species.	Width of prothorax.	Fig.	Coloration of head.	Coloration of prothorax.
purpurea	1·25 mm.	25	Shining blackish green.	Do. head.
limbalis	1·25 mm.	25	Blackish green with cupreous reflections.	Do. head.
sexguttata	1·5 mm.	28	Greenish black.	Do. head.
punctulata	·7–·9 mm.	31	Iridescent black.	Do. head.
repanda	1·2–1·5 mm.	34	Cupreous.	Do. head.
12-*guttata*	1·2–1·3 mm.	37	Cupreous.	Do. head.
generosa	1·5–1·75 mm.	40	Dull brown and pale brown (fig. 16).	Do. head.
tranquebarica	1·5–1·75 mm.	43	Greenish black.	More cupreous than head.
scutellaris	1·25–1·5 mm.	46	Dull green to purple.	Do. head.
lepida	·9–1·1 mm.	49	Shining black.	Dull black.
hirticollis	1·2–1·5 mm.	52	Reddish gold.	Do. head.
cuprascens	1·1 mm.	55	Greenish cupreous.	Do. head.

TABLE II.—Showing the characters of the second stages.

Species.	Width of prothorax.	Fig.	Coloration of head.	Coloration of prothorax.
purpurea	2 mm.	26	Dull black with cupreous reflections.	Do. head.
limbalis	1·5–2 mm.	26	Shining cupreous with greenish reflections.	Do. head.
sexguttata	1·75–2 mm.	29	Brown or blackish green.	Do. head.
punctulata	1·3–1·8 mm.	32	Iridescent black.	Do. head.
repanda	2 mm.	35	Cupreous.	Do. head.
12-*guttata*	1·8–2 mm.	38	Cupreous.	Do. head.
generosa	2–2·5 mm.	41	Dull brown to cupreous brown.	Do. head (see fig. 16.)
tranquebarica	2·25–2·5 mm.	44	Greenish black.	Dull cupreous.
scutellaris	2 mm.	47	Dark green to purple.	Do. head.
lepida	1·8–1·9 mm.	50	Shiny black.	Dull black.
hirticollis	2·5–3 mm.	53	Reddish gold.	Do. head.
cuprascens	1·9 mm.	56	Shining greenish cupreous.	Do. head.

TABLE III.—Showing the characters of the third stages.

Species.	Width of prothorax.	Fig.	Coloration of head.	Coloration of prothorax.
purpurea	3·5–4 mm.	27	Dull purplish black.	Do. head.
limbalis	3·35–5 mm.	27	Shining greenish cupreous.	Do. head.
sexguttata	3·5–3·75 mm.	30	Purplish black.	Do. head.
punctulata	2·4–2·8 mm.	33	Black.	Duller than head.
repanda	3–3·5 mm.	36	Cupreous.	Do. head.
12-*guttata*	3–3·5 mm.	39	Greenish cupreous.	Cupreous.
generosa	4·25–4·5 mm.	42	Dull brown (fig. 16).	Dull brown (fig. 16).
tranquebariea	3·5–4·2 mm.	45	Greenish black.	Dull cupreous, sides and ant. margin pale.
scutellaris	3·5–3·6 mm.	48	Variable, greenish black to purple, &c.	Do. head.
lepida	1·8–2 mm	51	Shiny black.	Duller than head.
hirticollis	3·25–4 mm.	54	Reddish gold.	Do. head.
cuprascens	Unknown.			

The lengths of the pupæ of the species herein considered are as follows :—

Purpurea, *purpurea* var. *limbalis*, and *sexguttata*, 11–12 mm. ; 12-*guttata*, 12-*guttata* var. *repanda*, 10–11 mm. ; *hirticollis*, 11–13 mm. ; *lepida*, 9–10 mm. ; *punctulata*, 8–9 mm. ; *tranquebarica* and *formosa* var. *generosa*, 14–16 mm. The pupa of *cuprascens* is unknown.

The first stages are much more nearly alike than the second and third. Some of the species add many more bristles in the last two stages than others. In spite of the general resemblance of the patterns of the different larval stages, the species fall into groups entirely different from those that have been made on the basis of adult characters. On the basis of the distribution of bristles in the adults, the species considered fall into the following groups:—Head and prothorax pilose—*generosa*, *purpurea*, 12-*guttata*, *tranquebarica*, *hirticollis*, *scutellaris*, ... , *cuprascens*, and *lepida*. Head bald, pronotum pilose on the sides only—*sexguttata* and *punctulata*. Yet the larval pilosity of the last two species is very near that of *purpurea*, *tranquebarica*, etc. While, as has been already stated, some taxonomists have placed *C. purpurea* and *C. sexguttata* in the same group, *C. lepida* and *C. scutellaris* have never been regarded as in any way related. The larvæ do not, however, differ so strikingly as do the adults.

The further study of these larval pilosity characters and a comparison with pilosity characters of the imagoes would no doubt lead to interesting results. A careful homologizing of the adult and larval areas bearing bristles must, however, be made before such a study can be carried far. It has been noted that bristles representing line A (fig. 57) are present in many representatives of the *Cicindela flexuosa* group, *Cicindela regalis* group, and a number of other unrelated species. The arrangement of bristles on the head and prothorax of *Ctenostoma* and some species of *Mantichora* appears to be definite, but its relation to the larval arrangement is not clear from casual inspection.

VI. Relation of Life-Histories and Habits to Environmental Factors.

A. *Hibernation.*

The physiological aspect of hibernation has not been studied in detail. Bachmetjew has performed extensive experiments on the temperature relations of insects, and has reported that the insect fluids do not freeze until a point in some cases as low as $-15°$ C. When the fluids freeze, the temperature rises to about $-1°{\cdot}5$ and the insect never regains life. The rapidity of thawing has no effect on this result; if cooled ever so low without freezing, the insect regains vitality. He suggests, in connection with hibernation, that the loss of water due to the insect's failure to feed for a long period in the late fall, causes an increased concentration of the body fluids which lowers their freezing-point. Greeley found that low temperature caused certain Protozoa to encyst or produce spores. Tower found that *Leptinotarsa* loses 30 per cent. of its weight, 3 per cent. excreta and 27 per cent. water, in preparing for hibernation, and was unable to prevent this preparation by experimental means in beetles that normally hibernate.

The larvæ of all species studied pass through at least one winter. With the approach of cold weather (late September) they dig their burrows deeper, piling the sand beside the opening in a single heap. They finally stop digging and close the mouth of the burrow with soil, go to the bottom and remain until spring (observed by Criddle, Günther, and Enock in the case of species not here considered). When brought into the vivarium and kept at 27°–30° C., they remain active for two or three weeks longer than out of doors. They finally close their burrows and go to the bottom, notwithstanding the higher temperature. Individuals fed continuously during the time they are kept under these abnormal conditions, were not notably influenced as to the time they closed their burrows. If the soil is kept dry they prepare for hibernation sooner than when it is very moist.

If the temperature be raised to 36°–40° C. and the soil and surrounding atmosphere kept moist, larvæ of *C. hirticollis*, *tranquebarica*, and *scutellaris* will nearly all go through their transformations without the winter rest and emerge as adults in December or January.

The adult beetles burrow into the ground for hibernation in the late summer or early autumn. Individuals of *C. repanda* have been found congregated in large numbers on sloping sandy surfaces in the middle of October. Their hibernation burrows are about 30 cm. in depth, going in obliquely for 15 cm. and then curving downward. The following depths were recorded for individuals of the following species, taken from a loamy-humus bank : *repanda*, 5–10 cm. ; *tranquebarica*, 15 cm. ; *purpurea*, 10–12 cm. ; *duodecimguttata*, 10–12 cm. Some of these were taken from the same burrow, and one of the burrows was evidently that of a carabid. Criddle has recently published an extensive paper describing the depth to which the adults dig and the method of digging.

The adults of species, e. g. *hirticollis*, which go into hibernation in early September are not affected by being placed in a warm vivarium. Adults which prepare for hibernation late in the autumn (*purpurea*, *scutellaris*, *tranquebarica*, etc.) may be delayed by high temperature. In all cases where high temperature continued, the individuals died in the soil or came out at the end of a month or more and died soon after.

It appears from these experiments that hibernation is a definite physiological process so well impressed on the species, that extreme stimulation is required to break it up.

B. *Temperature Relations.*

Under experimental conditions, the depth to which the larvæ of *C. purpurea limbalis* dig their burrows is related to the soil temperature (Table IV.)

TABLE IV.

	Temperature.			Average depth of burrow.
	Top.	6 cm. below.	10 cm. below.	
Moist	24° C.	22° C.	....	5·37 cm.
Dry	24° C.	22° C.	....	5·5 cm.
Moist	35° C.	....	33° C.	8·75 cm.
Dry	35° C.	....	33° C.	8·75 cm.
Moist	25° C.	24° C.	....	7·25 cm.

Lamp chimneys containing larvæ that had been in the cool moist conditions were transferred to the warm moist conditions. The larvæ at once excavated their burrows to depths comparable to those of the larvæ kept for some time in the *warm conditions.* One individual whose burrow was only 2 cm. deep, dug to a *depth* of 6·25 cm. in 28 hours, and to 10 cm. in 48 hours.

The pupal cells of *purpurea limbalis* are made by enlarging and sometimes shifting the inner end of the burrow (Pl. **24.** fig. 18). In the construction of the pupal burrows the same relations to temperature are shown as in the depth of burrows. Actual statistics were not preserved in the case of other species subjected to experimentel conditions, but observations on *scutellaris* and *tranquebarica* show that they respond to temperature in the construction of the pupal cells in the same way as *purpurea limbalis.* Under experimental conditions in which about 15 cm. of soil are heated (bottom 33°–39° C.; top 36°–41° C.) from above so as to give a difference of about one degree for each 7·5 cm. of depth, these species almost always constructed cells as near the bottom as possible. In cool conditions (bottom 22°; top 18°) cells are usually constructed near the top; none have been noted at the bottom. In view of these responses it is evident that marked differences in the depth of pupation may be brought about in a given brood of the same species by alternating short periods of warm and cool weather during the time of preparation of the cells. Individuals at *different depths would be subjected to very different conditions during their quiescent stages.*

In the habitat of *scutellaris* the temperature of the soil at 2.00 P.M. on a warm sunny day when the surface is dry, is about as follows:—Surface 47° C.; at a depth of 3·75 cm., 38°; 7·5 cm., 35°; 10 cm., $33\frac{1}{3}$°; 12·5 cm., 32°; 17·5 cm., 30°. The surface of the soil is subject to the greatest extremes; the conditions become more constant, both in temperature and moisture, as we go downward.

Few observations have been made on the depth of pupation in nature; one pupa of *C. scutellaris* was found at a depth of 10 cm., while *C. tranquebarica* has never been observed. *C. punctulata*, which can be subjected to a temperature of 47° C. during the quiescent stages without fatal results or modification of the adults, pupates at a depth varying between 2·5 and 7·5 cm.

The length of the prepupal and the pupal stages is related to temperature. The process of development is probably most rapid when the temperature during the day averages about 28°–30° C. (the temperature at which most of the records here presented were made). At this temperature the length of the combined quiescent stages has been noted as usually from four to six weeks. If the temperature is lowered to 20° or 22° it is six to eight weeks, and if lowered to an average of 15° to 17° it will be increased to ten or twelve weeks. If the temperature be kept between 36° and 38° the time is increased to eight weeks.

The effect of cold on the development of colour is similar: lowering the temperature ten degrees in *C. limbalis* caused an increase of time for development to three or four times and in some stages of the development it stopped it altogether. Such influences of temperature on growth, respiration, &c., have been noted by various workers.

C. *Moisture Relations.*

As will be noted in Table IV., *purpurea limbalis* does not respond strikingly in the depth of its burrows to moisture conditions. The relations of the depth of burrows to the soil moisture in nature has been found not to be striking. The larvæ that have burrows near the ground water-level never go to a depth which would give actual water in their burrows, and accordingly may have shallow burrows. When above the ground water-level variations in depth are apparently not definitely related to soil moisture. Statistics on this point are very contradictory.

With the exception of the larvæ of *C. duodecimguttata*, its subspecies *repanda*, and *hirticollis*, the species described in this paper do not leave the spot where the female lays the eggs, except under very unusual circumstances, such as the complete flooding of the habitat. Only a small percentage of the individuals come out even under such conditions. When too dry, they close the burrow near the mouth and go to the bottom; here they remain inactive, and if bad conditions continue, finally die.

When placed in sand (clay being their natural habitat) and kept at a temperature of about 19° to 24° C., about 15 per cent. of the larvæ of *C. purpurea limbalis* will leave their holes. Probably not more than from 3 to 10 per cent. of the larvæ of the other species, with similar habitats, migrate even under the very artificial conditions of my experiments.

C. duodecimguttata, *repanda*, and *hirticollis*, on the contrary, leave their burrows often. If the soil becomes too dry, they come out and seek a place which is suitably moist. In captivity, when kept in separate receptacles whence they cannot escape, they leave the soil, if it is allowed to become too dry, and run around and around the side of the dish until they die from exposure and exhaustion. They cannot dig a new burrow in sand if the surface is dry.

These two species thus adjust themselves to conditions and are much less variable in many of their characters than other species. This is especially noticeable in the geographical variation. However, since the larvæ of *C. hirticollis* have been found in unusual positions such as the tops of sand dunes, after heavy rains, it is possible for them to be overtaken by dry conditions after they have become helpless in connection with pupation.

In moist conditions most of the species go through their transformations two or three days to a week sooner than in very dry conditions.

D. *Food.*

The food of the larvæ consists of land crustacea, centipedes, spiders, dragonflies, butterflies, flies, beetles, and larvæ of all sorts, in fact any small animals that come within reach. If the larvæ are not fed, they will not die for a week or two, or even longer, but the lengths of their periods of growth are greatly increased.

It has been noted that pupæ which emerge late in the season and which have been in the warm vivarium for a period of two or three months, are much smaller than those that appear at the usual time of the species. This is probably due to an acceleration of physiological processes without sufficient feeding.

As was pointed out in connection with the larvæ of *C. lepida*, the burrow is of such a type (Pl. **24**. fig. 19) that the sand closes it and the larva is unable to feed during much of the time. The larval life is two years and the imagoes are small. *C. generosa*, on the other hand, has an especial arrangement for keeping the burrow open (Pl. **25**. figs. 22–24), and the larval life is one year and the imagoes large. Whether or not this time difference is related to food conditions, is uncertain.

E. *Relation of Habits and Responses of the Adults to the Environmental Conditions of the Young Stages.*

1. *Sexual Maturity and Mating.*

None of the species which hibernate reach sexual maturity in autumn. If the eggs were laid at this time the larvæ would not be able to feed and store up enough food to enable them to withstand the winter conditions. The imagoes show no tendency to copulate until after a number of the warm days of spring have passed, and mating takes place only on warm and usually sunny days.

2. *Egg-laying.*

Species which lay in hard soils like humus or clay, are able to do so only when it is moist. Accordingly, during a dry period they select a place near a spring or brook where the moisture is adequate. On the approach of the wet weather, the larvæ will accordingly be subjected to extremely moist conditions or may be destroyed by high water or other disturbances. During a wet period such species lay in higher and dryer places. If a dry period follows, the larvæ will be subjected to extremely dry conditions, and if the surface of the soil becomes very dry soon after the laying of the eggs, the larvæ may not be able to make their way to the surface, and accordingly starve (see p. 161).

Species which lay in moist sand, after a rain may do so on the top of a dune, and the larvæ arising from such eggs be subjected to dry conditions later unless they make some adjustment.

VI. General Discussion.

We have noted that the imagoes of many species undergo a series of changes, particularly in colour, after they have appeared in their regular habitats; that in some species this change continues to the time of death; and furthermore that the two generations of *limbalis*, *generosa*, and particularly *hirticollis*, overlap so as to mix those that have just emerged with the old individuals that have hibernated. The importance of considering these facts in the study of variation need hardly be mentioned. Not to know the life-histories would lead to endless confusion in the study of geographical variation and of variation from generation to generation.

The possibility of differences in environmental conditions in the same brood of *Leptinotarsa*, due to periods of extreme weather, has been noted by Tower. In *Cicindela* we have two additional possibilities: (*a*) that of the pupal cells being constructed at very different distances from the surface by different individuals; and (*b*) of the entire larval life of some individuals being passed under unusual conditions because of the responses to the environmental peculiarities and necessary limitations in connection with egg-laying in the particular soil which a given species selects. Since the young stages of some species are sensitive, at least during the pre-pupal and pupal periods, to external stimuli, and since the results of such stimuli are manifest in modifications of colour and colour pattern, there is opportunity for soil temperature and moisture to influence variability.

Nor is this the only importance to be attached to these habits and responses. The animals select a definite place in which to lay their eggs and the larvæ of most species never leave their burrows. The migrating larvæ select a place themselves, and if it is not found soon, they die. All this leads to a definite distribution dependent upon the domestic habits and instincts of the species. This distribution I propose to call ecological distribution, from Haeckel's * definition of that term. Ecological distribution will be discussed in a succeeding paper.

VII. Summary.

1. The eggs are laid in open burrows made by the ovipositor as in the European species; the period of incubation is usually about two weeks. (pp. 160–161.)

* Ecology is the science of the domestic side of organic life, of the life needs of organisms and their relation to other organisms with which they live.—'Wonders of Life,' 1905.

2. There are three larval stages; the first usually lasts a little more than one month and the others vary greatly in different species. (p. 161.)

3. The burrows differ greatly in different species; *generosa* has a burrow which opens into the side of a pit, an adaption to shifting sand (p. 165); *cuprascens* does not smooth the edge of the burrow in the usual manner (p. 169).

4. The life-histories are of three types:—

(*a*) Eggs laid in the late spring or early summer; larvæ hibernate usually in the third stage, pupate in the second summer; imagoes emerge about a month after pupation, hibernate, and become sexually mature late in the third spring,—larval life lasts twelve to thirteen months, adult life ten months,—two years between generations. (pp. 161–167.)

(*b*) Eggs laid in mid-summer; larvæ hibernate usually in the third stage, pupate in the following June; imagoes emerge in early July and become sexually mature very soon,—larval life ten months, adult life two months,—one year between generations. (p. 168.)

(*c*) Eggs laid in mid-summer; larvæ hibernate in the second stage, reach the third stage early in the second summer, hibernate again, and pupate in the following May; imagoes emerge in the early part of the third summer and become sexually mature soon,—larval life twenty-one months,—adult life two months,—two years between generations. (pp. 168–169.)

5. Temperature, moisture, and food influence the length of the different stages. (p. 176.)

6. Pigmentation and final hardening of the cuticula take place in the pupa in those parts which are employed in the final ecdysis and the bristles of the imago assist in the removal of exuvium. (p. 163.)

7. The generations frequently overlap: of importance in connection with colour-changes to be discussed later. (pp. 164 & 167.)

8. The habits and responses of the imagoes and larvæ bring about great differences in the environmental conditions of different individuals of the same brood. (pp. 176–179.)

This work is a part of investigations which were begun at the Hull Zoological Laboratory, the University of Chicago, in 1903, and which are still being carried on with the facilities afforded by this institution. It gives me pleasure to acknowledge my indebtedness * to the staff of Zoology of this institution, for much kindly advice and enthusiastic encouragement.

September, 1907.

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Addenda.

While this paper was passing through the press, a description of the egg of *C. repanda* came to my attention. It was overlooked because it was included in an article entitled "Habits of *Cicindela*" (Moore). The eggs described must, however, have been abnormal. They were about one-half the size of the usual Cicindelid eggs. Only two were found and these were fastened together by some filaments. The chorion was sculptured and wrinkled, while in all other known eggs it is smooth. I have found that two or three undeveloped eggs are sometimes left in the ovarian tubules when the laying is ended; it is barely possible that the eggs observed by Moore were the last from an ovarian tubule. This, however, does not explain the sculpture.

Since this paper was written Bruch has published an account of the egg, larva, pupa, and adult of *C. apiata*, Dej. (South America). His article is concerned chiefly with pure description, but he expresses the opinion that there are two generations per year. He has, however, no good observations to establish this point. He figures the ovipositor, hole and egg, as well as the other stages described.

Dr. Walter Horn has a paper in the press in which he criticises R. Shelford's paper on *Collyris* and gives descriptions of the larvæ of a species of *Amblychila* and a species of *Omus*.

6th March, 1908. E. V. S.

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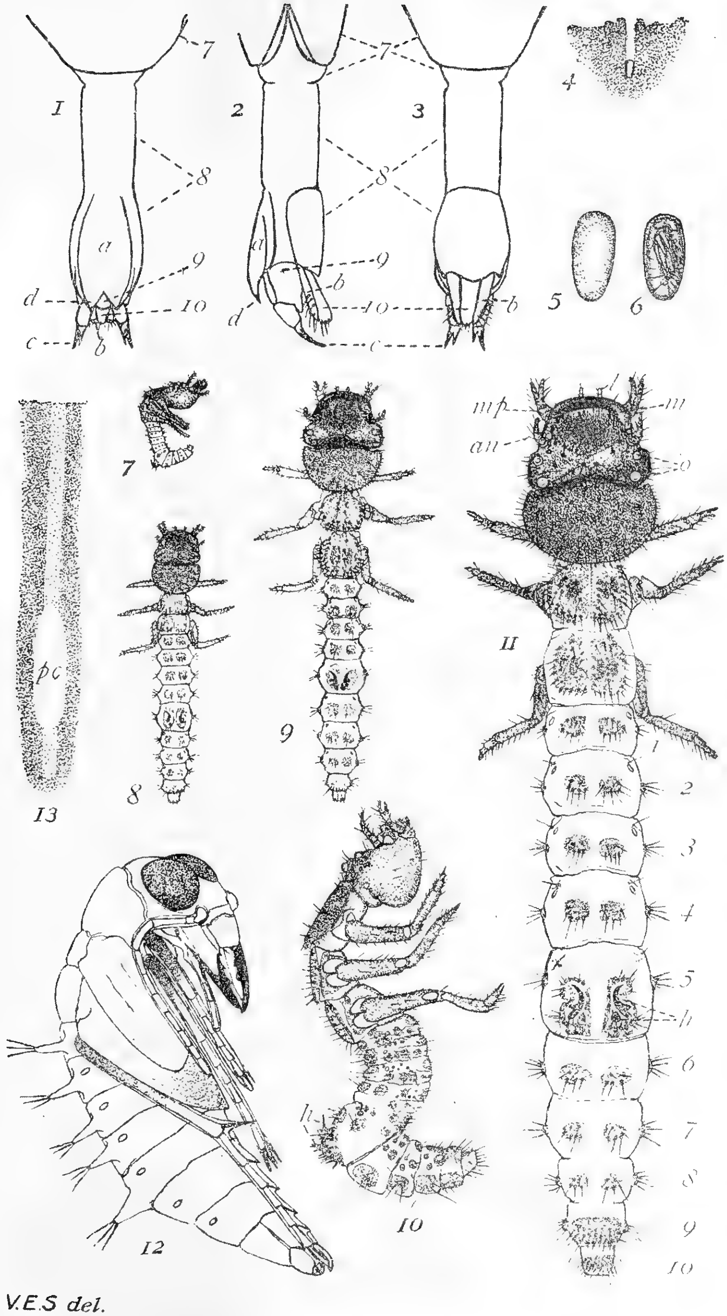

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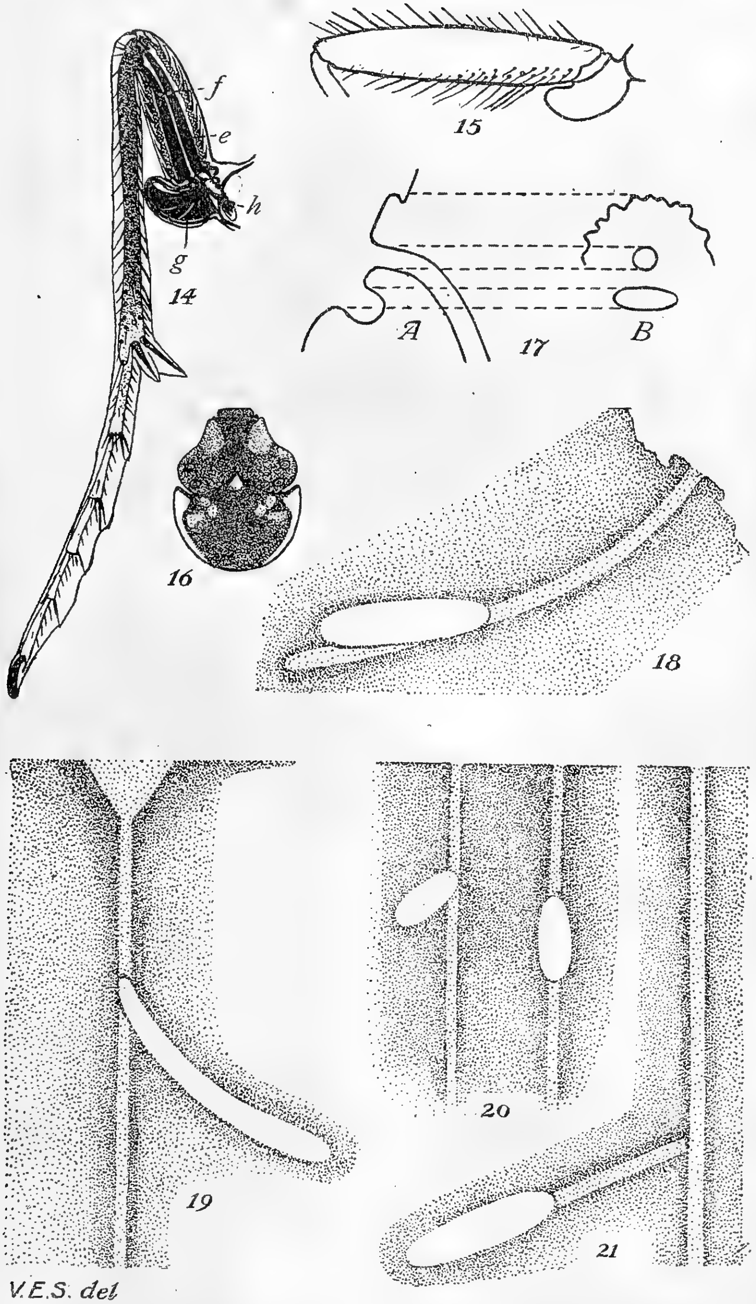

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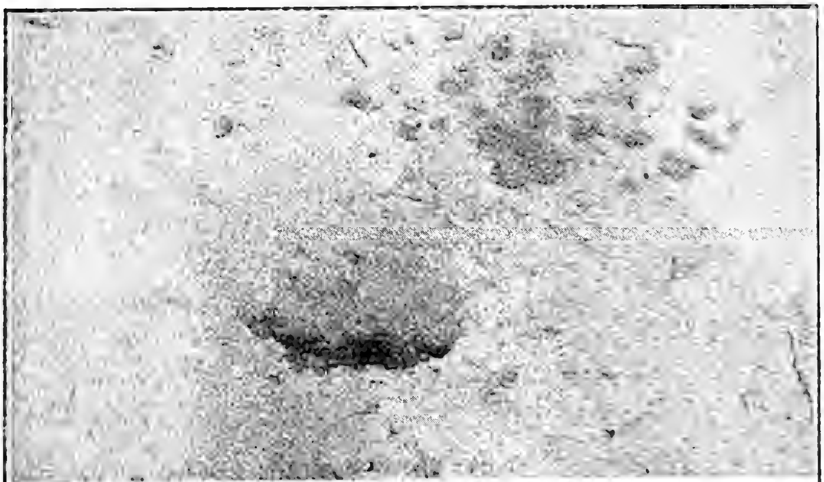

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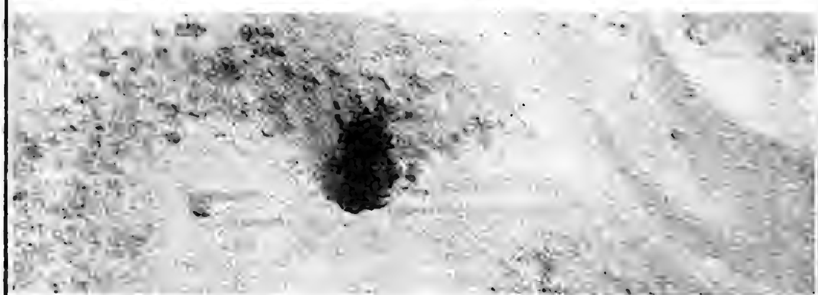

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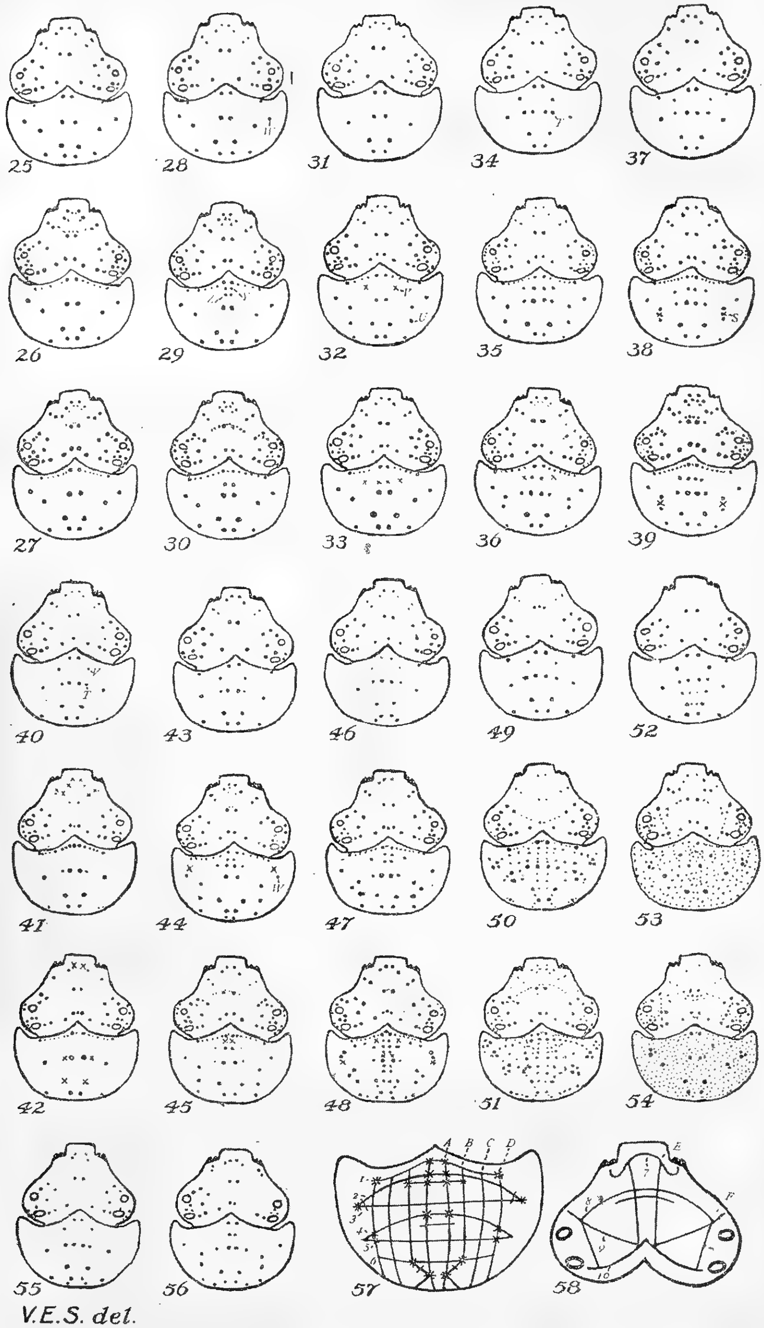
HABITS OF TIGER BEETLES.



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EXPLANATION OF THE PLATES.

PLATE 23.

Figs. 1–3. The ovipositor of *Cicindela purpurea*.

Fig. 1. Ventral view, × 4·5. Fig. 2. Side view. Fig. 3. Dorsal view.

a. Ventral chitinized plate. *b.* Outer gonapophysis of the 9th segment. *c.* Inner jointed gonapophysis of the 9th segment. *d.* Gonapophysis of the 8th segment.

Figs. 4–13. The life-history of *C. purpurea*.

Fig. 4. The egg in the ovipositor burrow, slightly reduced.
5. The egg at laying. × 4·5.
6. The egg just before hatching. × 4·5.
7. The larva at hatching. × 4·5.
8. The larva at the end of about two weeks. × 4·5.
9. The larva in the second instar. × 4·5.
10. Side view of the larva at the beginning of the third instar. × 4·5.
11. Full-grown larva. × 4·5.
12. Pupa. × 4·5.
13. The burrow and the pupal cell. × 0·4.

l. Labium. *m.* Mandible. *m.p.* Maxillary palp. *o.* Ocellus. *h.* Hooks. *an.* Antenna. *pc.* Pupal cavity.

Plate 24.

Figs. 14 & 15. An appendage of *C. purpurea.*

Fig. 14. Leg within the pupal skin, showing the wrinkling of the femur and the large bristles arranged so as to assist in the removal of the exuvium. × 4·5.
e. Extensor tibiæ. *f.* Flexor tibiæ. *g.* Flexor femoris. *h.* Extensor femoris.
15. Femur extended, showing an adult length. × 4·5.

Fig. 16. Colour pattern of the head and pronotum of *C. formosa generosa.*
17. The burrow of *C. hybrida,* modified after Lesne.
A. Diagrammatic section; B. Front view.
18. The burrow and pupal cell of *C. purpurea limbalis.* The clear space represents the pupal cell and the faintly stippled part the old burrow. × 0·5.
19. The burrow and pupal cell of *C. lepida.* The funnel which is sometimes formed by the action of gravity on the dry sand is indicated. × 0·5.
20. The two types of pupal cell made by *C. punctulata.* × 0·5.
21. The pupal cell of *C. scutellaris.* × 0·5.

Plate 25.

Fig. 22. A photograph of the head of *C. formosa generosa* in position at the mouth of the burrow. The pile of sand at the left is that thrown up by the animal.
23. A view of the same taken at an angle of 90 degrees to the direction of the former line of vision.
24. Photograph of the burrow opened so as to show a vertical section of both burrow and pit. (Photographs by V. E. S.)

Plate 26.

This plate shows the distribution of the bristles on the dorsal side of the larval head and prothorax. The figures of the different stages and different species are all shown the same size to facilitate comparison.

Figs. 25–27. Represent respectively the three stages of the larva of *C. purpurea.*
28–30. Represent respectively the first, second, and third stages of *C. sexguttata.*
31–33. *C. punctulata.*
34–36. *C. repanda.*
37–39. *C. 12-guttata.*
40–42. *C. generosa.*
43–45. *C. tranquebarica.*
46–48. *C. scutellaris.*
49–51. *C. lepida.*
52–54. *C. hirticollis.*
55 & 56. *C. cuprascens.*
57 & 58. Show the principal lines of bristles on the head and prothorax.
A, B, C, D, E, F are the longitudinal lines; 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 are the cross lines. Other lettering is only for convenience in the descriptions of the distribution. The most constant bristles are indicated in figs. 57 and 58 by the stars.

Some New Alcyonaria from the Indian and Pacific Oceans.—Preliminary Notice. By RUTH M. HARRISON, Lady Margaret Hall, Oxford. (Communicated by Prof. G. C. BOURNE, D.Sc., F.L.S.)

[Read 6th February, 1908.]

THE following abstract contains a preliminary account of five new species of the genus *Spongodes* (*Dendronephthya*, Kükenthal); two species of *Siphonogorgia*, of which one is new; twelve species of *Chironephthya*, of which eight are new; and four species of *Solenocaulon*. The specimens described were derived from three sources:—(1) A collection made in the Admiralty Islands by Capt. Bassett-Smith, R.N., when in command of H.M.S. Egeria,' and deposited in the British Museum; (2) the first collection of Alcyonaria made in the Bay of Bengal for the Trustees of the Calcutta Museum; (3) a single specimen of *Spongodes* from the China Seas, presented to the Oxford Museum by Capt. Chimmo. Short diagnoses are given of the new species; fuller descriptions and figures being reserved for a future paper.

Family NEPHTHYIDÆ.

Genus SPONGODES, *Lesson*, 1834.

A. Forms belonging to the Divaricate *cervicornis* group of Kükenthal.

SPONGODES THOMSONI, n. sp.

Branches given off from whole or greater part of both sides of stem in one plane; branches subdivided into twigs each bearing bunches of 3–10 polyps; polyp-stalks 1–2 mm. long, borne at right angles to stalk. One spicule projects 1 mm. beyond each polyp head. Spicules of anthocodia in 8 double rows arranged *en chevron*, one large spicule to each point, other smaller spicules irregularly disposed.

Colour: Stem and main branches yellowish white; twigs becoming gradually orange; polyps white.

Hab. Two specimens from Bay of Bengal.

SPONGODES ELEGANS, n. sp.

Main stem divides into two branches, each of which divides again into two, and these further subdivide into numerous twigs; two lower branches form a flattened collar nearly encircling the stem. Polyps, borne on stalks 1 mm. long, in clusters of 4–8; one large spicule projects about 2 mm. below each polyp. Anthocodia with 8 double rows of 4–6 spicules arranged *en chevron*, outermost larger and projecting beyond bases of tentacles. Tentacles with double row of colourless spicules.

Colour: Sterile stem a light brick-red: main branches white, shading gradually from pink to red twigs; polyps red with white tentacles.

Hab. Bay of Bengal.

SPONGODES BIFORMATA, n. sp.

Two lower branches flattened, forming two nearly complete semicircles round stem; above these two lateral branches, and above these again the main stem divides into two branches which further subdivide and bear polyps in bundles of 4–8 on stalks of 1–2 mm. Polyp heads protected by bundle of 3–5 spicules, two or three of which project slightly. On the lower flattened branches polyps alternately borne on stalks or sessile on the edge of the flattened branch. Branches very distinctly in one plane. Spicules of anthocodia *en chevron* in 8 double rows of 4–6 spicules each, all the same size and not projecting beyond bases of tentacles.

Colour: Base nearly white; all other spicules of stem, branches, anthocodia, and tentacles yellow.

Hab. Bay of Bengal.

B. Form belonging to the Divaricate *rigida* group of Kükenthal.

SPONGODES RUBESCENS, n. sp.

Whole colony very firm and rigid; main stem divided into numerous short branches which subdivide into smaller branches and twigs bearing polyps in groups of 2–8 at about right angles to branch. Lower branches flattened, one partly encircling the stem, others forming flattened plates with polyps all round the edges. One spicule projects about 1 mm. beyond each polyp. Spicules of anthocodia more or less in 8 double rows, but chevron arrangement not very distinct; spicules projecting beyond bases of tentacles. Tentacles with double rows of deep red spicules.

Colour: Stem and main branches white; secondary branches and twigs yellow; below the bunches of polyps the spicules show a red core, and there is a gradual transition from yellow to red; polyps red.

Hab. Bay of Bengal.

C. Form belonging to Umbellate *florida* group of Kükenthal.

SPONGODES CHIMMOI, n. sp.

Colony rigid, developed in one plane. Stem with long stolons, some reaching a length of 4·0 cm. Branches given off all round the stem, the lower ones at right angles and the upper ones vertical; lower branches not flattened. Polyp-bearing twigs closely crowded, giving a compact appearance and regular outline to colony. Polyps in clusters of 8–16, at about right angles to stalk, each polyp supported by a bundle of (generally) 3 spicules of which one projects 0·5–1·0 mm. Spicules of anthocodia in 8 double rows of 5–6 each, all about the same size and not projecting beyond bases of tentacles.

Colour: Stem and main branches white, gradually shading in the terminal twigs to crimson; polyps white. In the lowermost branches both twigs and polyps are white.

Hab. China Seas (*Capt. Chimmo*).

Family SIPHONOGORGIIDÆ (*Kükenthal*).

Genus CHIRONEPHTHYA.

CHIRONEPHTHYA VARIABILIS, *Hickson.*

Fragments of three specimens from the Bay of Bengal.

CHIRONEPHTHYA PENDULA, var. INDICA, n. var. = *Siphonogorgia pendula*, Studer.

Differs from Studer's specimen in the immense size of the spicules of the partition-walls.

Hab. Bay of Bengal.

CHIRONEPHTHYA SIPHONOGORGICA, n. sp.

Branches few in number, directed obliquely upwards and not further subdivided. Polyps borne directly on main stem and branches. Each polyp completely retractile within a definite calyx, which can be closed over the retracted polyp. Spicules of stem and branches disposed longitudinally and somewhat loosely packed together. Stem spicules bright coral-red; polyp spicules bright yellow: tentacles colourless.

Hab. Two specimens from Bay of Bengal.

CHIRONEPHTHYA FLAVOCAPITATA, n. sp.

Branches from main stem long and slender, only slightly subdivided, tending to droop downwards. Polyps directed nearly vertically upwards, not retractile. Tentacles can be folded over oral disc. Polyp spicules: crown with about six transverse rows; points with two large spicules arranged *en chevron* and smaller spicules irregularly disposed between them. Tentacles with a single row of small thorny spicules placed transversely.

Colour: Stem and branches pure white, with a few pale pink spicules interspersed; polyps deep orange; tentacles colourless.

Hab. Macclesfield Bank, Admiralty Islands.

CHIRONEPHTHYA PLANORAMOSA, n. sp.

The whole colony grows like an espalier pear tree; branches at nearly right angles to stem but inclined to bend downwards. Polyps spirally arranged with a terminal bunch of five; not retractile. Polyp spicules:

crown with about 8 transverse rows; points with about 3–5 spicules arranged *en chevron*; tentacles with a single row of irregular transverse spicules.

Colour: Base of stem rosy purple; the rest of the colony a pure white.

Hab. Macclesfield Bank, Admiralty Islands.

CHIRONEPHTHYA HICKSONI, n. sp.

Stem erect, cylindrical, dividing into two main branches, from which are given off short thick branches, tending to be directed upwards and very slightly further subdivided. Polyps on all branches, more numerous on terminal twigs, not retractile. Polyp spicules: crown with about 5 transverse rows; points with 2 or 3 spicules arranged *en chevron* and smaller ones irregularly disposed between them; tentacles with a double row of spicules more or less dovetailed into each other.

Colour: A uniform dull yellow, the tentacles only coloured a deep purple.

Hab. Macclesfield Bank, Admiralty Islands.

CHIRONEPHTHYA PURPUREA, n. sp.

Numerous branches; all directed practically vertically upwards, given off from the sterile stem; secondary branches few and small. Polyps borne on the stem, branches, and twigs; more numerous on twigs, directed vertically upwards and not retractile. Polyp spicules: crown with 7 or 8 transverse rows; points with 3 or 4 spicules arranged *en chevron*, but when four are present there is very constantly only one spicule on one side of the point and three on the other; tentacles with a single row of small thorny spicules placed transversely.

Colour: Stem and branches white, becoming cream in the terminal twigs; polyps, including the tentacles, a deep purplish red.

Hab. Tizard Reef, Admiralty Islands.

CHIRONEPHTHYA ANNULATA, n. sp.

Colony rigid, short thick branches given off all around the stem, only one or two of which are long enough to further subdivide. Polyp spicules: crown with about 6 transverse rows, points with 3–5 spicules somewhat irregularly arranged *en chevron*, of which one is generally larger than the others; tentacles with scattered small warty spicules.

Colour: Stem and branches deep crimson, terminal twigs with a few large conspicuous cream-coloured spicules, and shaded from crimson to buff-yellow, terminating in yellow calices; polyps crimson.

Hab. Admiralty Islands.

CHIRONEPHTHYA GRACILIS, n. sp.

Stem divides into two main branches directed vertically upwards, from which several short, very slender branches arise. Polyps borne on all branches, those on the main branches sessile and single, those on the terminal twigs in groups and generally on short stalks. Polyp spicules: crown with about 5 transverse rows; points with 3–5 spicules arranged *en chevron*, larger than those of the crown and with more pronounced warts; tentacle spicules comparatively large.

Colour: Stem and branches deep red; polyps bright orange.

Hab. Admiralty Islands.

CHIRONEPHTHYA RETRACTILIS, n. sp.

Colony consisting of one main erect branch and two short branches given off at about 1·75 cm. from base. Polyps borne all round stem; completely retractile within calyx, which projects from stem and closes over the polyp by all the spicules of the calyx converging in a point and not folding over as in a *Siphonogorgia*. The polyps contract in the same way. Polyp spicules: crown with about 5 transverse rows; points with 4 spicules arranged *en chevron*.

Colour: Stem and branches cream, with crimson-purple polyps.

Hab. Admiralty Islands.

Genus SIPHONOGORGIA.

SIPHONOGORGIA ROTUNDA, n. sp.

Stem and branches solid, smooth, rounded; branching not very great. Polyps borne all round stem, main and sub-branches; lower part of stem barren. Polyps nearly completely retractile, borne at right angles to stem and branches. In the polyp there are about 5 spicules in each point directed vertically upwards, below these about 8 spicules arranged *en chevron*, and below these a crown of about 6 transverse rows.

Colour: Stem and branches flesh-coloured; polyps white.

Hab. Bay of Bengal.

SIPHONOGORGIA PUSTULOSA, *Studer*.

Several branches of this species occur in the British Museum Collection.

Hab. Admiralty Islands.

Family BRIAREIDÆ.

Genus SOLENOCAULON.

SOLENOCAULON TORTUOSUM, *Gray*.

In the collection made by the Trustees of the Calcutta Museum this species occurs in three varieties:—

In variety A, the lateral branches are short and come off in pairs on opposite sides of the lateral holes. The polyps are non-retractile and project beyond conical calices.

In variety B, the lateral branches come off very regularly on alternate sides of the main trunk and are tubular at their commencement, becoming two parallel branches facing one another. Polyps non-retractile, but conical; calices not so much developed as in A.

In variety C, the lateral branches are borne on opposite sides of the lateral holes, and the latter are exactly opposite one another so that a front view of the colony looks like the tail of a kite, and a side view shows a series of holes right through the main trunk. Polyps completely retractile.

Hab. Bay of Bengal.

SOLENOCAULON RAMOSA, *Hickson.*

A colony 85 cm. long agrees with Hickson's diagnosis in every point except the greater size of the colony and the absence of all colouring-matter.

Hab. Bay of Bengal.

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On two new Species of Northern Amphipoda.

By the Rev. T. R. R. Stebbing, M.A., F.R.S., F.L.S.

(Plates 27 & 28.)

[Read 21st November, 1907.]

The species under consideration are derived from collections made by the *Goldseeker*, in connexion with the International investigation of the North Sea. For permission to lay the figures and descriptions before the Linnean Society I am indebted to Prof. D'Arcy W. Thompson, C.B., F.L.S., who is the representative for Scotland on the International Committee. In writing to me on the subject, Prof. Thompson observes: "It is remarkable how few new species turn up nowadays in our collections: we seem to be getting very near to the bottom of our local fauna." In the present case the new forms are of a rather striking character, so that, though they are small, it is a little surprising that they should have escaped earlier notice. Not only are they new, but, as will be seen, one of them makes an appeal that the family to which it obviously belongs should submit to a small change in its definition in order to receive the new comer. Similarly, the other asks for hospitality in a genus which can only give it a welcome by slightly enlarging its previous boundaries.

Both species come from a considerable depth. Both are apparently quite blind. Both are armed with numerous processes; and both, as preserved, are colourless and to some extent pellucid, these characters making it not a little difficult to disentangle the exact boundary lines of the various parts and appendages.

Family Paramphithoidæ.

1906. *Paramphithoidæ*, Stebbing, Das Tierreich: Amphipoda Gammaridea, Lieferung 21, p. 320.

As defined in the reference given above, the family contained the three genera, *Epimeria*, Costa, the much-restricted *Paramphithoe*, Bruzelius, and *Actinacanthus*, Stebbing. To embrace the new genus here instituted the definition requires to be modified only in one particular. Instead of affirming absolutely that the integument is indurated and the side-plates rigid, it should claim this solid firmness only as *usually* present.

Lepechinella, nov. gen.

Integument not indurated, dorsally processiferous. Head rostrate. Accessory flagellum of first antennæ rudimentary. Mandibles well developed; palp slender, with second joint much longer than first or third.

Inner plate of first maxillæ small, with only two apical setæ. Inner plate of second maxillæ shorter and narrower than the outer, not setose along the inner margin. First and second gnathopods with fifth joint longer than sixth. Peræopods 1–5 long and slender, with second joint narrow. Third uropods with short peduncle and long rami. Telson deeply emarginate.

The name is derived from that of the Russian author Lepechin, who in 1780 described and figured *Oniscus cuspidatus*, from the White Sea. Though that species is involved in some obscurity, it no doubt belongs to the genus *Paramphithoe*, and is in point of time the earliest member of the present family.

LEPECHINELLA CHRYSOTHERAS, sp. n. (Plate **27.**)

The head has an acute horizontal rostrum, reaching about halfway along the first joint of the first antennæ. The first peræon segment is furnished with two upstanding dorsal processes, each succeeding segment with one such process, an additional little process preceding the principal one on the sixth and seventh segments. On each of the first three pleon segments two small processes precede the principal process, which points backward on the second and downward on the third segment. The fourth segment has a large single process and the fifth a minute one. All these processes are attended by several pliant setæ, a sort of streamers, perhaps designed to attract, and at any rate in the dead specimen successfully retaining, much disguising refuse. The side-plates of the peræon present considerable variation in shape, that of the first segment forming two subacute lobes directed much forward, that of the second having a single lobe prolonged sharply downward. The three following pairs are bilobed, with the front lobe the longer and somewhat acute. The side-plates of the seventh segment have a little tooth directed backward. The first three pleon segments have the postero-lateral angles acute, those of the second and third segments being upturned.

No eyes could be perceived. The first antennæ have the first joint moderately long and stout, the second longer and much more slender, the third less than half as long as the first; the flagellum a little longer than the peduncle, eighteen-jointed. The secondary flagellum is very small, one-jointed, half as long as the first joint of the principal. The second antennæ are a little longer than the first, the gland-cone small, the fourth joint equal to the second joint of the first antennæ, the fifth considerably longer, somewhat longer than the ten-jointed flagellum.

The lips were not successfully dissected, so that it is uncertain whether the median part of the lower lip was bilobed, or only one-lobed as given in the figure.

The mandibles are normal, the cutting-edge dentate, the accessory plate, as usual, more strongly dentate in one member of the pair than in the other ;

the spine-row contains about six strong spines; the molar is well developed; the palp very slender, with its second joint much longer than either the first or third, which are subequal one to the other, the third carrying a few long setæ. The first maxillæ have a slight inner plate with two apical setæ, the outer plate armed with nine spines; the palp with large second joint armed on its broad apex with six teeth and a spine in one member, and with six spines in the other member of the pair, a difference which has been noticed in the family Atylidæ (see Das Tierreich, Amph. Gamm. p. 334). The second maxillæ have the inner plate shorter and much narrower than the outer, in both the setæ are confined to the distal margin. The maxillipeds have the inner and outer plates normal, the outer with about ten fringing spines, of which those on the inner edge are dentiform. The second joint of the palp is the longest, but it does not reach the end of the outer plate.

The first and second gnathopods are similar in structure, slender, setose; the fifth and sixth joints longer in the second pair than in the first, which has the hand distally rather more widened with a less oblique palm. The five pairs of peræopods are all much alike, with the second joint slender, the fingers long and curved, the fourth joint longer than the fifth in the first two pairs, but shorter than it in the three following pairs.

The first uropods have the peduncle long and the rami long, the outer longer than the inner. The second pair have the peduncle longer than the rami, of which the outer is the shorter. In the third pair the peduncle is very short, the rami long, the inner the shorter. The telson is short, little longer than broad, emarginate almost to the centre, each acute apex carrying a long upstanding seta. The specimen as preserved is colourless.

Length from apex of rostrum to end of telson, between 5 and 6 mm.

Locality. Lat. 59° 41′ N., long. 3° 0′ W., from a depth of 850 m.

The specific name is derived from the Greek word χρυσοθήρας, meaning a searcher for gold, in allusion to the name of the vessel, the *Goldseeker*, which was instrumental in bringing the typical specimen to light.

Family Eusiridæ.

1888. *Eusiridæ,* Stebbing, ‘Challenger’ Amphipoda, Reports, vol. xxix. p. 953.
1893. *Eusiridæ,* Sars, Crustacea of Norway, vol. i. p. 414.
1906. *Eusiridæ,* Stebbing, Das Tierreich, Amph. Gamm., Lieferung 21, pp. 338, 728.

The definition of the family given under the last reference includes the character that the mandibles have the third joint of the palp elongate. The new species here added to the family is in this respect exceptional, so that the statement must now be that the third joint in question is *generally* elongate.

Genus Rhachotropis, *S. I. Smith.*

1871. *Tritropis*, Boeck, Forh. Selsk. Christiania, 1870, p. 158.
1883. *Rhachotropis*, S. I. Smith, Proc. U.S. Nat. Mus. vol. vi. p. 222.
1906. *Rhachotropis*, Stebbing, Das Tierreich, Amph. Gamm., Lieferung 21, pp. 347, 729.

The species here included in the genus differs from its congeners and, so far as known, from the rest of the family, by having the third joint of the mandibular palp much shorter than the second. Also the postero-lateral margins of the third pleon segment cannot well be described in the terms which suit the other species. Nevertheless the whole sum of its characters seems to demand that this form should not, under existing circumstances, be separated from *Rhachotropis*. The telson indeed has only a small apical notch instead of the more or less prolonged slit which is usual, but it shares the character of its telson with *R. gracilis*, Bonnier, and *R. kergueleni*, Stebbing, in both of which, on the other hand, the third joint of the mandibular palp is greatly elongated. The new form is apparently blind, but so are several other species in this genus. It agrees with a certain number in having a microscopically two-jointed accessory flagellum to the first antennæ, and it should here be noticed that this is the case with *R. grimaldii*, Chevreux. That author's earlier statement on this point I have adopted in 'Das Tierreich,' without noticing his clear correction of it in his 'Résult. Camp. Monaco,' vol. xvi. p. 69, pl. 9. fig. 1 (1900). In other minute details, as well as in many obvious characters, it will be admitted, I think, that the new species is closely tied to this genus, although marked off from its companions by several striking features of its own.

Rhachotropis palporum, sp. n. (Plate 28.)

Rostrum rather short. Peræon broad, a little hairy and transversely rugose, without teeth or processes, except that the lower hind angles of the seventh segment are produced acutely backward. The anterior angles of the first segment are produced subobtusely forward. The first three pleon segments are large, projecting in seven teeth a-piece, of which the medio-dorsal tooth and the postero-lateral pair are short, the subdorsal pair of great length in the first and second segments. In these segments the pair between the subdorsal and postero-lateral pairs are minute, but in the third segment they are more obvious, while their neighbours are comparatively reduced. The second to the fifth segments show a median carina, the fourth segment having a small lateral pair of teeth and a very small median tooth to the rear between two rounded projections. The first three segments slope forward below the postero-lateral teeth. The side-plates of the peræon are not very deep, the first very shallow, produced acutely forward, the seventh produced backward in a small tooth.

No eyes were perceived. The antennæ of the single specimen, a female, agree in armature with those figured by Sars for *R. helleri* (Boeck), both pairs having a great number of the ciliated hairs usually regarded as auditory. In the first antennæ the first joint is stouter and a little longer than the second, each having apical teeth, the third joint is about two-fifths the length of the second. The flagellum is scarcely as long as the peduncle, ten- to eleven-jointed, armed with filaments. The accessory flagellum is extremely minute, with an insignificant second joint. In the second antennæ the gland-cone is conspicuous, the third joint is about as long as the first in the first antennæ, the second joint is decidedly longer, very slender; the flagellum is seventeen-jointed, yet not quite so long as the peduncle.

The upper lip has an almost smooth convex distal margin, flanked by a pair of whiskers, from the extremities of which extend a concave line of short hairs. The lower lip was not distinctly made out, but appears to agree with that figured by Sars for *R. helleri*.

The mandibles have a strong cutting-plate, that on the left ending in a solid tooth, that on the right bidentate. The accessory plate on the left has an edge divided into six teeth; this plate on the right is shorter, with only four teeth, two of which are notably smaller than the other two. There are four to five spines in the spine-row. The molar is of moderate size. The palp is much shorter than the massive trunk, its third joint tipped with three spines, its length twice that of the first and about half that of the sparsely-spined second joint. This character remarkably distinguishes the present species from others in this genus, which have the third joint of the palp strongly spined and longer than the second joint. There is nothing about the specimen to suggest that the palps are abnormal.

The first maxillæ have a large inner plate carrying two small setæ at the distal end of its inner border. The outer plate has nine slender denticulate spines. The palp is long, its first joint twice as long as broad, about two-fifths as long as the sparsely-setose second joint. In the second maxillæ the inner plate is rather shorter and broader than the outer, both with setæ confined to their broad apical borders. The maxillipeds have the inner plates short and broad, the truncate distal margin carrying three spine-teeth and two more slender spines; the outer plate is broad, with very numerous spines round the distal and inner margins. The palp is greatly elongated, and the long second joint has a peculiar appearance because the inner edge is not as usual continuous in a straight line or convex curve, but distally for more than half the total length concave. The third joint is also curved ; this joint is strongly spined on its inner surface. The finger is long, but a little shorter than the third joint.

The first and second gnathopods are characteristic of the genus, with their great oval hands and long fingers closing over the very oblique convex spine-fringed palms. The second gnathopod is larger than the first, and has the process of the wrist somewhat acutely produced. The first and second peræopods are slender and not exactly alike, since in the first pair the sixth joint is rather longer than the fifth and rather shorter than the seventh, but in the second pair it is rather shorter than either the fifth or the seventh. The three following pairs have the second joint expanded though not very strongly, but they agree with one another in having an acute projection of the hind margin at about the middle. Something similar to this is found in the third and fourth peræopods of *R. aculeata* (Lepechin), but in that species it disappears from the fifth pair, whereas in the present species in the fifth pair it is greatly accentuated, so that by this character alone the new form can be distinguished from all hitherto described members of the genus. As in other species, the fourth joint is short in the first and second peræopods but long and spinose in the remaining three pairs. The last three joints of the third and fifth pairs in our specimen were missing.

The marsupial plates attached to the second gnathopods and the first two pairs of peræopods are voluminous, but those on the third pair are narrow. In all, the fringes of the margin were rather scanty. The branchial vesicles are rather large on the second gnathopods and first two pairs of peræopods, diminishing on the next two, and on the fifth pair very small, being here transversely instead of longitudinally oval.

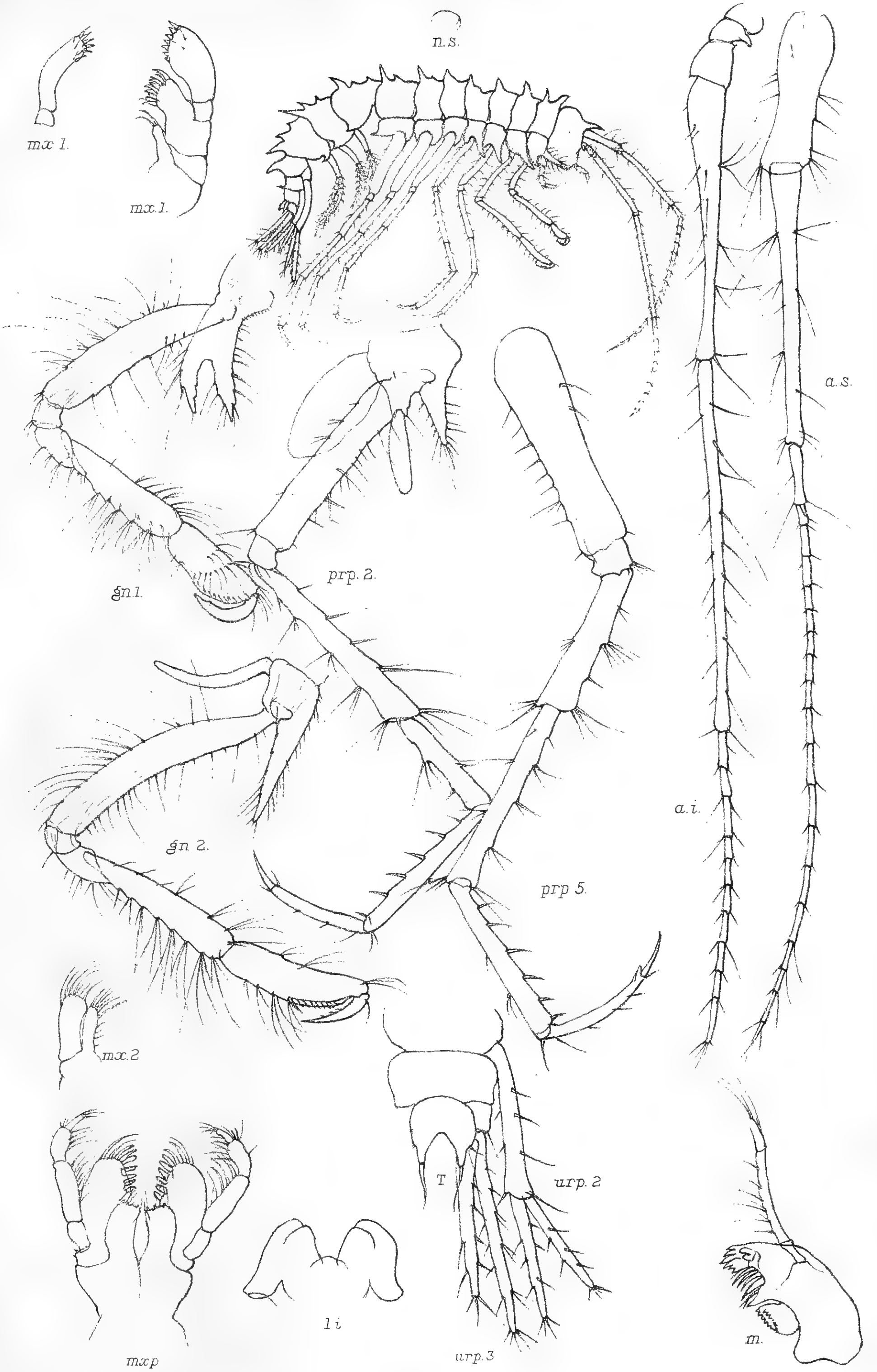
The pleopods are strong, with two slender coupling-hooks on the peduncle, five or six cleft spines to the inner ramus, and about twenty-three joints to each of the rami. The uropods have lanceolate rami, those of the first pair rather shorter than the peduncle, those of the other two pairs longer than their respective peduncles; the inner ramus of the second pair considerably longer than the outer and longer than any of the other rami. The telson is elongate, tapering, as long as the peduncle of the first uropod, with a pair of ciliated hairs or setæ near the base, the apices on each side of the small cleft acute.

The specimen in spirit colourless.

Length, from tip of rostrum to end of telson, 13·5 mm.

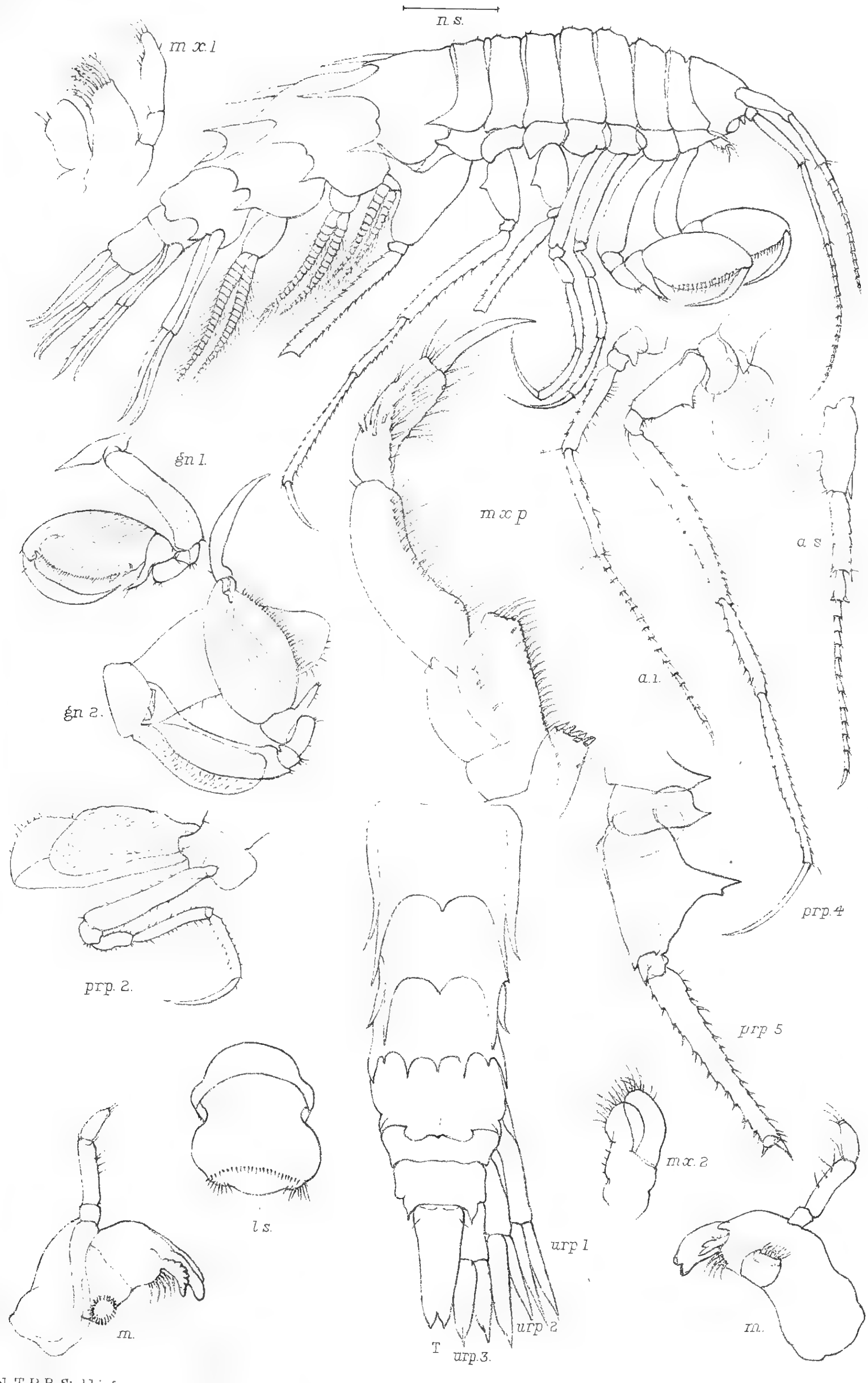
Locality. Lat. 59° 36′ N., long. 7° 0′ W., from a depth of 400 m.

The specific name calls attention to the differential characters in the palps of the mandibles and maxillipeds.



Del. T.R.R. Stebbing. J. T. Rennie Reid, Lith. Edinr.

LEPECHINELLA CHRYSOTHERAS n. g. et sp.



Del. T. R. R. Stebbing. J. T. Rennie Reid Lith. Edinr

RHACHOTROPIS PALPORUM n. sp.

EXPLANATION OF THE PLATES.

Plate 27.

Lepechinella chrysotheras, n. g. et sp.

n.s. Line indicating natural size of specimen figured below in lateral view.
a.s, a.i. First and second antennæ.
*m., l.i., mx.*1, *mx.*1., *mx.*2, *mxp.* Mandible, lower lip, one of the first maxillæ and separated palp of the other, second maxilla, maxillipeds.
*gn.*1, *gn.*2, *prp.*2, *prp.*5. First and second gnathopods, second and fifth peræopods.
*urp.*2, 3, *T.* Second and third uropods and telson in dorsal view.

The mouth-organs are magnified uniformly on a higher scale than the other appendages.

Plate 28.

Rhachotropis palporum, sp. n.

n.s. Line indicating natural size of specimen figured below in lateral view.
a.s, a.i. First and second antennæ.
*l.s., m., m., mx.*1., *mx.*2, *mxp.* Upper lip, mandibles, first and second maxillæ, and maxilliped.
*gn.*1, *gn.*2, *prp.*2, 4, 5. First and second gnathopods, second and fourth and part of fifth peræopods.
*urp.*1, 2, 3, *T.* The pleon in dorsal view, with the first, second, and third uropods and telson in position.

The mouth-organs are magnified uniformly on a higher scale than the other appendages, but in conformity with the lower scale of the preceding plate.

The PODOSOMATA (=Pycnogonida) of the Temperate Atlantic and Arctic Oceans. By Canon A. M. NORMAN, M.A., D.C.L., LL.D., F.R.S., F.L.S.

(PLATES 29 & 30.)

[Read 19th March, 1908.]

PODOSOMATA is a most appropriate name which has been assigned to the class which embraces the allies of *Pycnogonum*. The name was given by Leach in 1815*, and employed by him in his subsequent papers. It is curious how it should have escaped usage and had substituted for it Pycnogonides, and its variations Pycnogonoidea, Pycnogonidea, and Pycnogonida, which are all, with the exception of the first French term, of later date, and all objectionable, for it is not desirable that the name of a class should be founded on the title of a genus which it embraces. Dr. Dohrn (9) has employed the term Pantopoda, an appropriate title, yet not so appropriate as Podosomata, which, with our present knowledge, expresses a wider signification than was known to its author. Moreover, Leach divided his Podosomata into two families, Pycnogonideæ and Nymphonideæ, which find their equivalents in the two orders of Sars, Achelata and Euchelata, while of that author's remaining third order, Cryptochelata, no example was known in the beginning of the last century.

Having a large number of Podosomata in my hands, obtained partly by my own dredging excursions and partly by expeditions sent out by our Government, I wrote a considerable portion of this paper some years ago; but when there were added North-East American species given me by Mr. E. B. Wilson, a nearly complete series of co-types of the Mediterranean forms described by Dr. Dohrn, others obtained by the Norwegian North Atlantic Expedition through the kindness of Professor G. O. Sars, and yet others from the dredgings of the 'Ingolf' Expedition, for which I am indebted to the authorities of the Copenhagen Museum, it appeared to me that with these advantages it might be useful if I brought together what was known of this Class in that portion of the Ocean to which my study of the marine fauna has been confined. The following synopsis embraces all species known in the Temperate Atlantic (*i. e.*, north of 35° N., including the Mediterranean) and the Arctic Oceans.

The general classification of G. O. Sars has been adopted, except that the Orders have been differently arranged.

* Trans. Linn. Soc. vol. xi. p. 308.

	1 Mediterranean.	2 Western Europe—Spain to Denmark.	3 British Area.	4 Scandinavian—Norway, South and West.	5 East Arctic—Siberia to East Finmark.	6 High Arctic—Spitsbergen, Franz Josef Land, &c.	7 Faroe Channel.	8 West Arctic—Jan Mayen, Iceland, East Greenland.	9 West Greenland.	10 North-East America to lat. 35° N.
Phoxichilidium femoratum, *Rathke*	..	+	+	+	+	..	..	..	+	+
Anaphia petiolata, *Kröyer*	+	+	+	+						
virescens, *Hodge*	..	+	+							
robusta, *Dohrn*	+									
angulata, *Dohrn*	+									
typhlops, *G. O. Sars*	..	..	+	+						
lenta, *Wilson*	..	..	..	..	..	..	..	..	..	+
oculata, *Carpenter*	..	..	+							
Pallene brevirostris, *Johnston*	+	+	+	+	..	..	..	..	..	+
producta, *G. O. Sars*	..	..	+	+						
spectrum, *D. Dohrn*	+	..	+							
Tiberii, *A. Dohrn*	+									
phantopa, *A. Dohrn*	+									
acus, *Meinert*	..	..	..	..	..	..	..	..	+	
hastata, *Meinert*	..	..	..	..	..	..	..	..	+	
Pallenopsis longirostris, *Wilson*	..	..	..	..	..	..	..	..	..	+
tritonis, *Hoek*	..	..	+	..	..	..	+			
plumipes, *Meinert*	..	..	..	..	..	..	..	+		
Neopallene campanellæ, *Dohrn*	+									
Phoxichilus circularis, *Goodsir*	..	..	+	+	+	..	..	+	+	+
spinipes, *Fabricius*	..	..	..	+	+	+	..	..	+	
Cordylochele malleolata, *G. O. Sars*	..	..	+	..	+	+	+	+	+	
longicollis, *G. O. Sars*	..	..	..	+	..	..	..	+		
brevicollis, *G. O. Sars*	..	..	..	..	+					
Nymphon rubrum, *Hodge*	..	+	+	+	?					
brevirostre, *Hodge*	..	..	+	+						
mixtum, *Kröyer*	..	+	..	+	+	+	..	+	..	+
glaciale, *Lilljeborg*	..	..	..	..	+	..	..	..	+	
brevitarse, *Kröyer*	..	..	..	..	+	+	..	+	+	
grossipes, *Fabricius*	..	..	+	+	+	+	+	+	+	+
microrhynchum, *G. O. Sars*	..	..	..	..	+					
piliferum, *Carpenter*	..	..	..	..	..	+				
longitarse, *Kröyer*	..	..	+	+	+	+	..	..	+	+
Sluiteri, *Hoek*	..	..	+	..	+	+	..	+		
grœnlandicum, *Meinert*	..	..	..	..	..	..	..	..	+	
leptocheles, *G. O. Sars*	..	..	+	+	..	..	..	+	+	
Strömii, *Kröyer*	..	..	+	+	..	..	+	..	..	+
giganteum, *Goodsir*	..	..	+	+	+	+	+	+		
elegans, *Hansen*	..	..	..	+	+	+	+	+		
macrum, *Wilson*	..	..	+	+	+	..	..	+	+	+
stenocheir, *Norman*	..	..	..	..	..	..	..	+		
Sarsii, *Meinert*	..	..	..	..	..	..	..	+		
Hoekii, *Meinert*	..	..	..	..	+					
micronyx, *G. O. Sars*	..	..	..	..	+	..	..	+		
longimanum, *G. O. Sars*	..	..	..	..	..	..	+			

	1	2	3	4	5	6	7	8	9	10
	Mediterranean.	Western Europe—Spain to Denmark.	British Area.	Scandinavian—Norway, South and West.	East Arctic—Siberia to East Finmark.	High Arctic—Spitsbergen, Franz Josef Land, &c.	Faroe Channel.	West Arctic—Jan Mayen, Iceland, East Greenland.	West Greenland.	North-East America to lat. 35° N.
Nymphon gracile, *Leach*	..	+	+							
serratum, *G. O. Sars*	..	..	..	..	+	+	..	+	+	
megalops, *G. O. Sars*	..	..	..	..	+	+	..	+		
parasiticum, *Martens*	+									
Chætonymphon hirtum, *Fabricius*	..	..	+	+	..	..	..	+		
hirtipes, *T. Bell*	..	..	+	+	+	+	+	+	+	+
spinosissimum, *Norman*	..	..	+	+	..	..	..	..	..	+
tenellum, *G. O. Sars*	..	..	..	+	..	..	+	..	+	
macronyx, *G. O. Sars*	..	..	+	+	+	+	+	+		
Boreonymphon robustum, *T. Bell*	..	..	..	..	+	+	+	+	+	
Paranymphon spinosum, *Caullery*	..	+	+	..	..	..	..	..	+	
Ammothea vulgaris, *O. G. Costa*	+									
echinata, *Hodge*	+	+	+	+	..	..	..	..	..	+
scabra, *Wilson*	..	..	..	..	..	..	..	..	..	+
hispida, *Hodge*	+	+	+							
borealis, *Schimkewitsch*	..	..	..	..	+					
Langi, *Dohrn*	+									
lævis, *Hodge*	..	..	+	+						
appendiculata, *Dohrn*	+									
uniunguiculata, *Dohrn*	+									
biunguiculata, *Dohrn*	+									
Tanystylum orbiculare, *Wilson*	+	..	+	..	?	..	..	..	..	+
Tragæus communis, *Dohrn*	+									
Rhynchothorax mediterraneus, *O. G. Costa*	+									
Eurycyde hispida, *Kröyer*	..	..	..	+	+	+	..	..	+	
Barana castelli, *Dohrn*	+									
arenicola, *Dohrn*	+									
Ascorhynchus abyssi, *G. O. Sars*	..	..	..	..	..	..	..	+		
tridens, *Meinert*	..	..	..	..	..	..	..	+		
Scæorhynchus armatus, *Wilson*	..	..	..	..	..	..	..	..	..	+
Colossendeis proboscidea, *Sabine*	..	..	..	+	+	+	+	+	+	
angusta, *G. O. Sars*	..	..	..	+	..	..	+	+	+	
colossea, *Wilson*	..	..	..	..	..	..	..	+	..	+
clavata, *Meinert*	..	..	..	..	..	..	..	+		
macerrima, *Wilson*	..	..	..	..	..	..	..	+	..	+
minuta, *Hoek*	..	..	..	..	..	..	..	..	..	+
leptorhynchus, *Hoek*	..	+								
gigas, *Hoek*	..	..	..	..	..	..	..	..	..	+
Pycnogonum littorale, *Ström*	..	+	+	+	+	..	..	+	+	+
crassirostre, *G. O. Sars*	..	..	..	+	..	..	..	+		
pusillum, *Dohrn*	+									
nodulosum, *Dohrn*	+									
Endeis spinosus, *Montagu*	+	+	+	+						
charabdæus, *Dohrn*	+									
89	25	13	32	31	26	17	13	30	22	21

As regards the table of distribution (pp. 199, 200) it may be stated that:—

1. The term "British Area" will be found defined in my paper "The British Area in Marine Zoology" (Ann. & Mag. Nat. Hist. ser. 6, vol. v. 1890, p. 345).

2. A separate column has been assigned to the Faroe Channel, because several British Government vessels have dredged there. The Faroe Channel really geographically should fall under column 8. It is separated from the British Area by the "Wyville Thomson Ridge," south of which the water is entirely influenced by the Gulf-Stream, with a bottom temperature at 500 fathoms of 46° Fahr., while in the Faroe Channel the water belongs to the Arctic Ocean, and has a temperature at 500 fathoms at and below freezing-point; for the Gulf-Stream meeting and passing over the Wyville Thomson Ridge affects the upper waters, but has no influence on those at greater depths.

There are some described forms which I am unable to identify, and a list of these is given after the account of the known forms. At the end I give a catalogue of the chief works and papers which relate to the nomenclature of the class.

Order I. EUCHELATA, *G. O. Sars.*

Family 1. PHOXICHILIDIIDÆ, *G. O. Sars.*

Genus 1. PHOXICHILIDIUM, *H. M.-Edwards*, 1846.

PHOXICHILIDIUM FEMORATUM (*J. Rathke*).

Nymphon femoratum, Rathke (J.), (**46**) p. 201, pl. v. fig. H 1–3.
? *Phalangeum aculeatum*, Montagu, (**41**) p. 101, pl. v. fig. 8.
Orithya coccinea, Johnston, (**31**) p. 378, pl. xiii. figs. 4–6.
Phoxichilidium globosum, Goodsir, (**11**) p. 136, pl. iii. fig. 1.
" *maxillare*, Stimpson, Marine Invert. Grand Manan, p. 37.
" *coccineum*, Hodge, (**21**) p. 124, pls. iv. & v. (development).
" *maxillare*, Wilson, (**58**) p. 12, pl. iv. figs. 1 *a–c*; and (**57**) p. 480, pl. iii. figs. 12–15.
" *minor*, Wilson, (**58**) p. 13, pl. iv. figs. 2 *a–f*.
" *femoratum*, Hoek, (**25**) p. 240, pl. x. figs. 8–10; and (**28**) p. 512, pl. xxvi. figs. 18–21 & pl. xxvii. fig. 1.
" *femoratum*, Adlerz (G.), Bihang till K. Vet.-Akad. Handl. vol. xiii. (1888) p. 17 (separate copy), pl. i. figs. 4, 5, pl. ii. figs. 6–12 (development).
" *femoratum*, Sars, (**51**) p. 21, pl. iii. figs. 1 *a–g*.

The number of spines at the base of the propodos is subject to considerable variation, ranging from two to six; the former number (as figured by Hoek) may be on adult individuals, though perhaps not fully grown. Full-grown individuals from Seaham (*Hodge*) have four such spines on all the legs, except one specimen, which has only three.

Falmouth; Starcross, Devon; Isle of Cumbrae; Lerwick, Shetland (*A. M. N*); adult, young, and cysts of *Coryne* with embryo. Seaham, Co. Durham (*G. Hodge*); tide-marks, Vadsö, East Finmark (*A. M. N.*). Casco Bay, N.E. America, as "*P. maxillare*" and also as "*P. minor*" (*Wilson*). *Mus. Nor.*

Other localities are Irish Sea (*Halhed*); both East and West coasts of Ireland (*Carpenter*); whole coast of Norway, and at Florö dredged in 100 fathoms (*Sars*); Denmark (*Hansen*); Greenland (*Kröyer*); Holland and Northern France (*Hoek*); Murman Coast (*Jarzynsky*).

Genus 2. ANAPHIA, *Say*, 1821=Anoplodactylus, *Wilson*, 1878.

1. ANAPHIA PETIOLATA (*Kröyer*).

Phoxichilidium petiolatum, Kröyer, (**32**) p. 123, & (**33**) pl. xxxviii. figs. 3 *a–f*.
Pallene attenuata, Hodge, (**22**) p. 281, pl. xv. figs. 1–5, & (**22***) p. 463.
„ *pygmæa*, Hodge, (**23** *a*) p. 116, pl. xiii. figs. 16, 17, and (**23** *b*) p. 198, pl. v. figs. 16, 17.
Phoxichilidium mutilatum, Semper, Arb. aus der Zool.-zoot. Instit. Würzburg, vol. i. p. 271, pl. xvii. figs. 12-16.
„ *longicolle*, Dohrn, (**9**) p. 177, pl. xiii. figs. 1–8.
„ *exiguum*, Dohrn, (**9**) p. 181, pl. xii. figs. 19–22.
„ *pygmæum*, Hoek, (**28**) p. 514, pls. xxvi., xxvii. figs. 22–25.
Anoplodactylus petiolatus, Sars, (**51**) p. 26, pl. ii. figs. 2 *a–l*.
Phoxichilidium longicolle, Schimkewitsch, (**52**) p. 18.
Anoplodactylus petiolatus, Norman, (**45**) p. 152.

In my paper, "A Month on the Trondhjem Fiord," referred to above, I have given my reason for the opinion that the several forms in the foregoing list should be regarded as synonyms of *A. petiolata*.

a. Typical. Fowey, Cornwall; Plymouth; Isle of Cumbrae; Trondhjem Fiord (*A. M. N.*). Naples as *P. longicolle* (*Dohrn*).

b. As *P. pygmæa* from Hodge; Spain (*Pedro Antiga*), Naples (*A. M. N.*, and *Dohrn* as *P. exiguum*). *Mus. Nor.*

Firth of Forth (*D'Arcy Thompson*); exceedingly common round the coast of Ireland (*Carpenter*), Irish Sea (*Halhed*), Northern France and Holland (*Hoek*), Denmark (*Hansen*), Heligoland (*Semper*), Southern Norway and as far north as Tjötö in Nordland (*Sars*); Porto Lagunas (*Schimkewitsch* [**52**]); Alaska (*Cole*).

2. ANAPHIA VIRESCENS (*Hodge*).

Phoxichilidium virescens, Hodge, (**23** *a*) p. 115, pl. xiii. figs. 13–15; (**23** *b*) p. 197, pl. v. figs. 13–15.

Polperro, Cornwall (cotypes *Hodge*); Starcross, Devon (*C. Parker*); Plymouth (*A. M. N.*). *Mus. Nor.*

St. Malo (*Grube*).

My specimens from Hodge are now pale in colour, but those from Starcross are of a brilliant green. The very smooth joints of all the limbs readily distinguish this species from the following.

3. ANAPHIA ROBUSTA (*Dohrn*).

Phoxichilidium robustum, Dohrn, (**9**) p. 158, pl. xii. figs. 13–18.

Naples (*Dohrn*). *Mus. Nor.*

This species is distinguished from its allies by its very massive limbs, by the form of the proboscis which has projected angles (Dohrn, fig. 15), and by the nodulous processes at the end of the third coxal and of the femoral joints, and the spine-bearing nodule near the extremity of the second tibial joint (Dohrn, fig. 13).

4. ANAPHIA ANGULATA (*Dohrn*). (Plate **29**. fig. 8.)

Phoxichilidium angulatum, Dohrn, (**9**) p. 154, pl. xii. figs. 1–12.

Naples (*Dohrn*). *Mus. Nor.*

This species comes very near to *P. virescens*, Hodge, but the examination of a specimen from Naples shows a distinctive character which is not figured by Dohrn. On the inner side of base of the claws there is a nodulous process (fig. 8) which is altogether absent in Hodge's species. This nodule has its counterpart in that of the dactylus of the gnathopod of the genus *Amphilochoides* among the amphipodous Crustacea (see Sars, Crust. Norway, Amphipoda, pl. lxxv. figs. 2 *p* 1 and 2 *p* 2). As Dohrn's pl. xii. fig. 7 does not represent the dactylus fully extended this nodulous process is not seen, and it must not be confounded with Dohrn's "rudimentaren Nebenkralle," which is also present.

5. ANAPHIA TYPHLOPS (*G. O. Sars*).

Anoplodactylus typhlops, Sars, (**50**) no. 6.
,, *typhlops*, Sars, (**51**) p. 29, pl. ii. figs. 3 *a–e*.
,, *typhlops*, Carpenter, (**6***) p. 5, pl. iii. figs. 12–19.

The type specimen was taken by Sars at Magero, south of the Trondhjem Fiord, Norway, in about 100 fathoms; 77 miles W.N.W. of Achill Head, West Ireland, in 352 fathoms (*Carpenter*).

6. Anaphia lenta (*E. B. Wilson*). (Plate **29.** figs. 1–3.)

? *Anaphia pallida*, Say, Journ. Acad. Sci. Phil. vol. ii. 1821, p. 59, pl. v. figs. 7 & 7 *a*.
Phoxichilidium maxillare, S. I. Smith (*nec* Stimpson), Report Invert. Vineyard Sound in Rep. Commiss. Fish and Fisheries, 1874, p. 544, pl. vii. fig. 35.
Anoplodactylus lentus, Wilson, Amer. Journ. Sci. & Art, vol. xv. 1878, p. 200; (**58**) p. 14, pl. iv. figs. 3 *a–e*; (**57**) p. 482, pl. iii. figs. 16–18.

N.E. America (cotypes *Wilson*). *Mus. Nor.*

Möbius has united this, which is the type species of the genus, with *A. petiolata*. Had he seen the two species it is impossible that he could have done this. *A. lenta* looks to the eye like a large *Nymphon*. One of my specimens has the body and proboscis 6·5 mm. long, and the stretch of the first pair of legs is 60 mm., while Sars gives as measurement of *A. petiolata* "length of body 2 mm., extent 10 mm.," and this may be taken as usual size of the adult. In *A. lenta* the neck is short (fig. 1) and the oculiferous tubercle situated only very little in advance of the base of the proboscis; the tubercle itself is low, the height scarcely exceeding the breadth, and terminates in a little point. The propodal joint of the legs (fig. 3) has at the base four spines, of which the third is the most developed; beyond these the margin is beset with 10–12 curved spines.

7. Anaphia oculata (*G. H. Carpenter*).

Anoplodactylus oculatus, Carpenter, (**6***) p. 4, pl. D, figs. 7–11.

One male taken in 306 fathoms 50 miles off Tearaght, West of Ireland, August 7th, 1903 (*Carpenter*).

Family 2. Pallenidæ.

Genus 1. Pallene, *Johnston*, 1837.

1. Pallene brevirostris, *Johnston*.

Pallene brevirostris, Johnston, (**31**) p. 380, pl. xii. figs. 7–8.
" " Grube, (**14**) p. 28, pl. i. figs. 5 *a–c*.
" " Hoek, (**25**) p. 237, pl. xv. figs. 4–7; and (**28**) p. 511, pl. xxvi. fig. 17.
" *empusa*, Wilson, (**57**) p. 476, pl. ii. figs. 5–7; (**58**) p. 9, pl. iii. figs. 2 *a–g*.
" *brevirostris*, Hansen, (**17***) p. 649.
" *emaciata*, Dohrn, (**9**) p. 193, pl. xiv. figs. 10–21.
" *brevirostris*, Sars, (**51**) p. 32, pl. iii. figs. 1 *a–h*.

Seaham, Co. Durham (*G. Hodge*); Cullercoats, Northumberland, and Plymouth (*A. M. N.*); Noank, Connecticut (cotypes of *P. empusa*, Wilson); Naples (cotype of *P. emaciata*, Dohrn). *Mus. Nor.*

St. Vaast de la Hougue (*Grube*).

I think that there can be no doubt that the three species of Johnston, Wilson, and Dohrn should be united. The number of larger spines at the base of the propodos vary from 3 to 5, and this extent of variation I have found to occur on the different legs of the same specimen, and the length of the neck is also subject to variation.

Other localities are Jersey (*D'Arcy Thompson*); Ballynakill Harbour, West Ireland, 6–8 fathoms, and off Dublin Bay (*Carpenter*); Irish Sea (*Halhed*); Isle of Cumbrae, Scotland (*D. Robertson*); Holland (*Hoek*); Denmark (*Hansen*); south-west of Norway, Stavanger and Tjötö in Nordland (*Sars*).

2. Pallene producta, *G. O. Sars.*

Pallene producta, G. O. Sars, (**50**) no. 3; (**51**) p. 36, pl. iii. figs. 2 *a–d*.
 „ „ Carpenter in Ninth Annual Rep. Liverpool Biol. Comm. 1896, p. 15.

Norway (cotype from *G. O. Sars*). *Mus. Nor.*

Sars procured this species in 60–100 fathoms at Apelvær in the Trondhjem district. Stebbing has found it at Millport in the Firth of Clyde, and Carpenter has determined a specimen which came from the Isle of Man. This form comes suspiciously near to *P. brevirostris*, but as I have seen only a single specimen I follow Sars in keeping it distinct.

3. Pallene spectrum, *D. Dohrn.*

Pallene spectrum, Dohrn, (**9**) p. 197, pl. xv. figs. 1, 2.

Plymouth (*A. M. N.*); Naples (cotype *Dohrn*). *Mus. Nor.*

I am glad to be able to add this species to the British fauna.

4. Pallene Tiberii, *A. Dohrn.*

Pallene Tiberii, Dohrn, (**9**) p. 198, pl. xvii. figs. 10, 11.

Naples (cotype *Dohrn*). *Mus. Nor.*

5. Pallene phantopa, *A. Dohrn.*

Pallene phantopa, Dohrn, (**9**) p. 196, pl. xiv. figs. 1–9.

Naples (cotype *Dohrn*). *Mus. Nor.*

6. Pallene acus, *Meinert.*

Pallene acus, Meinert, (**37**) p. 48, pl. iv. figs. 8–13.

Taken by the 'Ingolf' Expedition in Davis Strait, lat. 63° 06′ N., long. 56° W., in 1099 fathoms.

Davis Strait (cotype *Meinert*). *Mus. Nor.*

7. Pallene hastata, *Meinert.*

Pallene hastata, Meinert, (**37**) p. 49, pl. iv. figs. 14–19.

Taken by the 'Ingolf' Expedition in the southern part of Davis Strait, lat. 61° 50′ N., long. 56° 21′ W., 1435 fathoms.

Davis Strait (cotype *Meinert*). *Mus. Nor.*

The two preceding species approach very closely to each other, and may prove to be one species.

Genus 2. Pallenopsis, *E. B. Wilson*, 1880.

1. Pallenopsis longirostris, *Wilson.*

Pallenopsis longirostris, Wilson, (**59**) p. 252, pl. iv. figs. 19–22; pl. v. figs. 24, 25.

One male and one female taken by the 'Blake' Expedition at 39° 40′ N., long. 71° 10′ W., in 500 fathoms.

2. Pallenopsis tritonis, *Hoek.*

Pallenopsis tritonis, Hoek, (**29**) p. 7, pl. i. figs. 1–6.
" *Holti,* Carpenter, (**6***) p. 4, pl. i. figs. 1–6.

Taken by the 'Triton,' 1882, in the same dredge with *Cordylochele malleolata*, *Nymphon macrum*, and *Chætonymphon macronyx*, lat. 59° 40′ N., long. 7° 21′ W., in 516 fathoms, that is within the British warm area just south of the Faroe Channel. The specimen described by Professor Carpenter was dredged 77 miles W.N.W. of Achill Head, north-west of Ireland, in 382 fathoms, in company with *Anaphia typhlops* and *Nymphon leptocheles.* It can scarcely be doubted that these are one species, the former an adult male $8\frac{5}{7}$ mm. long and a hind leg 26 mm., the latter a half-grown female 5 mm. long and a leg 15 mm.

3. Pallenopsis plumipes, *Meinert.*

Pallenopsis plumipes, Meinert, (**37**) p. 51, pl. iv. figs. 1–7.

The type and only specimen taken by the 'Ingolf' at lat. 61° 32′ N., long. 13° 40′ W., in 950 fathoms.

Genus 3. Neopallene, *A. Dohrn*, 1881.

Neopallene campanellæ, *Dohrn.*

Neopallene campanellæ, Dohrn, (**9**) p. 200, pl. xv. figs. 11–15.

Naples (cotype *Dohrn*). *Mus. Nor.*

Genus 4. PHOXICHILUS, *Latreille*, 1804, as corrected 1818 = Pseudopallene, *Wilson*, 1878 ; *nec* Phoxichilus *auct. plur.*

1. PHOXICHILUS CIRCULARIS (*Goodsir*).

Pallene circularis, Goodsir, (**11**) p. 137, pl. ii. fig. 2, & (**13**) figs. 9, 10.
„ *intermedia*, Kröyer, (**32**) p. 119 ; (**33**) pl. xxxvii. figs. 2 *a–d*.
„ *discoidea*, Kröyer, (**32**) p. 120, and (**33**) pl. xxxvii. figs. 3 *a–g* (*juvenis*).
„ *hispida*, Stimpson, Invert. Grand Manan, p. 37.
„ *discoidea*, Wilson, (**58**) p. 12, pl. iii. figs. 3 *a–c* ; and (**57**) p. 479, pl. ii. fig. 10 (*juvenis*).
„ *hispida*, Wilson, (**58**) p. 10, pl. iii. figs. 1 *a–c* (*adultus*), and (**57**) p. 478, pl. ii. fig. 9.
Pseudopallene intermedia, Hansen (**18**) p. 175, pl. xix. figs. 2, 2 *a*.
„ *circularis*, Sars, (**51**) p. 38, pl. iii. figs. 3 *a*, *b*.

Florö, Norway (*A. M. N.*) ; Greenland, 175 fathoms, 'Valorous' Expedition. *Mus. Nor.*

Firth of Forth (*Goodsir*); West Norway and as far north as Vadsö (*Sars*); near Novaya Zemlia (*Hansen*); Murman Coast (*Jarzynsky*) ; north of Iceland and Denmark Strait (*Meinert*); Greenland (*Kröyer*) ; N.E. America (*Wilson*).

2. PHOXICHILUS SPINIPES (*Fabricius*).

Pycnogonum spinipes, Fabricius, Fauna Grœnlandica, p. 232.
Pallene spinipes, Kröyer, (**32**) p. 118 ; (**33**) pl. xxxvii. figs. 1 *a–g*.
„ „ Sars, (**51**) p. 42, pl. iii. figs. 4 *a–g*.

Tromsö (*J. S. Schneider*); Greenland, lat. 67° 56′ N., long. 55° 27′ W., in 20 fathoms, 'Valorous,' 1875. *Mus. Nor.*

Norwegian west coast, at Lofoten, and as far as Vadsö, but rare (*Sars*) ; Murman Coast (*Jarzynsky*) ; Kara Sea (*Sars*) ; Greenland (*Kröyer*); Franz Josef Land (*Carpenter*).

Genus 5. CORDYLOCHELE, *G. O. Sars*, 1888.

1. CORDYLOCHELE MALLEOLATA, *G. O. Sars*.

Cordylochele malleolata, Sars, (**49**) no. 48, and (**50**) no. 11.
Pallene malleolata, Hoek, (**29**) p. 6, pl. i. fig. 7.
Cordylochele malleolata, G. O. Sars, (**51**), p. 45, pl. iv. figs. 1 *a–k*.
„ „ Meinert, (**37**) p. 50.

Twice taken by the 'Porcupine' Expedition in 1869, at Station 64, lat. 61° 21′ N., long. 3° 44′ W., in 640 fathoms, and Station 74, lat. 60° 39′ N., long. 3° 9′ W., in 203 fathoms; the first of these stations is in the Faroe Channel, the second just within the British Area (*Mus. Nor.*).

Hoek states that four specimens of this species were dredged by H.M.S.

'Triton' in 1882 at Station 10, lat. 59° 40′ N., long. 7° 21′ W., in 516 fathoms; bottom temperature 46°–49° Fahr.; the station is within our area.

Between Finmark and Beeren Island, and on the north-west coast of Spitsbergen in 191–459 fathoms, also in the Kara Sea in 40–50 fathoms (*Sars*); the Greenland Sea, the Denmark Strait, and far up Davis Strait (*Meinert*).

2. CORDYLOCHELE LONGICOLLIS, *G. O. Sars.*

Cordylochele longicollis, Sars, (**50**) no. 12, and (**51**) p. 49, pl. iv. figs. 2 *a–g*.
„ „ Meinert, (**37**) p. 50.

Lofoten Island (cotype *Sars*). *Mus. Nor.*

Sars only procured it during the North Atlantic Expedition at Lofoten and Selsövig in Nordland, depth 100–120 fathoms; and Meinert records it as taken by the 'Ingolf' in the Atlantic south-west of Iceland and in Davis Strait in between 400 and 500 fathoms.

3. CORDYLOCHELE BREVICOLLIS, *G. O. Sars.*

Cordylochele brevicollis, Sars, (**50**) no. 13, and (**51**) p. 51, pl. iv. figs. 1 *a–g*.

Sars has procured this species at Vadsö, and it was brought back by Nordenskjöld from the Kara Sea, where it was dredged in 50 fathoms.

Family 3. NYMPHONIDÆ.

Genus 1. NYMPHON, *Fabricius*, 1794.

1. NYMPHON RUBRUM, *Hodge.* (Pl. **29**. figs. 4–7.)

Nymphon gracile, Johnston, (**31**) p. 380, pl. xii. figs. 9–12 (nec *Nymphon gracile*, Leach).
„ *rubrum*, Hodge, (**21**) p. 41, pl. x. fig. 1.
„ *gracile*, Hoek, (**25**) p. 243, pl. xv. figs. 11–13, and (**28**) p. 498, pl. xxiii. figs. 1–5.
? *Nymphon rubrum*, var. *intermedium*, Schimkewitsch, (**53**) p. 40, pl. ii. figs. 1 *a–f*.
Nymphon gracile, Hansen, (**17***) p. 127, pl. vii. fig. 18.
„ *rubrum*, G. O. Sars, (**51**) p. 58, pl. v. figs. 2 *a–k*.

This is the species which most recent authors have called *N. gracile*. The figures by Hoek of "*N. gracile*" and those of Sars of *N. rubrum* fully illustrate this species. The peculiar armature of the propodos is usually, if not always, a most distinctive character. At the base are some spines (commonly four but they range from two to four); these spines (figs. 4, 5) gradually increase in size from the first to the last, beyond the last and at some little distance *there is another and smaller spine*. This peculiar armature is shown in Sars's figure 2, *i*; and still better in Hoek's (**28**) pl. xxiii. fig. 5. There is very considerable variation in the proportionate lengths of the tibial, tarsal, and propodal joints.

Var. PERPLEXA (fig. 6). Among normal specimens of *N. rubrum* from St. Andrews given me by Prof. McIntosh, I have found other examples which show great divergence with respect to the tarsus and propodos, yet agree closely among themselves. The tarsus is remarkably short, not exceeding one third the length of the propodos. The propodos (fig. 6) is considerably curved, and has the four basal spines placed as usual but of small size, while the distal separated spine is entirely absent. The association of the very short tarsus with the disappearance of the usual characteristic distal spine of the propodos is very curious; but I do not find other characters to justify a specific separation of the form.

Plymouth, Starcross, Devon; Cullercoats, Northumberland; Isle of Cumbrae; St. Andrews, var. *perplexa*; Oban (*A. M. N.*). Cork (*G. H. Carpenter*). *Mus. Nor.*

Firth of Forth (*D'Arcy Thompson*); Dublin Bay and Dalkey Sound, also off Rockahill, Irish Sea, and Ballynakill Harbour, Galway (*Carpenter*). Holland (*Hoek*). Rare south of Norway (*Sars*).

2. NYMPHON BREVIROSTRE, *Hodge*. (Pl. **29**. figs. 9–12.)

Nymphon brevirostre, Hodge, (**22**) p. 282, pl. xv. figs. 6–11, and Ann. & Mag. Nat. Hist. ser. 3, vol. xi. 1863, p. 464.

Nymphon gracile, Sars, (**51**) p. 55, pl. v. figs. 1 *a–h* (exclusive of all synonyms).

This is the smallest *Nymphon* known to me; length of body scarcely 3 mm.; span of fully outstretched legs 17 mm. The form is very robust for its size both as regards the body and legs, and these are unusually short. The lateral processes of the trunk are equal in length to the breadth of the trunk itself, the intervals between the processes are moderately broad. The cephalic segment (fig. 8) is subequal in length to the united hinder segments, the neck is very short; the frontal portion is much widened at the extremity to receive the chelifori. The caudal segment, when directed backwards, reaches to a little more than half the length of the lateral body-lobes. The oculiferous tubercle is conical and, viewed from the front, has two small points near the summit (just as in Sars, pl. v. fig. 1 *c*). The proboscis is often no longer than its breadth as viewed from above, but in other specimens half as long again, its extremity widely rounded. The chelifori (fig. 10) are robust, the scape three times as long as broad, and the hand of nearly equal length; hand generally carried bent inwards (fig. 9), so that the proboscis reaches beyond it; the finger and thumb are strong and margined with short teeth, the thumb at about half its length is usually suddenly contracted in breadth so as to form a notch, over which hangs a bundle of short setæ. The palpi have the second joint slightly longer than the third, which latter is equal in length to combined length of the two terminal joints, the last of which is longer than the somewhat clavate-shaped penultimate, and is stout, obtusely rounded at the extremity, and covered with short setæ *.

The false feet have the fourth joint somewhat longer than the fifth, which equals in length the first three joints of the terminal portion ; each of the five joints of the terminal portion is shorter than the preceding ; the last four of these are furnished with flattened knife-shaped spines with serrated margins, consisting of a pair of larger serræ at the base, followed by six or seven pairs of smaller but distinct serræ ; the number of these serrated spines ranges from about ten on the fifth joint to seven on the last joint ; the nail is rather more than half the length of the last joint and is beset on the margin with nodular teeth.

The ambulatory legs (fig. 11) have the second coxal joint contracted at the base and widened distally, and it is one and a third times as long as its greatest breadth ; the femoral joint (in ♀ greatly swollen) is slightly longer than the preceding portion of the limb ; first tibial equal to the femoral ; second tibial only slightly longer ; tarsus very short, length and breadth usually subequal, bearing a distal strong spine ; propodos (fig. 12) three to four times as long as tarsus, very broad and strongly built, arcuate, armed with three to five strong spines of considerable size on the first two-thirds of its length, and spinules on the more distal portion ; dactylus strong, scarcely more than one-third the length of the propodos ; supplementary claws hardly half its length ; the legs bear a few scattered spine-like setæ.

There can, I think, be scarcely a doubt that Sars's *N. gracile* is this species. It is like it in almost every particular ; the only points in which there is not absolute agreement with my specimens are that the neck looks rather longer in fig. 1 (but not so in fig. 1 *b*), and that the propodos is shorter in proportion to the length of the tarsus on the one hand and of the claw on the other.

Starcross and Plymouth, Devon ; Oban ; St. Andrews (*A. M. N.*) ; Shetland (*Pearcey*). *Mus. Nor.*

Hodge's type-specimen was taken near the Dogger Bank in 25–30 fathoms. Firth of Clyde (*D. Robertson*). A few specimens have been taken in Norway (*Sars*).

3. NYMPHON MIXTUM, *Kröyer*.

Nymphon mixtum, Kröyer, (**32**) p. 110, and (**33**) pl. xxxv. figs. 2 *a–f*.
" " Hansen, (**17**) p. 128, pl. vii. fig. 19.
" *grossipes* (*armatum* on plate), Hoek, (**26**) p. 44, pl. iii. figs. 9–12, and pl. iv. fig. 1.
" *mixtum*, G. O. Sars, (**51**) p. 68, pl. vi. figs. 3 *a–i*.

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* It is obvious that Hodge's description and figure of the palpi are erroneous, they do not agree with each other and are both wrong.

Shetland (**43**); Hardanger and Trondhjem Fiords, Norway (*A. M. N.*); Tromsö (*J. S. Schneider*). *Mus. Nor.*

Denmark (*Hansen*); whole coast of Norway; North of Finmark; south of Jan Mayen; Kara Sea (*Sars*); Spitsbergen and East Greenland (*Bucholz*); coasts of North America and East Greenland (*Lönnberg*).

4. Nymphon glaciale, *Lilljeborg.*

Nymphon glaciale, Lilljeborg, "Bidrag till Norra Rysslands och Norriges fauna," Kongl. Vet.-Akad. Handl. 1850, vol. ii. p. 311.
Nymphon glaciale, G. O. Sars, (**50**) no. 17, (**51**) p. 63, pl. vi. figs. 1 *a–g*.

'Valorous,' 1875, Greenland, lat. 67° 56′ N., long. 55° 27′ W., in 20 fathoms (*Mus. Nor.*).

Russian Lapland (*Lilljeborg*); Kara Sea, 3–12 fathoms (*Sars*).

5. Nymphon brevitarse, *Kröyer.*

Nymphon brevitarse, Kröyer, (**32**) p. 155, (**33**) pl. xxxvi. figs. 4 *a–f*.
" " G. O. Sars, (**51**) p. 61, pl. vi. figs. 3 *a–g*.
" " Meinert, (**37**) p. 37.

Wilson synonymized this *Nymphon* of Kröyer with *N. grossipes*, regarding it as the young of that species; but Sars and Meinert both regard it as a distinct form.

Greenland (*Kröyer*); Matotschkin Skarr in 10–15 fathoms (*Sars*); between Greenland and Iceland, 752 fathoms (*Meinert*); Spitsbergen (*Möbius*); Franz Josef Land (*Carpenter*).

6. Nymphon grossipes (*Fabricius*).

Nymphon grossipes, Fabricius, Fauna Grœnlandica, p. 229.
" *Johnstoni*, Goodsir, (**11**) p. 138, pl. iii.* fig. 5, and (**13**) p. 3, pl. i. figs. 14, 15.
" *grossipes*, Kröyer, (**32**) p. 108, and (**33**) pl. xxxvi. figs. 1 *a–h*.
" " Wilson, (**58**) p. 20, pl. vii. figs. 1 *a–q*, and (**57**) p. 491, pl. vi. figs. 32–37, pl. vii. fig. 42.
" " Hoek, (**27**) p. 12, pl. i. figs. 17–21.
" " Hansen, (**18**) p. 170, pl. xviii. figs. 8, 8 *a*.
" " G. O. Sars, (**51**) p. 65, pl. vi. figs. 2 *a–i*.

It cannot be considered certain that Fabricius's description was drawn up from this species rather than *C. mixtum*. Johnston described the species two years before Kröyer, and his type preserved in the British Museum is unquestionably the present species. Meinert unites *P. mixtum* with this species; and in examining a large number of specimens I find that *N. grossipes* is subject to very considerable variation, so much so as to make me doubt whether *N. mixtum* and *N. glaciale* are really specifically distinct

* The figures in the description of Plate iii. are wrongly numbered, and are corrected (at any rate partially) by Goodsir in his subsequent paper (**13**).

from it. Hansen and Meinert regard *N. mixtum* as a form of this species, and Möbius (**40**) not only synonymizes these two Nymphons with *N. grossipes*, but also *N. gracile*, Leach, *N. rubrum*, Hodge, and *N. piliferum*, Carpenter !

Off Northumberland (*A. M. N.*) ; off Durham coast (*G. Hodge*) ; Firth of Forth (*Dr. Henderson*) ; Faroe Channel in several dredges down to 632 fathoms (*'Porcupine,'* 1869) ; Greenland (*A. Hancock*) ; Eastport, N.E. America (*Wilson*). *Mus. Nor.*

Hoek records the species as having been taken by the 'Knight Errant' in the cold area of the Faroe Channel ; and by the 'Triton' in both the Faroe Channel and the warm area south of the Wyville Thomson Ridge. This has generally been regarded as an Arctic form, and Sars has not found it south of the Arctic Circle on the Norwegian coast ; its not unfrequent occurrence therefore on our eastern coast from the Firth of Forth to the coast of Durham is of considerable interest. Orkney and Moray Firth (*D'Arcy Thompson*). Off Lofoten and Tromsö ; north-west coast of Spitsbergen ; Matotschkin Skarr in 2–743 fathoms (*Sars*). Greenland (*Kröyer*) ; Barents Sea (*Hoek*) ; Kara Sea (*Hansen*) ; Denmark Strait and between Iceland and Greenland (*Meinert*). N.E. coast of America, and reaching as far south as lat. 41° 32′ N., long. 65° 55′ W., where it was taken in 524 fathoms by the 'Blake' Expedition (*Wilson*).

7. Nymphon microrhynchum, *G. O. Sars.*

Nymphon longitarse, Hansen, (**18**) p. 169, pl. xviii. figs. 7 *a–c* (*nec* Kröyer).
„ *microrhynchum*, Sars, (**50**) no. 20.
„ „ Sars, (**51**) p. 73, pl. vii. figs. 1 *a–g*.

Kara Sea (*Hansen* and *Sars*).

8. Nymphon piliferum, *G. H. Carpenter.*

Nymphon piliferum, Carpenter, (**4**) p. 628, pl. xlvi. figs. 1–13.

Franz Josef Land, brought home by Mr. W. S. Bruce (*G. H. Carpenter*).

9. Nymphon longitarse, *Kröyer.*

Nymphon longitarse, Kröyer, (**32**) p. 112, (**33**) pl. xxxvi. figs. 2 *a–f*.
„ „ Wilson, (**58**) p. 19, pl. vii. figs. 2 *a–h*, and (**57**) p. 489, pl. vi. figs. 30, 31.
„ „ Hoek, (**27**) p. 15, pl. i. figs. 22, 23.
„ „ G. O. Sars, (**51**) p. 75, pl. viii. figs. 3 *a–h*.

Vadsö, East Finmark (*A. M. N.*) ; off Salem, Massachusetts Bay (*Wilson*). *Mus. Nor.*

Coast of Durham (*Hodge*). N.E. America, Greenland, Spitsbergen, Kara Sea, Barents Sea, whole coast of Norway (*Wilson*, *Kröyer*, *Hoek*, *Sars*) ;

south of Faroe Channel, *i. e.* in British area (*Hoek*) ; Franz Josef Land (*Carpenter*) ; Baffins Bay and Frederikshaab (*Meinert*).

10. Nymphon Sluiteri, *Hoek*.

Nymphon Sluiteri, Hoek, (**27**) p. 18, pl. ii. figs. 30–34.
" " Hansen, (**18**) p. 166, pl. xviii. figs. 5 *a, b*.
" " G. O. Sars, (**51**) p. 78, pl. vii. figs. 2 *a–g*.

Kara Sea (*Copenhagen Museum*). *Mus. Nor.*

This species has been added to the British fauna by H.M.S. 'Triton' in 1882, under Sir John Murray (lat. 59° 13′ N., long. 7° 13′ W.), at a depth of 555 fathoms (*Hoek*). Between Finmark and Beeren Island, 191 fathoms ; Kara Sea, 20–60 fathoms (*Sars*) ; Barents Sea, 292 fathoms (*Hoek*) ; Franz Josef Land, 237 fathoms (*Carpenter*); between Faroe Islands and Jan Mayen, 700–1444 met. (*Meinert*) ; König Karls Land (*Möbius*).

11. Nymphon grœnlandicum, *Meinert*.

Nymphon grœnlandicum, Meinert, (**37**) p. 41, pl. iii. figs. 14–22.

Davis Strait, lat. 60° 54′ N., long. 55° 10′ W., in 393 fathoms. Co-type taken by 'Ingolf' Exped. (*Copenhagen Museum*). *Mus. Nor.*

Nymphon grœnlandicum is scarcely distinguishable from *N. leptocheles*. Indeed, Herr Meinert's description and figures in all ways seem to accord with that species except the following sentence respecting the ambulatory legs: "tarsal joints together distinctly longer than half the second tibial joint; the second tarsal joint much longer than the first one." As regards the first part of this sentence, in the two specimens examined by me I find the author's words to apply to some of the legs but not to others, and in *N. leptocheles* there is also considerable variation in the proportionate length of the two ultimate joints to the second tibial. As regards the second part of the sentence it is obviously a *lapsus pennæ*, since it is at variance with the illustration given (fig. 22) and with the specimens; and for "longer" should be read "shorter."

The specimens of *N. grœnlandicum* differ from the usual *N. leptocheles* in the much more setose ambulatory legs, more especially the tibial joints, on which the setæ are numerous and longer than the breadth of the joint itself.

12. Nymphon leptocheles, *G. O. Sars*.

Nymphon leptocheles, G. O. Sars, (**50**) p. 348, and (**51**) p. 78, pl. viii. figs. 1 *a–i*.
" " Norman, (**45**) p. 153.
" " Meinert, (**37**) p. 48.

I have dredged this species in the following places off the Norwegian coast:—Kors Fiord, near Bergen, 1878 ; Hardanger Fiord, off the southern portion of Huglin Island, in 100 fathoms, 1879 ; Christiania Fiord, 30-100 fathoms; Florö, 1882, in 45–70 fathoms; Rödberg, Trondhjem Fiord, 150–250 fathoms, 1893. It was also procured by the 'Porcupine,' 1869, lat. 59° 34′ W., long. 70° 13′ W., in 542 fathoms, a station within the British Area. *Mus. Nor.*

Off Achill Head, Co. Mayo, Ireland, in 382 fathoms (*Carpenter*); Davis Strait and near Iceland, in 362–600 fathoms (*Meinert*); entire west coast of Norway, in 50–191 fathoms (*Sars*).

13. NYMPHON STRÖMII, *Kröyer.*

Nymphon Strömii, Kröyer, (**32**) p. 111, and (**33**) pl. xxxv. figs. 3 *a–f*.
„ „ Wilson, (**58**) p. 17, pl. i. figs. 2 *a*, *b*, and pl. vi. figs. 1 *a–h*; and (**57**) p. 485, pl. v. and pl. vi. fig. 29.
„ „ Adlerz (G.), Bihang till K. Vet.-Akad. Handl. vol. xiii. (1888) p. 1 (separate copy), pl. i. figs. 1–3.
„ „ G. O. Sars, (**51**) p. 80, pl. viii. figs. 2 *a–k*.

Near Holy Island, Northumberland (*G. Hodge*); Shetland* (*A. M. N.*); N.N.E. of Shetland, in 267 fathoms ('*Porcupine*,' 1869); Bergen, Hardanger and Trondhjem Fiords, Norway (*A. M. N.*); off Salem, Massachusetts (*Wilson*). *Mus. Nor.*

Phalangium marinum, Ström, and *Nymphon grossipes*, Abildgaard ('Fauna Norvegica,' pl. cxix., but not *Pycnogonum grossipes*, Fabricius) would seem to be this species.

I find *Nymphon Strömii* to vary so greatly in the proportionate lengths of its several parts that I cannot but think that Hoek and others who would unite the following species with the present have much to justify the view which they take.

N.E. America (*Wilson*); south and west coasts of Norway as far as Lofoten Islands in 10–50 fathoms (*Sars*); Faroe Channel (*Hoek*); Sumburgh Head (*D'Arcy Thompson*).

14. NYMPHON GIGANTEUM, *Goodsir.*

Nymphon giganteum, Goodsir, "Description of a New Species of *Nymphon*," Hist. Berwickshire Naturalists' Club, 1844, p. 114, pl. iii., and Ann. & Mag. Nat. Hist. vol. xv. p. 293.
Nymphon gracilipes, Heller, (**20**) p. 16, pl. iv. fig. 15, pl. v. figs. 1, 2.
„ *Strömii*, Hoek, (**27**) p. 9, pl. i. figs. 7–16 (partim).
„ „ Hansen, (**18**) p. 163, pl. xviii. fig. 3.
„ *gracilipes*, G. O. Sars, (**51**) p. 83, pl. viii. figs. 3 *a–g*.

Nymphon giganteum of Goodsir is, I think, clearly the *N. gracilipes* of Heller. Goodsir's type-specimen was obtained off Embleton, on the Northumberland coast, and G. Hodge recorded it in 1863 and 1865 from

* I took it and recorded it from Shetland (**43**) in 1861 in 80 fathoms; but the specimen has been destroyed.

the same coast, and one of these specimens was given to me by him. In the British Museum is a very fine specimen dredged by Mr. George Barlee off Lerwick, Shetland, and it has been subsequently procured by myself (**43**) and by the 'Porcupine' Expedition in the Shetland Sea.

Off Holy Isle, Northumberland (*G. Hodge*); N.E. of Shetland, lat. 61° 15′ N., long. 1° 44′ W., 267 fathoms ('*Porcupine*,' 1869, Stat. 66); Hardanger Fiord, Norway, 150–180 fathoms (*A. M. N.*). *Mus. Nor.*

East Finmark, Spitsbergen, Jan Mayen, Kara Sea, 10–459 fathoms (*Sars*); Grinnell Land (*Miers*); Franz Josef Land (*Heller*); Barents Sea and Faroe Channel (*Hoek*); East Greenland (*Lönnberg*).

I am inclined to agree with those writers who would unite the last species and this. If that is done the name given by Goodsir has precedence over *N. Strömii*, Kröyer, see Hoek (**27**) p. 9, Meinert, &c.

15. Nymphon elegans, *Hansen.*

Nymphon gracilipes, G. O. Sars, (**48**) p. 365 (*fide* Sars's name only).
" *elegans*, Hansen, (**18**) p. 165, pl. xviii. figs. 4 *a–d.*
" " G. O. Sars, (**51**) p. 86, pl. ix. figs. 1 *a–g.*
" " Carpenter, (**4**) p. 631.
" " Meinert, (**39**) p. 42.

'Porcupine,' 1869, Stat. 57, lat. 60° 5′ N., long. 6° 17′ W., in 632 fathoms; 'Triton,' 1882, Stat. 9, lat. 6° 5′ N., long. 6° 21′ W., 608 fathoms; these stations are both in the cold area of the Faroe Channel, and therefore not British (*Mus. Nor.*).

Greenland Sea, 118 fathoms (*Hansen*); near Iceland, off Nordland and Lofoten in Norway, Bear Island, Spitsbergen, and Kara Sea, in 40–743 fathoms (*Sars*); East Greenland (*Lönnberg*); Franz Josef Land (*Carpenter*); Denmark Strait (*Meinert*).

16. Nymphon macrum, *Wilson.*

Nymphon macrum, Wilson, (**57**) p. 487, pl. iv. figs. 21–23.
" *brevicollum*, Hoek, (**26**) p. 45, pl. iii. figs. 13–15, pl. xv. figs. 12, 13.
" *macrum*, Hoek, (**29**) p. 4.
" " G. O. Sars, (**51**) p. 89, pl. ix. figs. 2 *a–g.*
" " Norman, (**45**) p. 154.
" " Meinert, (**37**) p. 43.

Gulf of Maine, N.E. America, 110 fathoms (*Wilson*); among Alcyonarians and Corals on the precipices at Rödberg in the Trondhjem Fiord, in 150–250 fathoms (*A. M. N.*); 'Triton,' 1882, Stat. 11, lat. 59° 39′ N., long. 7° 13′ W., in 555 fathoms. *Mus. Nor.*

The 'Triton' dredging referred to is within the British Area, and Hoek (**29**) p. 4, records four specimens from another 'Triton' Station, no. 10, which is also in the warm area and within the boundary of our fauna.

N.E. America, as above, in 85–115 fathoms (*Wilson* and *Hoek*); off west coast of Norway and eastwards as far as Vardö, in 40–191 fathoms (*Sars*); Davis Strait and Denmark Strait, in 315–582 fathoms (*Meinert*); Newfoundland (*Topsent*).

17. NYMPHON STENOCHEIR, sp. n. (Pl. **30**. figs. 1–9.)

Body slender (fig. 1), smooth, lateral processes widely separated, longer than the trunk is broad. Cephalic segment subequal in length to the three posterior segments, neck not slender, widening in front, where the segment is moderately broad; caudal segment scarcely as long as the lateral processes. Oculiferous tubercle (fig. 2) low, truncate above, the angles slightly projecting. Proboscis long, narrow, distally rounded, nearly equal in length to the cephalic segment. Chelifori (figs. 4, 5) slender, with a remarkably slender hand; hand not much shorter than the scape; palm of nearly the same breadth throughout, more than twice as long as the very small and delicate fingers, which are gently bent. Palpi (fig. 3) slender, second and third joints subequal, and the terminal rather longer than the penultimate. False legs (fig. 8) greatly produced, much longer than the body; spines (fig. 9) somewhat elongated, with marginal teeth small and subequal. Ambulatory legs extremely slender, very smooth, with only scattered minute spinules, except at termination of tarsus; length of fore leg 21·5 mm., made up as follows: three coxal joints combined 2·5 mm.; femoral and first tibial each 5 mm., second tibial 7 mm.; tarsal and propodal (fig. 6) each 1 mm.; propodos (fig. 7) six times as long as broad, bearing on basal half four or five spines, each of which is larger than the preceding, beyond this the palm bears numerous spines of small size; the claw is slender, but more than half as long as the palm, the secondary claws are quite rudimentary, not larger in size than the spines at the end of the propodos. Length of body 4·75 mm., of proboscis 1·5 mm.

This is a strongly characterized species, and taking jointly into consideration the characters of chelifori, spines of false legs, and the propodos of ambulatory legs, with the very minute auxiliary claws, it is difficult to say what described form is its nearest ally.

A single specimen was taken by the 'Porcupine,' 1869, in the Faroe Channel, Stat. 64, lat. 61° 21′ N., long. 3° 44′ W., in 640 fathoms.

18. NYMPHON SARSII, *Meinert*.

Nymphon Sarsii, Meinert, (**57**) p. 38, pl. iii. figs. 1–6.

A single specimen only known, taken by the 'Ingolf' Expedition between the Faroe Isles and Iceland, lat. 63° 4′ N., long. 9° 22′ W., in 262 fathoms (*Meinert*).

19. NYMPHON HOEKII, *Meinert.*

Nymphon Hoekii, Meinert, (**57**) p. 39, pl. iii. figs. 7–13.

Two specimens taken in the middle of the Denmark Strait, lat. 65° 14′ W., long. 30° 39′ W., in 752 fathoms (*Meinert*).

20. NYMPHON MICRONYX, *G. O. Sars.*

Nymphon micronyx, Sars, (**51**) p. 91, pl. xi. figs. 3 *a–g.*

The types, and as yet only known specimens of this species, were taken by Nordenskjöld's Expedition of 1875–6 in the Matotschin-Skarr Strait, in 2–15 fathoms (*Sars*).

21. NYMPHON LONGIMANUM, *G. O. Sars.*

Nymphon longimanum, Sars, (**50**) no. 29.
" " Sars, (**51**) p. 93, pl. x. figs. 1 *a–f.*
" " Lönnberg, (**34***) p. 356.

Kara Sea, 60 fathoms (*Sars*) ; East Greenland, 1–10 metres (*Lönnberg*).

22. NYMPHON GRACILE, *Leach.*

Nymphon gracile, Leach, (**35**) p. 45, pl. xix. fig. 1, ♂.
" *femoratum,* Leach, (**35**) p. 45, pl. xix. fig. 2, ♀.
? *Nymphon gracile,* H. Milne-Edwards, Hist. Nat. Crust. vol. iii. p. 533, pl. xli. fig. 7.
Nymphon gallicum, Hoek, (**28**) p. 501, pl. xxiii. figs. 6–9, and pl. xxx. fig. 41.

I have examined the type-specimens of the two species of Leach in the British Museum. They are the male and female of the same species which was subsequently named by Hoek *N. gallicum.* The figures of the latter author are very good. It is a shore and shallow-water form, and is a much larger species than *N. rubrum*, and belongs to an entirely different section of the genus, characterized by the longer and more slender chelæ of the *N. Strömii* allies. This is the species which was understood by Mr. Hodge and myself to be *N. gracile* forty years ago, at the time when Mr. Hodge described his *Nymphon rubrum.*

Herm (as *N. gracile*, 1861, *Hodge*) ; St. Clement's Bay, Jersey, 1865, Plymouth and Starcross, Devon (*A. M. N.*) ; Co. Kerry and Bantry, Ireland (*G. H. Carpenter*). *Mus. Nor.*

It will be seen that I have now in my collection a specimen from Herm, given me by Mr. Hodge forty-one years ago under the name *Nymphon gracile.* It was in 1865 that he described his *Nymphon rubrum.* Hoek mistook the species, and subsequent writers have generally adopted his mistaken views.

Irish Sea (*Halhed*). Professor G. H. Carpenter (**2** & **6***) records it from many places on the West Coast of Ireland ; Hoek from Roscoff and Ile Verte, Brittany, and Schimkewitsck (**52**) from Cap de las Vergines, 'Vettor Pisani'; Hansen from Denmark.

23. NYMPHON SERRATUM, *G. O. Sars.*

Nymphon serratum, Sars, (**49**) p. 471, (**51**) p. 95, pl. x. figs. 2 *a–h*.
" " Hoek, (**27**) p. 16, pl. i. figs. 24–28, pl. ii. fig. 29.
" " Hansen, (**18**) p. 161, pl. xviii. figs. 2 *a–c*.
" " Meinert, (**37**) p. 37.

'Valorous,' Expedition off Disco, Greenland, 175 fathoms (*Mus. Nor.*).

Barents Sea (*Hoek*); Kara Sea and Davis Strait (*Hansen*); between Beeren Island and Spitsbergen in 146–180 fathoms (*Sars*); Spitsbergen (*Möbius*); Denmark Strait, 204–267 fathoms (*Meinert*).

24. NYMPHON MEGALOPS, *G. O. Sars.*

Nymphon megalops, Sars, (**48**) p. 366, (**51**) p. 98, pl. x. figs. 3 *a–g*.
" " Meinert, (**37**) p. 37.

A cotype from the Norwegian North Atlantic Expedition received from Professor Sars (*Mus. Nor.*).

N.W. of Finmark and S.W. of Spitsbergen, 299–743 fathoms, near Iceland; Greenland Sea (*Sars*); Denmark Strait (*Meinert*).

25. NYMPHON PARASITICUM, *Martens.*

Nymphon parasiticum, Martens (Hugo), Mitt. Zool. Stat. Neapel, vol. xviii. 1906, p. 136, pl. vii. figs. 1–6.

This is merely the parasitic stage of a species in *Tethys leporina*; the adult is not yet known.

Genus 2. CHÆTONYMPHON, *G. O. Sars*, 1888.

1. CHÆTONYMPHON HIRTUM (*Fab.?*) (*Kröyer*).

? *Nymphon hirtum*, O. Fabricius, Entom. systemat. vol. iv. p. 417.
Nymphon spinosum, Goodsir, (**11**) p. 139, pl. iii. fig. 3, and (**13**) p. 3, pl. i. figs. 17, 18.
" *hirtum*, Kröyer, (**33**) pl. xxxvi. figs. 3 *a–g*.
" *pallenoides*, Sars, (**49**) p. 470.
" " Wilson, (**59**) p. 254, pl. iii. fig. 14.
" *hirtum*, Hansen, (**18**) p. 161 note.
Chætonymphon hirtum, Sars, (**51**) p. 101, pl. xi. figs. 1 *a–g*.
" " Norman, (**45**) p. 154.
" " Hoek, (**29***) p. 297, pl. iii. figs. 14–19.

In the paper just mentioned Hoek in 1898 records the occurrence of *C. hirtum* off Margate, and regards the fact of its living there as something wholly unexpected; but although the species had not been observed so far south as this, yet the eastern coast of England would appear to be the district in which it occurs most frequently. In 1894 in my paper on the fauna of the Trondhjem Fiord (**45.** p. 154) there will be found a list of the localities in which *C. hirtum* had been met with on the British coast, and I expressed the opinion that *Nymphon spinosum* of Goodsir was this species, and not that to which Sars had referred it, inasmuch as the only *Chætonymphon* of which there is any record of occurrence on our east coast is *C. hirtum*, and that in my collection I had this species from the Firth of Forth, whence Goodsir procured the species which he named. *C. hirtum* was recorded as living on the British coasts between thirty and forty years ago both by the late Mr. George Hodge (**22**. p. 28 & **24**. p. 41) and by myself (**43**. p. 301), on the east coast of England and at Shetland.

Specimens are at the present time in my possession from Shetland (**43**) and Cullercoats, Northumberland (*A. M. N.*), off Ryhope, Co. Durham (*G. Hodge*), Firth of Forth (*Dr. Henderson*), Aberdeenshire (*R. Dawson*). *Mus. Nor.*

Montrose, East Haven (*D'Arcy Thompson*) ; Irish Sea (*Carpenter*) ; Norway in 80–90 fathoms (*Sars*) ; Iceland (*Kröyer*).

2. CHÆTONYMPHON HIRTIPES (*T. Bell*).

Nymphon hirtipes, Bell, Last of the Arctic Voyages—Crustacea, p. 403, pl. xxxv. fig. 3.
„ „ Wilson, (**58**) p. 22, pl. v. figs. 2, 3; pl. vi. figs. 2 *a–b*.
„ *hirtum*, Wilson, (**57**) p. 495, pl. vii. figs. 38–41.
„ *hirtipes*, Hansen, (**18**) p. 159.
„ „ Hoek, (**27**) p. 6, pl. i. figs. 1–8.
Chætonymphon hirtipes, Sars, (**51**) p. 103, pl. xi. figs. 2 *a–k*.
Nymphon spinosum, Meinert (nec Goodsir), (**37**) p. 44.

Off Halifax, Nova Scotia, (*Wilson*) ; Bog Fiord, 100–120 fathoms, and Varanger Fiord, 125 fathoms, both in East Finmark (*A. M. N.*) ; off Disco, Greenland, 175 fathoms ('*Valorous*' Expedition, 1875). 'Porcupine' Exped. 1869, Stats. 64, 65, 78, 88, in from 290 to 705 fathoms: of these the first station was in the Faroe Channel, the second and third were just on the border of the British Area, while the last in lat. 59° 26′ N., long 8° 23′ W., makes the species a member of our fauna. *Mus. Nor.*

Arctic Norway, Jan Mayen, Kara Sea, 50–100 fathoms, Spitsbergen, Iceland (*Sars*); Siberian and Polar Sea (*Stuxberg*); Novaya Zemlia (*Hansen*); Franz Josef Land (*Carpenter*); White Sea, Murman Coast, and Karl Konigs Land (*Möbius*) ; East Greenland (*Lönnberg*) ; Greenland (*Miers & Rodger*) ; N.E. America (*Bell & Wilson*).

3. CHÆTONYMPHON SPINOSISSIMUM, *Norman*.

Chætonymphon spinosum, Sars (nec Goodsir), (**51**) p. 107, pl. xi. figs. 3 *a–i*.
„ *spinosissimum*, Norman, (**45**) p. 154.

Meinert (**37**) and Möbius have united this species with the foregoing. I cannot acquiesce in that view ; and indeed Meinert's own statement hardly agrees with his conclusion. He says that he has had the opportunity of examining a very large number of specimens, and he writes respecting them :

"The species is somewhat variable ; but I find no sufficient reason to divide the forms belonging hither into two species, as has been done by Sars, even if I have to acknowledge that most of the specimens found and examined can tolerably well or decidedly be said to belong either to the *N. spinosum* of Sars or to his *N. hirtipes*, as these species are diagnosticated and described in his last large and excellent work."

Hardanger and Trondhjem Fiords, Norway, in 120–190 fathoms (*A. M. N.*). N.E. America, lat. 44° 35° N., long. 57° 13′ W., 150 fathoms (*U.S. Nat. Mus.*). 'Porcupine,' 1869, Stat. 78°, lat. 60° 14′ N., long. 4° 30′ N., 290 fathoms, and Stat. 88, lat. 59° 26′ N., long. 8° 23′ W., in 705 fathoms. It is therefore to be added to the British fauna. *Mus. Nor.*

Norwegian coast from Stavanger to Tjötö in Nordland (*Sars*).

4. CHÆTONYMPHON TENELLUM, *G. O. Sars.*

Chætonymphon tenellum, Sars, (**50**) p. 353 ; and (**51**) p. 169, pl. xii. figs. 1 *a–h*.
Nymphon tenellum, Meinert, (**37**) p. 45.

'Porcupine' 1869, Stat. 51, lat. 60° 5′ N., long. 80° 14′ W., in 440 fathoms. *Mus. Nor.*

The station referred to is only 0° 5′ northward of the British Area, and as, moreover, it is situated in the warm water south of the Faroe Channel, there can be little doubt that the species may be added to our fauna *.

Two specimens dredged in the sea west of Finmark in 620 fathoms (*Sars*) ; south of Davis Strait in 420–600 fathoms (*Meinert*).

5. CHÆTONYMPHON MACRONYX, *G. O. Sars.*

Nymphon macronyx, Sars, (**48**) p. 365.
" " Hoek, (**26**) p. 95, pl. xv. figs. 1–7.
" " Hansen, (**18**) p. 167, pl. xviii. figs. 6 *a–c*.
Chætonymphon macronyx, Sars, (**51**) p. 111, pl. xii. figs. 2 *a–k*.
Nymphon macronyx, Meinert, (**37**) p. 43.

'Triton' Expedition 1882, lat. 60° 5′ N., long. 6° 21′ W., 608 fathoms, and 59° 30′ N., long. 7° 13′ W., in 555 fathoms (*Mus. Nor.*).

This last locality is in the warm area, bottom temperature 45°·5 Fahr. ; and within the limits of our seas. I have five specimens received from Sir John Murray as from this locality, and they have a different aspect from those taken at Stat. 9, being paler in colour and much more transparent. This is worthy of notice because Hoek, having seen only a single specimen of each of the two species *Chætonymphon macronyx* and *Boreonymphon robustum* from the warm area, with wise caution thought the evidence insufficient to prove

* In a 'Catalogue of Crustacea and Pycnogonida of University College, Dundee,' by Professor D'Arcy Thompson, C.B., after *Chætonymphon tenellum* is given as a locality "Ireland." On enquiry, Prof. Thompson informs me that "Ireland" is a misprint for "Iceland."

that they really lived south of the cold depths of the Faroe Channel. He wrote (**29.** p. 1) :—"*Nymphon macronyx*, G. O. Sars is represented by hundreds of specimens from the cold area and by one specimen only from the warm area; and this is also the case with *Nymphon robustum*, Bell. Of both species the number of specimens collected at stations in the cold area was so large, that the occurrence of one specimen at a station in the warm area seems rather unimportant—it must be considered as a specimen which has got astray; but whether this happened before or after its being dredged I cannot say with certainty. As in both cases the station in the warm area from which the single specimen was obtained follows one in the cold area from which several hundred specimens of the one and upwards of fifty of the other species were collected, it is even probable that the same fishing apparatus (trawl) being used—one specimen was overlooked, either remaining between the meshes of the trawl, or clinging to the rope. The nature of the animals with their long and numerous legs, each furnished with a claw, favours this suggestion."

Hoek's caution is greatly to be commended; and I should not have had much hesitation in applying it to even the four examples from the warm area in my collection, if it had not been that they were distinctly different from those in the cold area in their paler colour and much greater transparency.

A male from the cold area is curiously abnormal, the ocular tubercle is altogether absent, not a vestige of it can be seen.

Off the northern portion of the Norwegian coast, off Spitsbergen and in the Kara Sea (*Sars*); Faroe Channel (*Hoek*); Jan Mayen (*Meinert*); East Greenland (*Lönnberg*); Davis Strait (*Rodger*); Franz Josef Land (*Carpenter*).

Genus 3. Boreonymphon, *G. O. Sars*, 1888.

Boreonymphon robustum (*T. Bell*).

Nymphon robustum, T. Bell, Belcher's 'Last of the Arctic Voyages,' vol. ii. p. 409, pl. xxxv. fig. 4.
Nymphon abyssorum, Norman, (**44**) p. 129, woodcut.
,, *hians*, Heller, (**20**) p. 17, pl. v. figs. 3–6 (separate copy).
,, *robustum*, G. O. Sars, (**48**) p. 365.
,, ,, Hoek, (**27**) p. 20, pl. ii. figs. 35–40.
,, ,, Hansen, (**18**) p. 158, pl. xviii. fig. 1.
,, ,, Hoek, (**29**) p. 3.
Boreonymphon robustum, Sars, (**51**) p. 115, pl. xii. figs. 3 *a–d*.
,, ,, Norman, (**45** *) p. 167.

'Porcupine,' taken at Stations 52, 55, 57, 59, 61, 64, 65, the whole of which were in the Faroe Channel; and as it was not taken by the 'Porcupine' anywhere south of the Wyville-Thomson Ridge, additional weight is given to the suggestion of Hoek (see under *Chætonymphon macronyx*) that the single specimen said to have been procured by the 'Triton' in the warm area was by error assigned to that locality. I may say that Stat. 65 is exactly on the border-line of the British area as regarded by myself, but the bottom temperature being only 30° Fahr. at a depth of 345 fathoms, it more properly belongs to the cold area. 'Triton,' Stat. 9, Faroe Channel, 608 fathoms; Varanger Fiord, East Finmark, in 125 fathoms (*A. M. N.*). *Mus. Nor.*

Wellington Channel (*Bell*); Kara Sea; N.W. of Spitsbergen; near Iceland, 260–649 fathoms (*Sars*); Barents Sea (*Hoek*); Franz Josef Land (*Heller*); König Karls Land (*Möbius*); Denmark Strait (*Meinert*); East Greenland (*Lönnberg*); West Greenland (*Rodger*).

Genus 4. Paranymphon, *Caullery*, 1896.

Caullery, (**7**) p. 363, and Meinert, (**37**) p. 46.

The only character which Caullery gave for his new genus was that the palpi were composed of six joints. Meinert has already shown that the statement was not correct, for they are really composed of seven joints. Other characters were added by this latter author, namely, that the processes of the trunk are very long; the chelæ bent backwards, with few and weak teeth; the ovigerous legs eight-jointed and furnished with claws: and the ambulatory legs without auxiliary claws.

Paranymphon spinosum, *Caullery*. (Pl. **30**. figs. 10–14.)

Paranymphon spinosum, Caullery, (**7**) p. 361, pl. xii. figs. 1–6.
" " Meinert, (**37**) p. 46, pl. iv. figs. 20–28.

The description of Caullery was very brief. Meinert has extended it. The following note will add some particulars.

The body is moderately robust, with unusually long lateral processes; these processes are distally furnished with a remarkable long fleshy lobe, which is beset with minute tubercles; these lobes are so long that if extended along the limb they reach the middle of the second coxal joint (fig. 10). The oculiferous tubercle is in the form of a greatly produced cone, the height of which is equal to the length from its own base to the end of the proboscis; no vestige of eyes is to be seen. The abdomen, like the oculiferous tubercles, is pyramidal in form and carried directly upwards; it is of remarkable length, equalling in fact that of the rest of the body exclusive of the proboscis (fig. 10). The proboscis is short and broad, the width at the base being subequal to its length, it does not reach the end of the scape of the chelifori. The chelifori (fig. 13) have the hand much shorter than the scape; the palm not longer than broad, the chela is gaping; the movable finger longer than the thumb, the former with some teeth mostly at the base, the latter with teeth most developed in the middle portion; the extremities of both acute. The palpi are seven-jointed, the distal joints are represented in Meinert's fig. 24. The false legs consist of nine joints (counting the terminal nail as one); and Meinert's fig. 26 fairly represents the distal portion; there is an entire absence of the serrated flattened spines so characteristic of most genera. The ambulatory legs have the second coxal joint, as usual, about twice as long as the first and third; the femoral and tibial joints are subequal in length, the second tibial slightly the longer; the tarsus does not quite equal the propodos in length; these joints are very slender, and gradually attenuated until they terminate with the long, slender sharp nail (fig. 14); the propodos is not armed with any conspicuous spines, and the nail is entirely destitute of supplementary claws.

Caullery described and figured some objects which he regarded as clavate-formed spinules. Meinert came to the conclusion that what Caullery saw were simply spines with mud attached to their summits. He is most likely right. They may have been a condition of the objects which I am about to describe, but as far as my example shows these latter are not present on the palpi, the position which Caullery's club-shaped spines held; and Meinert's fig. 24 correctly represents the last five joints of the palpi.

The specimen of this species which was dredged by the 'Porcupine' was mounted in gelatine shortly afterwards. The whole body in this specimen, including the lateral processes, is covered with remarkable stalked stellate bodies (fig. 11 represents portions of two lateral processes). They do not appear to be spines, and if they were they might be compared with the extraordinary covering of stellate spines which Dr. Calman has recently made known to exist on the carapace of a new Cumacean, *Pseudodiastylis ferox* *. But the bodies on *Paranymphon* have a very different appearance from spines; fig. 12 represents one of them greatly magnified: they appear as though directly connected with the dermis of the *Paranymphon*, to be flexible, and to be in different degrees of expansion or contraction. Whether they really are parts of the animal itself, or whether they are parasites upon it, is a question which I am quite unable to decide, and which the future must be left to determine. In my perplexity I sent this mounted specimen to Copenhagen and asked Dr. Hansen to compare it with the numerous specimens collected by the 'Ingolf' Expedition. The Copenhagen specimens did not show similar conditions, but the naturalists there were equally unable with myself to determine what these peculiar organs or organisms are. Three of the 'Ingolf' specimens were kindly given me by the authorities of the Copenhagen Museum; on them I can find no stellate bodies, but just in the same positions I find the body and its lateral processes covered with minute punctures, which it is *possible* are the stellate bodies in a closely contracted state.

'Porcupine,' 1869, Stat. 17, lat. 54° 28′ N., long. 11° 44′ W., in 1230 fathoms. This locality lies S.S.E. of Rockall, and in the British Area.

The three specimens procured by the 'Caudan' were from as many stations in the Bay of Biscay. By the 'Ingolf' Expedition it was dredged in Davis

* Calman, The Cumacea of the 'Siboga' Expedition, 1905.

Strait, lat. 63° 30′ N., long. 54° 25′ W., in 582 fathoms, and also off the south-eastern side of Greenland, lat. 64° 56′ N., long. 36° 19′ W., in 204 fathoms.

Order II. CRYPTOCHELATA, *Sars.*

Family 1. AMMOTHEIDÆ.

Genus 1. AMMOTHEA, *Leach*, 1815.
=Alcinous, *O. G. Costa*=Achelia, *Hodge*.

1. AMMOTHEA VULGARIS (*O. G. Costa*).

Alcinous vulgaris, O. G. Costa, (**8**) p. 11, pl. ii A. fig. 1.
Ammothea franciscana, A. Dohrn, (**9**) p. 135, pl. iii. figs. 1–7.

Naples (cotypes *Dohrn*). *Mus. Nor.*

2. AMMOTHEA ECHINATA (*Hodge*).

? *Parabœa spinipalpis*, Philippi, Archiv f. Naturgesch. lx. Jahrg. 1843, p. 178, pl. ix. fig. 3, ♀.
? *Zetes spinosa*, Stimpson, Invert. Grand Manan, p. 37.
? *Ammothea pycnogonoides*, Quatrefages, Mémoire sur l'Organisation des Pycnogonides, Ann. des Sci. Nat. ser. 3, vol. iv. 1845, p. 71, pl. i. figs. 1, 2, pl. ii. figs. 2, 3.
Achelia echinata, Hodge, (**23**) p. 197, pl. iv. figs. 7–10.
Ammothea brevipes, Hodge, (**23**) p. 196, pl. iv. figs. 1–4 (*juvenis*).
Achelia echinata, Grube, (**14**) p. 27.
Ammothea achelioides, Wilson, (**58**) p. 16, pl. v. figs. 1 *a–e*; and (**57**) p. 484, pl. iv. figs. 19, 20 (*juvenis*).
Achelia spinosa, Wilson, (**58**) p. 7, pl. ii. figs. 1 *a–h*; and (**57**) p. 473, pl. i. fig. 4, pl. ii. fig. 8.
Ammothea echinata, Hoek, (**28**) p. 568, pl. xxv. figs. 14–16 (*adult et juv.*).
" *fibulifera*, Dohrn, (**9**) p. 141, pl. iv. figs. 1–22.
" *echinata*, G. O. Sars, (**51**) p. 120, pl. xiii. figs. 1 *a–m*.
" " Meisonheimer (J.), Beit. z. Entwick. d. Pantopoden, Zeits. f. Wiss. Zool. vol. lxxii. (1902) pp. 193–248, pls. xiii.–xvii.

Jersey; Isle of Wight; Starcross, Salcombe and Plymouth, Ilfracombe; Isle of Cumbrae; Roundstone, Ireland; Naples (*A. M. N.*). Channel Islands and Seaham (cotypes of "*Achelia echinata*" from *Hodge*). Naples (cotypes of "*A. fibulifera*," Dohrn). *Mus. Nor.*

Other localities are Irish Sea (*Halhed*), Ballynakill and other parts of Ireland (*Carpenter*), west coasts of France and Holland (*Hoek*), west coast of Norway in many places (*Sars*), St. Vaast de la Hougue (*Grube*).

3. AMMOTHEA SCABRA (*Wilson*).

Achelia scabra, Wilson, (**57**) p. 475.

One male dredged fifteen miles off Cape Ann, N.E. America, in 23 fathoms, and one female on St. George's Bank in 45 fathoms (*Wilson*).

4. Ammothea hispida (*Hodge*).

Achelia hispida, Hodge, (**23**) p. 197, pl. v. fig. 11.
Ammothea longipes, Hodge, (**23**) p. 196, pl. iv. figs. 5, 6 (*juvenis*).
" " Grube, (**14**) p. 25, pl. i. figs. 4 *a–c*.
" *magnirostris*, Dohrn, (**9**) p. 147, pl. vi. figs. 1–11.

Gouliot Caves, Sark, 1865 (*A. M. N.*); Starcross, Devon, 1883 (*C. Parker*). *Mus. Nor.*

Naples (*Dohrn*); St. Vaast de la Hougue (*Grube*).

There can I think be little doubt that *Ammothea magnirostris* of Dohrn is the *Achelia hispida* of Hodge. The most marked characteristic of the species consists in the large fleshy tubercles, one of which is situated on each lobe of the body, but these are not easily seen in unmounted and dirty specimens, and were overlooked by Hodge. The substitution of hairs for spines on the legs distinguishes the present from the preceding species and from *A. Langi.*

The front margin of the cephalic segment is abruptly truncate, but the corners are produced forwards into lobes (see Dohrn, pl. vi. figs. 1 & 3); the ocular tubercle is less elevated than in its allies; the rostrum is wide centrally as well as at its termination, and somewhat contracted at the base. The palpi are very long, and when extended forwards surpass the length of the rostrum by three and a half or four joints; the five terminal joints are subequal in length to each other. In immature specimens the chelifori are remarkably long for the genus, and the chela itself is widely gaping, and the inner margin of the finger quite simple. What appears to be a peculiarity in the species is that the rostrum is often bent downwards, and the palpi turned completely backwards underneath the body, so as to be quite invisible from the dorsal view.

5. Ammothea borealis, *Schimkewitsch*.

Ammothea borealis, Schimkewitsch, C. R. Soc. St. Pétersb. 1895, 'On some forms of Pantopoda' (in Russian), p. 36, pl. ii. figs. 2, *a*, *b*.

The White Sea (*Schimkewitsch*).

Apparently this is closely allied to *A. hispida*, if it be not the same.

6. Ammothea Langi, *Dohrn*.

Ammothea Langi, Dohrn, (**9**) p. 146, pl. v. figs. 1–8.

Naples (cotypes *Dohrn*). *Mus. Nor.*

7. Ammothea lævis (*Hodge*).

Achelia lævis, Hodge, (**23**) p. 197, pl. v. fig. 12.
Ammothea lævis, G. O. Sars, (**51**) p. 124, pl. xiii. figs. 2 *a–m*.

Polperro, Cornwall (cotypes as "*Achelia lævis*," G. Hodge). Jersey (*A. M. N.*). Starcross, Devon (*C. Parker*). *Mus. Nor.*

Christiansund, West Norway, in 20–30 fathoms (*Sars*). Böhm (**1**) has recorded this species from Kerguelen. Irish Sea (*Halhed*).

8. AMMOTHEA APPENDICULATA, *Dohrn.*

Ammothea appendiculata, Dohrn, (**9**) p. 152, pl. vii. figs. 1–5.

Naples (cotypes *Dohrn*). *Mus. Nor.*

9. AMMOTHEA UNIUNGUICULATA, *Dohrn.*

Ammothea uniunguiculata, Dohrn, (**9**) p. 155, pl. vii. figs. 1–5.

Naples (*Dohrn*).

10. AMMOTHEA BIUNGUICULATA, *Dohrn.*

Ammothea biunguiculata, Dohrn, (**9**) p. 158, pl. viii. figs. 1–3.

Naples (*Dohrn*).

Genus 2. TANYSTYLUM, *Miers*, 1879 = Clotenia, *Dohrn*, 1881.

TANYSTYLUM ORBICULARE, *E. B. Wilson.*

?? *Pasithoe umbonata*, Gould, Proc. Boston Soc. Nat. Hist. vol. i. p. 92.
Tanystylum orbiculare, Wilson, (**58**) p. 5, pl. ii. figs. 2 *a–f*; (**57**) p. 471, pl. iii. figs. 11 *a–f*.
Clotenia conirostris, Dohrn, (**9**) p. 164, pl. viii. figs. 4–11, pl. ix. figs. 1–5.
Tanystylum conirostre, Carpenter, (**3**) p. 297, pl. vi. figs. 1–5.
? *Tanystylum Hoekianum*, Schimkewitsch, (**53**) p. 44, pl. ii. figs. 5 *a–c*.

Wood's Hole, Massachusetts (from U.S. Nat. Mus.). Naples (cotype "*Clotenia conirostris*," Dohrn). *Mus. Nor.*

Wilson says that on the American coast *Tanystylum orbiculare* extends from Martha's Vineyard to Virginia, and that it is almost invariably found on Hydroids or Ascidians growing on piles of wharves, etc., down to 14 fathoms. At Naples I took it near Castell dell' Uovo. It was added to our fauna by Mr. J. E. Duerden, who found two specimens at Bundoran, in Donegal Bay, and sent them to Mr. G. H. Carpenter.

Genus 3. TRAGÆUS, *A. Dohrn*, 1881.

TRAGÆUS COMMUNIS, *Dohrn.*

Tragæus communis, Dohrn, (**9**) p. 164, pl. ix. figs. 6–14, pl. x. figs. 1–5.

Naples (cotypes from *Dohrn*, and *A. M. N.*). *Mus. Nor.*

Genus 4. RHYNCHOTHORAX, *O. G. Costa*, 1861.

RHYNCHOTHORAX MEDITERRANEUS, *O. G. Costa.*

Rhynchothorax mediterraneus, Costa, (**8**) p. 7, pl. i. figs. 1, 2.
" " Dohrn, (**9**) pl. xvii. figs. 1–9.

Naples (*Dohrn*). *Mus. Nor.*

Family 2. Eurycididæ.

Genus 1. Eurycyde, *Schiödte*, 1857 = Zetes, *Kröyer*, 1844 (preoccupied).

Eurycyde hispida (*Kröyer*).

Zetes hispidus, Kröyer, (**32**) p. 108, (**33**) pl. xxxviii. figs. 1 *a–h*.
Eurycyde hispida, Schiödte, Nat. Bidrag till en Beskrivelse af Grönland, 1857, p. 71.
„ „ Hansen, (**18**) p. 171, pl. xix. figs. 1 *a–h*.
„ „ Sars, (**51**) p. 128, pl. xiv. figs. 1 *a–g*.

Kara Sea (*Copenhagen Museum*). *Mus. Nor.*
Greenland (*Kröyer*); Christiansund and two localities further north on the coast of Norway, Kara Sea (*Sars*); Murman Coast (*Jarzynsky*); König Karls Land (*Möbius*); Davis Strait (*Rodger*).

Genus 2. Barana, *A. Dohrn*, 1881.

1. Barana castelli, *Dohrn*.

Barana castelli, Dohrn, (**9**) p. 125, pl. i. figs. 1–16, pl. ii. fig. 1.

Naples (cotypes *Dohrn*). *Mus. Nor.*
Found at two or three places in the Bay of Naples (*Dohrn*).

2. Barana arenicola, *Dohrn*.

Barana arenicola, Dohrn, (**9**) p. 129, pl. ii. figs. 2–8.

Naples (cotype *Dohrn*). *Mus. Nor.*

Genus 3. Ascorhynchus, *G. O. Sars*, 1876.

1. Ascorhynchus abyssi, *Sars*.

Ascorhynchus abyssi, Sars, (**48**) No. 8; (**50**) No. 41; and (**51**) p. 133, pl. xiv. figs. 2 *a–t*.

Numerous specimens taken by the Norwegian North Atlantic Expedition in from 1081 to 1539 fathoms, between Norway and Faroe and Iceland, and further north between Spitsbergen and Beeren Island on the east and Jan Mayen and Greenland on the west (*Sars*).

2. Ascorhynchus tridens, *Meinert*.

Ascorhynchus tridens, Meinert, (**37**) p. 55, pl. v. figs. 7–18.

'Ingolf' Exped. (cotypes *Meinert*). *Mus. Nor.*
This was taken by the 'Ingolf' in the same area in which Sars found *A. abyssi*, and also in the south-eastern part of the Greenland Sea. It seems very doubtful if it is a distinct species.

Genus 4. SCÆORHYNCHUS, *E. B. Wilson*, 1881.

SCÆORHYNCHUS ARMATUS, *E. B. Wilson.*

Scæorhynchus armatus, Wilson, (**59**) p. 245, pl. ii. figs. 3, 4, pl. v. figs. 26–31.

Four males and five females from lat. 41° 24′ N., long. 60° 35′ W., in 1242 fathoms.

This genus appears to be closely related to the preceding, but differs in having well-developed chelæ to the chelifori of the male.

Family 3. COLOSSENDEIDÆ.

Genus COLOSSENDEIS, *Jarzynsky*, 1870.

1. COLOSSENDEIS PROBOSCIDEA (*Sabine*).

Phoxichilus proboscideus, Sabine, Suppl. to Appendix Capt. Parry's Voyage, p. 226.
Colossendeis borealis, Jarzynsky, (**30***) (*fide* Sars).
„ *proboscidea*, Sars, (**48**) p. 368; and (**50**) no. 42.
Anomorhynchus Smithii, Miers, (**39**) p. 50, pl. vii. figs. 6–8, and p. 264.
Colossendeis proboscidea, Hoek, (**26**) p. 98.
„ „ Hoek, (**27**) p. 22, pl. ii. figs. 41, 42.
„ „ Hansen, (**18**) p. 174.
„ „ Sars, (**51**) p. 138, pl. xv. figs. 1 *a–d*.
„ „ Carpenter, (**4**) p. 633.
„ „ Meinert, (**37**) p. 59, pl. v. figs. 21, 22.

Kara Sea (*Copenhagen Museum*). *Mus. Nor.*

Its known distribution is as follows: To the south of Greenland (*Parry*); off Storeggen Bank, W. Norway, 412 fathoms (*Sars*); Murman Coast (*Jarzynsky*); Siberian Polar Sea (*Stuxberg*); Franz Josef Land (*Miers & Carpenter*); Barents Sea and Faroe Channel (*Hoek*); Kara Sea and North Greenland (*Hansen*); near Jan Mayen (*Meinert*); near Beeren Island (*Möbius*).

2. COLOSSENDEIS ANGUSTA, *G. O. Sars*.

Colossendeis angusta, G. O. Sars, (**48**) p. 368.
„ „ Wilson, (**59**) p. 243, pl. iii. figs. 8 & 13.
„ „ Hoek, (**29**) p. 5, pl. i. fig. 8.
„ „ Hansen, (**18**) p. 175.
„ „ Sars, (**51**) p. 140, pl. xv. figs. 2 *a–f*.
„ „ Meinert, (**37**) p. 59.

'Porcupine,' 1869, locality lost. 'Triton,' 1882, Faroe Channel, lat. 60° 18′ N., long. 6° 15′ W., 640 fathoms (*Mus. Nor.*).

'Hirondelle,' lat. 46° 4′ N., lat. 49° 2′ W., near Newfoundland (*Topsent*). Atlantic, off W. Norway, and N.W. of Beeren Island, 417–658 fathoms (*Sars*). Kara Sea (*Hansen*). Off N.E. America down to as far south as lat. 38° 15′ N., long. 73° 18′ W., and in depths from 810 to 1242 fathoms (*Wilson*). Near Jan Mayen and south of Iceland (*Meinert*).

3. Colossendeis colossea, *E. B. Wilson.*

Colossendeis colossea, Wilson, (**59**) p. 244, pl. i. fig. 1, pl. iii. figs. 5–8.
„ „ Meinert, (**37**) p. 58.

'Blake' Expedition at five stations from lat. 41° 33′ N., long. 65° 51′ W., in 810 fathoms, southwards to lat. 39° 43′ N., lat. 70° 55′ W., in 1002 fathoms (*Wilson*); and by the 'Ingolf' it was dredged in 1300 fathoms in the Denmark Strait, and at lat. 61° 44′ N., long. 30° 29′ W., 1135 fathoms (*Meinert*). Newfoundland (*Topsent*).

4. Colossendeis clavata, *Meinert.*

Colossendeis clavata, Meinert, (**37**) p. 57, pl. v. figs. 19, 20.

'Ingolf' Expedition, lat. 62° 6′ N., long. 19° W., that is in the Atlantic to the south of Iceland, 1041 fathoms (*Meinert*).

5. Colossendeis macerrima, *E. B. Wilson.*

Colossendeis macerrima, Wilson, (**59**) p. 246, pl. i. fig. 2, pl. iii. figs. 9–12, pl. v. fig. 32.
„ „ Meinert, (**37**) p. 60.

A single specimen taken by the 'Blake' in 922 fathoms at lat. 38° 18′ N., long. 73° 18′ W. (*Wilson*). Between Iceland and Greenland in the Denmark Strait, and in the mouth of Bredebugt, Iceland, in the former case in 1300 fathoms and in the latter in 76 fathoms (*Meinert*).

6. Colossendeis minuta, *Hoek.*

Colossendeis minuta, Hoek, (**26**) p. 73, pl. x. figs. 12–14.

Dredged by the 'Challenger,' lat. 42° 8′ N., long. 63° 39′ W., *i. e.*, about two degrees south of Halifax, Nova Scotia, in 1250 fathoms (*Hoek*).

7. Colossendeis leptorhynchus, *Hoek,* var. septentrionalis, *Caullery.*

Colossendeis leptorhynchus, var. *septentrionalis,* Caullery, (**7**) p. 362, pl. xii. fig. 7.

Dredged by the 'Caudan' in 1710 metres in the Bay of Biscay. It seems impossible to make anything out of this. *C. leptorhynchus* is only as yet known from specimens taken by the 'Challenger' at many stations ranging from 33 to 51 degrees south of the equator. It is possible that the 'Caudan' species may be *C. macerrima* of Wilson.

8. Colossendeis gigas, *Hoek.*

Colossendeis gigas, Hoek, (**26**) p. 61, pl. viii. figs. 1, 2, pl. x. figs. 1–5.
„ „ Topsent, (**56**) p. 177.

Dredged by the 'Hirondelle,' lat. 40° 8′ N., long. 29° 48′ W., in 1850 metres (*Topsent*).

Order III. ACHELATA, *G. O. Sars.*

Family 1. PYCNOGONIDÆ, *G. O. Sars.*

Genus 1. PYCNOGONUM, *Brünnich*, 1764.

1. PYCNOGONUM LITTORALE, *Ström.*

Pycnogonum littorale, Ström, Physisk og œconomisk Beskrivelse over Fögderiet Söndmör, 1762, p. 209, pl. i. fig. 17.
„ *balænarum,* Linné, Syst. Nat. ed. xii. i. p. 1028.
„ *pelagicum,* Stimpson, Marine Invert. Grand Manan, p. 37 (*immature form*).
„ *littorale,* G. O. Sars, (**51**) p. 7, pl. i. figs. 1 *a–i*.

Sars's figures are excellent and there is no need of extending references for this well-known form.

Specimens in my collection are from Guernsey; Essex Coast; Cullercoats, Northumberland; Isle of Cumbrae; Shetland, very large; Valentia, Ireland (*A. M. N.*). Lat. 59° 23′ N., long. 7° 4′ W., in 374 fathoms ('*Porcupine*,' 1869). Eastport, N.E. America (*Wilson*). *Mus. Nor.*

It is usually a shore or shallow-water species, but sometimes reaches great depths, and it ranges from the west coast of France northwards right round the coasts to the White Sea; found again at Iceland, Greenland, and down the American coast to lat. 41° 30′. Off St. George's Banks it is recorded by Smith and Hargar (U.S. Fish. Comm., 1872) from 406 fathoms. Wilson gives the measurements of a large female as: body (without rostrum) 10 mm., rostrum 5 mm., legs 15 mm. One of my Shetland specimens is slightly larger—body 11 mm., rostrum 6 mm., front leg 15 mm.

2. PYCNOGONUM CRASSIROSTRE, *G. O. Sars.*

Pycnogonum crassirostre, G. O. Sars, (**50**) No. 2; (**51**) p. 12, pl. i. figs. 2 *a–h*.
„ „ Norman, (**45**) p. 151.
„ „ Meinert, (**37**) p. 61.

Kors Fiord, near Bergen, 180 fathoms, 1878; in the Hardanger Fiord, in Stoksund, 80–100 fathoms, and off Midso Lighthouse, 50–100 fathoms, 1879; Rodberg, in Trondhjem Fiord, in about 70 fathoms, 1893 (*A. M. N.*). *Mus. Nor.*

The types described by Sars were found mixed with some *P. littorale*, which he had collected from different parts of the coast.

Meinert records a specimen as taken by the 'Ingolf' Expedition in Denmark Strait, in the mouth of Bredebugt in Iceland, in 70 fathoms.

3. PYCNOGONUM PUSILLUM, *Dohrn.*

Pycnogonum pusillum, Dohrn, (**9**) p. 207, pl. xvi. figs. 4 8.

Naples (cotype *Dohrn*). *Mus. Nor.*

4. PYCNOGONUM NODULOSUM, *Dohrn.*

Pycnogonum nodulosum, Dohrn, (**9**) p. 203, pl. xvi. figs. 1–3.

Bay of Naples (*Dohrn*).

Family 2. ENDEIDÆ.

Genus 2. ENDEIS, *Philippi*, 1843.

=Phoxichilus, *auct. nec Latreille, and* Chilophoxus, *Stebbing,* 1902.

The Rev. T. R. R. Stebbing has in 'Knowledge' (**54***, August 1902, p. 157) introduced certain changes in nomenclature which it is necessary to notice ; and as the publication in which these changes are made is not likely to be seen by naturalists, in justice to him I give here his full statement :—

"Not without some fear of evoking those electric flashes which are ever ready to smite the rash disturbers of long accepted terminology, I must here invite the special attention of naturalists to the new names *Chilophoxus* and Chilophoxidæ and to the cancelling the names Pallenidæ and *Pseudopallene* in favour respectively of Phoxichilidæ and *Phoxichilus.* The last-named genus was instituted by Latreille in the 'Nouveau Dictionnaire d'Histoire Naturelle,' tom. 24. p. 137, as far back as 1804, not as had been stated in 1816. The only species assigned to it was *Pycnogonum spinipes* of O. Fabricius. It is impossible, therefore, to retain *Phoxichilus* apart from that species. Consequently *Pseudopallene*, Wilson, 1878, to which both Sars and Meinert refer the above-named *P. spinipes* of the 'Fauna Grœnlandica,' becomes a synonym of Latreille's far earlier genus, and the family hitherto known as Pallenidæ must be henceforward known as Phoxichilidæ. All species which have been assigned to *Phoxichilus* on the ground of a real generic agreement with Montagu's *Phalangium spinosum*, must now be transferred along with this species to *Chilophorus*, while *Pseudopallene circularis*, Goodsir, will find its place in the true *Phoxichilus* as now reinstated."

Before entering upon Mr. Stebbing's argument let me state that if that argument be considered just, as I believe it to be, *Chilophorus* is at once a synonym, since there is the genus *Endeis* of Philippi, the first species given for which is congeneric at least, if not identical, with *P. spinosum*, Montagu ; the only error in Philippi's description is that he mistook the seven-jointed false feet for palpi (Philippi, Archiv f. Naturg. Jahrg. ix. p. 195).

It is now desirable to examine into the history of the genus *Phoxichilus*—

LATREILLE (Nouv. Dict. d'Hist. Nat. vol. xxiv. 1804, p. 137) :—

"43. Genus Phoxichile, *Phoxichilus.* Dix pattes, les antérieures beaucoup plus petites et repliers dans le ventre ; mandibules coudées, terminées par une pièce en crochet ; point de palpes" ; with a reference to *Pycnogonum spinipes*, O. Fabr.

Latreille again, four years later (Gen. Crust. et Insect. 1806, p. 143) has :—

"Fam. Pycnogonides : I. Mandibulæ (biarticulatæ); pedes decem, antici duo spurii ; inflexi, oviferi. Genus *Nymphon* : Mandibulæ didactylæ. Palpi duo. Genus *Phoxichilus* : Mandibulæ monodactylæ, palpi nullæ" ; with reference again to *Pycnogonum spinipes*, O. Fabr.

In both these quotations the characters given are directly the opposite to those of *P. spinipes*, which has strongly developed "Mandibulæ didactylæ." There is one genus which if we substitute the name palpi for mandibulæ will answer to the generic descriptions of the original *Phoxichilus*, and Sabine was so far quite justified in calling the first discovered Colossendeis, *Phoxichilus proboscideus*.

But we must pursue *Phoxichilus* further :—

Leach (Trans. Linn. Soc. vol. xi. 1815, p. 306) describes the genus as having "Mandibulæ nullæ." Nothing is said of any palpi. The characters here then are not those of Latreille and are still further away from those of *P. spinipes*.

Latreille (Dict. d'Hist. Nat., Nouvelle Edition, 1818, vol. xxvi. p. 14). Here we have a full account of *Phoxichilus*, and Latreille tells us of the blunder he made, and that the mandibles really "finissoient en pince didactyle, de même que celles des *Nymphons*," but that *Phoxichilus* is distinguished from *Nymphon* by the absence of palpi. He concludes : "Le *Nymphon femoratum*, Rathke, et le *Phalangium spinosum*, Montagu, paraissent appartenir au genre des Phoxichiles." After the accurate description of the genus follows the first unfortunate intimation that *Phalangium spinosum* may belong to the genus.

Johnston, in 1837 (**31**), was, I believe, the first writer who actually used the joint names *Phoxichilus spinosus*, which have since that date been employed.

Lamarck (Hist. Nat. Anim. sans Vert. vol. v. 1838, p. 103) only increased the confusion by giving among his characters "mandibulis duabus vel uniungulatis, vel chelatis," including in his genus both the *spinipes* Fabr. and the *spinosus* Montagu, the latter of which, however, he re-named *Phoxichilus monodactylus*.

Milne-Edwards (Hist. Nat. des Crust. vol. iii. 1840, p. 535) consummated the confusion, giving to *Phoxichilus* only one species *P. spinosus*, removing *P. spinipes*, Fabr., and giving it as a doubtful synonym under *Pallene brevirostris*.

The change made by Stebbing must, I fear, be of necessity adopted ; but instead of writing as Mr. Stebbing has done that *Phoxichilus* was established by Latreille "so far back as 1804, not as has been stated in 1816," I should write "Latreille 1804 *as corrected by him in* 1818," for the first description was not only insufficient, but absolutely wrong, while in that of 1818 the error was corrected and the description is thoroughly full and clear.

1. ENDEIS SPINOSUS (*Montagu*).

Phalangium spinosum, Montagu, (**41**) p. 100, pl. v. fig. 7.
Phoxichilus spinosus, Johnston, (**31**) p. 377.
Endeis gracilis, Philippi, Arch. f. Nat., Jahrg. ix. Bd. i. 1843, p. 176, pl. ix. fig. 1.
Phoxichilus spinosus, Quatrefages, Mémoire sur l'organisation des Pycnogonides, Ann. des Sci. Nat., Zool. ser. 3, vol. iv. (1845) p. 71, pl. i. figs. 2, 2 *a*, pl. ii. fig. 1.
„ *spinosus*, Kröyer, (**32**) p. 125; (**33**) pl. xxxv. figs. 1 *a–f*.
„ *lævis*, Grube, (**15**) pp. 31 & 50, pl. i. figs. 1 *a–c*.
„ *inermis*, Hesse, Ann. des Sci. Nat. vol. vii. p. 199.
„ *vulgaris*, Dohrn, (**9**) p. 169, pl. x. fig. 6, pl. x *a*. figs. 16–20, pl. xi. figs. 1–10, 12, 13, 16–27.
„ *spinosus*, Hoek, (**28**) p. 58, pl. xxviii. fig. 33.
„ „ Sars, (**51**) p. 15, pl. i. figs. 3 *a–g*.
„ „ Carpenter, (**2**) p. 199, pl. xii. figs. 1, 3, 5, 7.
„ *lævis*, Carpenter, (**2**) p. 200, pl. xii. figs. 2, 4, 6, 8.

Professor Carpenter, in his paper above referred to, gives the opinion, illustrated by figures, that the *P. lævis* of Grube is distinct from *P. spinosus* of Montagu; but I agree with the view of Hoek, that they are the same species, though exhibiting considerable diversity as regards the development of the spination of the limbs. In the young the spines are scarcely developed, and the larger the examples are the stronger in proportion is the spiny growth. The largest specimens I have seen are from Birturbuy Bay, Co. Galway. They are brilliant red or almost black: a female measures, body (exclusive of proboscis) 4·25 mm., proboscis 2 mm., front leg 17 mm. Younger specimens are greenish, and still younger white in colour.

Birturbuy Bay, Co. Galway, very large; Jersey; Gouliot Caves, Sark; Plymouth, off Berry Head, and Starcross, Devon; Isle of Cumbrae; Strangford Lough, Ireland; Naples (cotypes of *P. vulgaris*, Dohrn). *Mus. Nor.*

Off Aran Island, the larger form, and several places on the coast of Galway, the smaller form (*Carpenter*). Dublin Bay (*Scharff*). Killalo Bay (*Miss Warren*). Dunmanus Bay, Irish Sea (*Halhed*, *A. Newburgh*). West coast of France (*Grube* and *Hoek*). On the Norwegian coast it was first found by Kröyer, and Sars records it from near Stavanger, Florö, and Manger, Norway; and Topsent records it from the Azores.

2. ENDEIS CHARABDÆUS (*Dohrn*).

Phoxichilus charabdæus, Dohrn, (**9**) p. 174, pl. x. figs. 7–18, pl. x *a*. figs. 14, 15, 21, 22, pl. xi. figs. 11, 14, 15.
„ *charabdæus*, Schimkewitsch, (**52**) p. 20.

Bay of Naples (cotype *Dohrn*). *Mus. Nor.*

Abrolhos Isles (*Schimkewitsch*).

Doubtful Species.

Costa (O. G.). Fauna del Regno di Napoli : Crostacei et Arachnedi. Napoli, 1836 and following years.

Foxichilus pygmæus.

Phanodemus horribus.

„ *collaris.* Gulf of Taranto.

„ *inermis.* Gulf of Taranto.

Philippi (A.). "Ueber die Neapolitanischen Pycnogoniden." Archiv f. Naturgesch. ix. Jahrg. i. Bd., 1842.

Paritoca spinipalpis, p. 178.

Endeis didactyla, p. 176 = ? *Ammothea Langi*, Dohrn.

Costa (O. G.). Microdoride Mediterranea. Napoli, 1861.

Platychelus sardonicus, p. 11.

Alcynous megacephalus, p. 14.

Goodsir (H. D. S.). "Description of some new species of Pycnogonidæ." Edinburgh New Philos. Journ. vol. xxxii. 1842, p. 365, and Ann. & Mag. Nat. Hist. vol. xiv., 1844.

Pephredo hirsuta, p. 137, fig. 7 (as *P. capillata*).

Nymphon pellucidum, p. 138, fig. 5, & p. 3, figs. 19, 20.

„ *minutum*, p. 138, fig. 6, & figs. 24, 25.

„ *similis*, p. 3, figs. 21–23.

Pasithoe vesiculosa, p. 2, figs. 11–13.

Gosse (P. H.). "On some new and little known Marine Animals." Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, p. 30, pl. iii. figs. 12, 13.

Phoxichilidium olivaceum ; probably *Anaphia virescens*, Hodge.

Claparède (R. E.). Beobachtungen über Anat. und Entwickl. Wirbelloser Thiere, 1863, p. 103, pl. xviii. fig. 12.

Phoxichilidium cheliferum.

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Oiceobathys arachne ; probably an *Ammothea.*

Hesse (M.). Do. do. Vingt-quatrième Article. Ibid. vol. xx. 1874, pl. viii. figs. 1–24.

Oomerus stigmatophorus.

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EXPLANATION OF THE PLATES.

Plate 29.

Fig. 1. *Anaphia lenta*, E. B. Wilson. Cephalic segment.
2. „ „ False leg.
3. „ „ Last joints of ambulatory leg.
4. *Nymphon rubrum*, Hodge. Last joints of ambulatory leg from Plymouth specimen.
5. „ „ do. do. do. from a Shetland specimen.
6. „ „ do. do. do. var. *perplexa*, St. Andrews.
7. „ „ Oculiferous tubercle.
8. *Anaphia angulata*, Dohrn. Last joints of ambulatory leg.
9. *Nymphon brevirostre*, Hodge. Cephalic segment.
10. „ „ Cheliforus.
11. „ „ Ambulatory leg.
12. „ „ do. do. propodos.

Plate 30.

Fig. 1. *Nymphon stenocheir*, sp. n., from above.
2. „ „ Oculiferous tubercle.
3. „ „ Palp.
4. „ „ Cheliforus from the front.
5. „ „ Chela from the side.
6. „ „ Last joints of ambulatory leg.
7. „ „ Propodos.
8. „ „ False leg.
9. „ „ Spines of false leg.
10. *Paranymphon spinosum*, Caullery. Last segment of body, showing abdomen and remarkable processes from the lobes of the body.
11. „ „ Portion of two lobes of the body covered with remarkable appendages.
12. „ „ One of the appendages highly magnified.
13. „ „ A cheliforus.
14. „ „ Last joints of an ambulatory leg.

On a Possible Case of Mimicry in the Common Sole.

By A. T. Masterman, M.A., D.Sc., F.L.S.

[Read 5th March, 1908.]

There are two common species of Weever (Trachinidæ) found in British waters, namely, the Greater Weever (*Trachinus draco*) and the Lesser Weever (*Trachinus vipera*). Both are venomous, and the poison is concentrated at the spines of the first dorsal fin and the opercular spine in its immediate neighbourhood.

The habits of *T. vipera* are the better known. On all occasions it attempts to bury itself in the sand until only the top of its head, with eyes and mouth, and dorsal fins are above the surface. In this position it apparently lies in wait for the shrimps and small fry which form its food. As a probable adaptation to this habit, the eyes and mouth of the fish are elevated into a dorsal position, so that the least possible surface of the body need be exposed above the sand.

The habits of *T. draco* are closely similar. It is abundant off the coast of Norway, and on occasions it is taken in great shoals. Of its habits Professor Smitt remarks * :—

"The Great Weever lives in water of a moderate depth with a sandy bottom. It buries itself in the sand and keeps in hiding, in order more suddenly to attack its prey, which consists of small fishes and crustaceans."

In British waters *T. draco* is found further off-shore and in deeper water than *T. vipera*. The experience of our trawlers in the Southern North Sea and in the English Channel is that *T. draco* is found in greatest abundance on the off-shore trawling-grounds, whilst *T. vipera* occurs most frequently close inshore in sandy bays. *T. draco* "occurs along the whole west coast (of Norway) from Bergen in Norway to the south of Scania, and into the Baltic as far as the coast of Prussia, where it is, however, extremely rare." "To the south it is common as far as the Mediterranean and the Black Sea."†

T. vipera is very abundant in the English Channel and the North Sea, but Smitt describes only a single specimen from the coast of Norway. In British waters, especially towards the north, it is more common than *T. draco*. Like the latter, it is often found in large shoals.

In both species the first dorsal fin has six (occasionally seven in *T. draco*, according to Kröyer ‡, who remarks that seven spines are common in the males) sharp strong spines or rays, with a conspicuous black membrane. Upon provocation this fin is erected and spread out in the most conspicuous manner. Its intense black colour, in contrast with the pale yellow and brown tints of

* 'Scandinavian Fishes,' Part i. p. 131.

† *Loc. cit.* p. 130.

‡ *Cf.* Canestrini, 'Fauna d' Italia.'

the fish and with the light drab of the sand, makes it clearly visible from a considerable distance. It has been suggested by Garstang that this is a case of warning coloration. Considering the poisonous nature of the fish and its abundance, one cannot doubt that this black danger signal must act as a powerful deterrent to its enemies *. If this is the case, the habit of aggregation into large shoals would be beneficial through accumulative warning action.

The right or upper pectoral fin of the Common Sole (*Solea vulgaris*) is well developed, and the upper half of the fin has a large, deep black patch. This patch is, as remarked by Smitt, more conspicuous in the young Sole than in the adult, but it is a clearly recognizable feature throughout life, except in the very earliest stages. When a number of Soles are displayed in the market, the little black dot in the pectoral region of each fish can be seen at some considerable distance.

The habitat of the Sole is well-known. "The usual depth at which Soles are found is from 20 to 30 fathoms, but it may exist at greater depths ; it probably does not extend beyond 100 fathoms. Adult Soles may occur at any depth less than 20 fathoms; but usually in shallow water, less than 10 fathoms deep, only young individuals are found" †.

Cunningham goes on to describe the habit of the Sole of burying itself in the sand and instinctively going through the motion of doing so when placed upon the bare floor of a tank. "Usually when resting undisturbed beneath the sand or gravel it leaves its eyes uncovered, and these can be detected by careful search."

The smaller fry of Soles, like the Lesser Weever, are commonly found on the shallow sandy flats worked by shrimp-trawls.

The Sole therefore resembles the Weevers in the soft or sandy nature of the ground frequented by it, in the depth of water, and in the habit of concealing itself under the sand.

The general distribution of the Sole is well-known. It occurs in small numbers off the coasts of Norway, and only ranges to 62° N. (Collett). It is scarce in the Baltic, though found in more abundance in the Skager-Rak and the Skaw. In the southern half of the North Sea, as represented by a line from Flamborough Head to the Naze, it is common, but is found in greatest abundance in the English and Bristol Channels. It ranges southwards along the Atlantic seaboard of Morocco and into the Mediterranean. It is found off the coast of Scotland, but is not a common fish north of Berwick.

The suggestion here made is that the black patch of the pectoral fin in the Sole is a case of mimicry in relation to the black dorsal fin of the Weever.

* Poulton, 'Colours of Animals,' p. 164; Camb. Nat. History: Fishes, &c. p. 174.

† 'The Sole,' Cunningham, p. 101.

With the above facts already known, I have attempted to obtain further evidence, confirmatory or otherwise, of this theory, by observation of the habits of the Sole. The process of burying is effected in the case of the Sole by an undulating motion of the dorsal and anal fins. Each fin is thrust outwards and downwards into the sand, some of which is at the same time thrown on to the back of the fish.

In the Lesser Weever, the body of the fish works its way down into the sand by side-to-side undulations of the hinder half of the body, and especially the caudal fin. The pectoral fins also largely assist by a process of scooping into the soft sand. In both Sole and Weever the process is very rapidly and effectively carried through, and in both the motions are performed even if no sand be present.

On the approach of an enemy it is the usual habit of the Plaice, the Turbot, the Sole, and some other flat-fish to lie concealed on or in the sand or loose gravel. This is persisted in until the psychological moment when the fish is apparently convinced that its presence is known to the enemy and that further concealment is useless. The property of the skin of flat-fish to modify its coloration in accordance with the conditions of light assists immensely the power of concealment; and it is further helped in varying degree by a persistent capacity for remaining motionless which, when highly developed, becomes a habit of simulating death. So far as one can judge by specimens which have been for some years in the aquarium tanks, I find that the Turbot and the Plaice "bolt" first, the Sole next, and the Sand-Sole (*S. lascaris*) appears to carry the habit of quiescent lying in the sand to the extreme of actually simulating death.

But whenever the fish is aroused and seeks refuge in flight, there is a marked difference in the behaviour of these species. In the Turbot and the Plaice, there is a general scurry in which the pectoral fins are seen to take part by quick striking movements, no doubt assisting to raise or depress the head. In the Sole, on the contrary, the upper pectoral fin is erected sharply and spread, either just before "bolting" or immediately thereafter, and, as a rule, it is not employed as a motor-fin. It forms a motionless black flag held up conspicuously like that of the Weever, and with exactly the same menacing attitude. There are at the Plymouth Laboratory several large Soles which have been five years in the tanks, and it is remarkable to observe how, when they have been disturbed, they sail around with the little pectoral fin held stiffly erect. Further than this, the fin is held up with its plane lying in the central plane of the fish, though the natural position is perpendicular to this plane. It is difficult to account for this very marked and persistent habit in any other way than as a case of mimicry.

The Dab (*P. limanda*) and, to some extent, the Flounder (*P. flesus*) have also a habit of holding their upper pectoral fins erect. In the former the pectorals are perhaps better developed than in any other British flat-fish. They are put to active use in swimming, but when a Dab is about to alight on the sand, and its body is descending at an angle to the ground, it very commonly holds the upper pectoral fin stiffly erect, possibly for the purpose of guiding its descent.

The Soles, as a family, have a characteristically elongated body. The dorsal and anal fins are extended along its whole length and are specialized as a means of locomotion. Probably in correlation with this feature the family has a marked reduction in proportionate size of the pectoral fins as compared with the Pleuronectidæ, and the various subfamiles exhibit varying stages of degeneration of these fins. They have been classified in accordance with this feature. In the group of *Monochires* there is only one pectoral fin, the right or upper. (*Solea monochir* of the Mediterranean.)

In the *Microchires*, represented in British waters by the Thickback (*Solea variegata*) and the Solenette (*Solea lutea*), both pectoral fins are present, but they are vestigial. They can be of little or no use for swimming purposes. In the Solenette the right pectoral is often of a brownish tint, but I have never seen it of the conspicuous black hue as shown in the figure by Couch. In *S. variegata* the upper pectoral is inconspicuous and of the same tint as the surface of the body.

In the Sole (*Solea vulgaris*) and the Sand-Sole (*Solea lascaris*) the pectorals are comparatively well developed. In the latter the black patch varies greatly, from two or three black streaks or spots to a sharply-defined black blotch. There appears to be some difference of opinion as to the black patch upon the right pectoral of *Solea lascaris*. Couch is very decisive upon the point in text and figures. Day figures and describes a black patch with a white border. Cunningham remarks in his text that the black patch is present, but shows little trace of it in his excellent figure. An enquiry upon this point indicates that whilst the black patch of the Sole is very conspicuous when the fish is at rest, that of the Sand-Sole is largely if not entirely hidden by the partial closing of the fin. In Cunningham's figure the fin is shown in the closed condition and the black patch is scarcely recognizable.

There are half-a-dozen Sand-Soles in the Plymouth Laboratory which have resided in the tanks for two years or more. They show a right pectoral of the same uniform tint as the rest of the body but with a few black streaks. The coloration in this case may have undergone considerable change. According to Moreau, the pectoral is "jaunâtre ou grisâtre à la base et sur les côtés, blanche à l'extrémité ; elle est marquée dans sa partie moyenne et postérieure d'une tache noire, arrondie, bien circonscrite" *.

Similarly Dr. Günther † describes the Channel Lemon Sole, under

* 'Poissons de la France,' Part iii. pp. 309–310.

† British Museum Catalogue, vol. iv. p. 467.

S. aurantiaca, as having a "pectoral with an ovate black spot on its hinder half." In *S. lascaris*, from the Madeiras and Mediterranean, he describes "a black ocellus edged with yellow on the extremity of the lower half of the pectoral." This description applies equally to his two species, *S. impar* and *S. margaritifera*.

According to Moreau and Cunningham, Günther's *S. aurantiaca* is identical with *S. lascaris* of the Mediterranean Sea. There is another species (*Solea melanochira*, Moreau *) found in the Mediterranean which has the upper pectoral considerably developed. This fin is of an intense blue-black with a whitish border. The fin is long and is borne upon a peduncle. In varying degree the blackish tint of the upper pectoral seems to be characteristic of the Soles proper, and is not found in the *Microchires* or *Monochires* nor in other Pleuronectidæ. If the inference is correct that the preservation of the pectorals in the Soles proper may be due to their employment as imitation danger-signals, it might be conjectured that the hypertrophy of the pectorals in *Solea melanochira* is traceable to a similar function, even more conspicuously developed.

In *S. vulgaris* the black spot always has a definite relation to the anterior border of the fin, extending backwards from its edge ; in *S. lascaris* the spot at most just touches its border with its circumference and usually does not reach so far.

In estimating the probability of these black fins of the Soles owing their existence to the phenomenon of mimicry, the mimicked forms being, in this instance, the Trachinidæ, we have to consider :—

(1) That the geographical distribution of *Solea vulgaris* and its nearest allies is closely similar to, if not identical with, that of the two common species of *Trachinus*.

(2) That the sand-loving and sand-hiding habits of the two forms are closely similar, and that they actually inhabit the same grounds, the young Soles with *T. vipera* and the adults in deeper water with *T. draco*.

(3) That on disturbance each type holds its black fin erect in a menacing manner ; that of the Sole is held at right angles to the normal position for Pleuronectidæ.

(4) That the pectoral fin of other Pleuronectidæ, or even Soleidæ, is not coloured black, and is not held erect in the same manner.

The use of black as a warning colour is significant. In land animals we are familiar with black, combined with red or yellow, being employed for this purpose, but the general facts of marine coloration seem to show that red or yellow are, in the presence of reddish tints on sea-floor and amongst seaweeds and zoophytes, colours of concealment rather than the reverse.

* Revue et Magasin de Zoologie, 1874, t. xi. p. 115.

With the prevailing greens and blues of the transmitted light there remains little else than intense black, contrasted with a light background, to serve for warning or recognition marks.

There is a common littoral fish (*Uranoscopus scaber*), a member of the same family as *Trachinus*, found in the Mediterranean Sea. Its habits, as regards burying itself in the sand, appear to be closely similar to those of the *Trachini* and it has an erectile first dorsal fin of a jet-black colour. There is a formidable spine on the operculum, and this fish, like *Trachinus*, is said to be poisonous. It inhabits the same grounds as *Trachinus*, and a black or black-and-white first dorsal fin appears to be as characteristic of the genus *Uranoscopus* as it is of the genus *Trachinus*. It is difficult not to conclude that it obtains a considerable amount of protection by possessing a conspicuous black dorsal fin, and that its close resemblance to *Trachinus* may be of mutual service to both kinds of fish.

On the other hand, it seems a general rule that in sand-loving round fishes, whatever colour-markings may be necessary tend to become concentrated in the dorsal fin, which alone is visible when the fish is buried in sand (*cf.* Gobiidæ, Centronotidæ, &c.).

Notes on some Freshwater Sponges collected in Scotland. By N. ANNANDALE, D.Sc., F.L.S., C.M.Z.S., Superintendent, Indian Museum, Calcutta.

[Read 2nd April, 1908.]

As the local records of freshwater sponges in Scotland appear to be neither numerous nor altogether trustworthy, I have thought it worth while to publish the following notes, which are based on specimens submitted to me by Sir John Murray and Mr. W. Evans and on others found by myself during a recent visit to Scotland. I do not think it probable that the two species here recorded exhaust the list of those that occur, but few naturalists have taken the trouble to collect the Spongillinæ of Great Britain, which are therefore imperfectly known. Several interesting forms will probably be discovered in the lakes of Scotland and England if stones from the bottom are examined. So far as my own experience in Scotland and India goes, the under surface of stones from lakes is a favourite station for the less conspicuous and smaller species, which are in many respects the most interesting. These are not always easy to distinguish at sight from patches of algæ, but their gritty constitution, due to the spicules of which their skeleton is formed, can usually be felt if they are held between the finger and thumb, and in most cases it is possible to distinguish the spicules with the aid of a hand-lens. Freshwater sponges should either be preserved in very strong spirit—absolute alcohol if possible—or dried. I shall be glad to examine and report upon specimens sent to me at Calcutta.

SPONGILLA LACUSTRIS auctorum.

This species, which is probably distributed all over the world, is extremely variable in almost every character; it is also, perhaps consequently, able to survive in many kinds of environment, being found in brackish and even salt water, in rivers, canals, lakes and small ponds. I have recently found small but typical specimens in a pond in the Bombay Presidency, while in Bengal two forms occur that may be no more than local races, namely *S. proliferens* and *S. reticulata*. Apart from these, the closely related *S. alba* of Carter is a common Indian species and has recently been recorded from Africa *. In Europe and North America *S. lacustris* appears to be commoner than any other freshwater sponge; in India it is much less abundant than the very distinct species *S. carteri*; it has not as yet been recorded from Africa but is known from South America, while several closely allied forms, which may not be specifically distinct, occur in Australia: as a fossil it has considerable antiquity. From Great Britain the following recent species have been recorded as well as *S. lacustris*:—*Ephydatia fluviatilis*, *E. mülleri*, and *Spongilla fragilis*; while *Tubella pennsylvanica*, *Heteromeyenia ryderi*, and a form probably conspecific with the North American *Ephydatia crateriformis*, have been found in Ireland. *Trochospongilla horrida* or *erinaceus* is the only other species known from Western Europe, but has not as yet been recorded from the British Isles. *S. lacustris* may be distinguished from all other species, in my opinion, by the following characters:—The sponge is soft and easily compressed, bright green when growing exposed to light; as a rule a basal portion can be distinguished, bearing long cylindrical branches. The skeleton spicules are sharply pointed and smooth; they are arranged so as to form distinct radiating fibres, which are joined together by less distinct transverse fibres or by single spicules in a network; neither kind of fibre is very coherent. Numerous minute, pointed, cylindrical flesh-spicules, which are more or less uniformly covered with little spines, are scattered about in the substance of the sponge and in the external membrane. The gemmules, which generally have a yellowish colour, are spherical and open by a single aperture (in var. *multiforis* by several apertures) which is usually surrounded by a

* As *S. cerebellata*, Bowerbank; see Kirkpatrick, Ann. & Mag. Nat. Hist. (ser. 7) xx. 1907, p. 524. Although *S. cerebellata* is certainly a form of *S. alba*, Carter, I cannot agree that the latter is not distinct from *S. lacustris*, close ally as it is of this species.

cup-shaped chitinoid funnel. The spicules on the gemmule are arranged in two layers, one of which lies parallel to the external surface of the gemmule outside, while the other is tangential to the internal coat and is more or less irregularly arranged; in form the gemmule-spicules resemble the flesh-spicules but are always stouter.

Of Scottish examples of this sponge I possess three sets,—one from the Glasgow Canal at Edinburgh, given me by Mr. W. Evans and taken in October 1907, one (a single specimen) given me by Sir John Murray and labelled "River Dee at Crossmichael, water 4 to 6 feet deep, 27th June, 1905," and one obtained by myself from Loch Baa in Mull, in October 1907. Each of these sets of specimens represents a different form or phase of the species; but it is, in my opinion, better not to separate them as varieties. The term "var.," at any rate in the Spongillinæ, has several different meanings, such as local race, temporary or seasonal phase, modification directly due to environment, distinct and permanent form distinguished by small but constant differences, and so on: in most cases it is impossible to say exactly what it means, and its use is merely the confession of a desire "to beg the question." It seems to me that if two forms are found growing together on a number of occasions in a number of localities, and if the specimens taken on different occasions are consistently different *inter se*, they should be regarded as distinct species, no matter how small the difference may be. If, however, different forms are only found in different localities or environments, or at different times of year, but agree in the majority of their characters, then they are probably no more than temporary phases which would not breed true if their environments were changed. It must be confessed, however, that such rules are easier to make than to keep. Especially in the Eastern tropics, the Spongillinæ have only been studied in a very few localities; I have rarely visited a new locality in India without finding forms that were previously unknown to me and did not agree with any published description. It has not always been possible to decide in a very definite manner whether these were true species or not, and I have usually adopted the system of giving even doubtful species names, trusting to future researches to confirm or disprove their valency. It is almost impossible to make progress in classifying or arranging a large collection unless the specimens are given names. Personally I regard many of the species I name without seeing "types," whether they be "new" or old, as named provisionally. Many published descriptions of the lower invertebrates are quite inadequate, and organisms so plastic as the sponges, as a matter of fact, conform imperfectly to any system of nomenclature as yet defined; unfortunately it is almost impossible, at any rate in a warm climate, to keep them alive and healthy in captivity, and so study their variation from generation to generation. It is by no means improbable that someone will some day evolve a system of classification such as that foreshadowed in Bernard's "Catalogue of the Madreporarian Corals in the collection of the British Museum" as regards *Porites*, in which species are no longer recognized. At present, at any rate by museum zoologists, generic and specific names cannot be ignored, for no satisfactory substitute for them has yet been proposed.

The specimens of *S. lacustris* from Edinburgh may be taken to represent the typical form of the species, but even they are not absolutely identical *inter se*; some of them have no branches, while in others these structures are well developed, as is usually the case in British specimens. In the branchless examples the skeleton spicules are rather shorter than in the others. In the branched examples the gemmules are abundant, being young and imperfectly developed towards the distal end of the branches, but fully formed at their bases and in the flat part of the sponge. There are no gemmules in the specimens without branches, which are probably immature.

The specimen from the River Dee encrusts the stem of a water-weed and is devoid of branches. It contains a few gemmules of unusually large size, but apparently still immature, the internal coat being very soft and as yet having few spicules and no crust associated with it. The skeleton in this form is rather more coherent than usual, but cannot be compared in this respect with that of *S. alba*, which is hard to the touch.

I have refrained from giving measurement of the spicules or gemmules so far, because I believe that measurements of these structures in the more variable species of *Spongilla* are apt to lead to confusion by being taken as standards of comparison; there is nothing really remarkable as regards them either in the specimens from Edinburgh or in that from the River Dee.

The third Scottish form I have examined is altogether more abnormal. I found it in considerable abundance on the lower surface of stones near the edge of Loch Baa in the island of Mull. Several of my specimens had evidently attained their full growth, being practically dead and consisting merely of skeletons to which a few cells still adhered. Notwithstanding their abundance, however, no specimen measured as much as 10 mm. in diameter; there was no trace of branches, each sponge consisting of a little mound-shaped structure of oval outline and having a single osculum of relatively large size. The gemmules, although they were fully formed, bore no spicules, and the flesh-spicules were very few, occurring only in the substance of the sponge. The colour, considering the conditions under which the sponges were growing, was normal, being a dirty cream where they were shut off from light and a faint green where a little light reached them between the stones. The spicules and gemmules, as perhaps was natural, were smaller than usual; the gemmules measuring about 0·334 mm. in diameter, and the skeleton-spicules being 0·279 mm. long and proportionately rather slender. Distinct spicule-fibres projected vertically from the surface.

On the whole, this form of *S. lacustris* from Mull is nearly as worthy of specific rank as my *S. reticulata* from Eastern Bengal, although its peculiarities lie in a different direction, the Indian form * being distinguished by the great development of its branches, which are laterally compressed and anastomose to form a reticulated structure. The Mull sponge, however, is linked to the typical *S. lacustris* by one found in America and named by Bowerbank † *S. lacustris* var. *abortiva*, which has few spicules on the gemmule and an apparently aspiculous dermal membrane. This form, however, is described by Potts ‡ as "coating and branching," and has the skeleton-spicules rather stout; there is no crust on the gemmules, a character in which it agrees with the Hebridean form. I do not propose, for reasons stated above, to give the latter a name, but it is a form of considerable interest, possibly a distinct local race. *S. proliferens* from Bengal resembles it in its small size and has no true branches, but is remarkable for its prolific reproduction by means of external buds and has a tubular outgrowth attached to the foramen of the gemmule.

There is one other point to which it may be interesting to refer before leaving *Spongilla lacustris* (on which there is already far more literature than on any other species), namely, its occasional association with a Phylactolæmatous Polyzoon. Growing in the substance of the specimens given me by Mr. Evans I found a *Plumatella* identical with Allman's *P. coralloides*, which was originally found in similar circumstances. This Polyzoon is a temporary phase of the same author's *P. fruticosa*, not of Linné's *P. repens* as I formerly § thought. The same phase is common in *S. carteri* in Calcutta and Bombay, and occurs occasionally in the former locality in at least one other species of sponge, viz., *S. crassissima*, the hardness of which, however, is evidently less favourable to its growth.

Tubella pennsylvanica, *Potts*.

Tubella pennsylvanica, Potts, Proc. Acad. Nat. Sci. Philadelphia, 1887, p. 14; Hanitsch, Irish Naturalist, iv. p. 129, 1895.

This species was originally described from several localities in the United States, and was later recorded by Hanitsch from the West of

* 'Records of the Indian Museum,' i. p. 387.

† Proc. Zool. Soc. 1863, p. 470.

‡ Potts, Proc. Acad. Nat. Sci. Philadelphia, 1887, p. 189.

§ Journ. Asiat. Soc. Bengal, 1907, p. 88. Allman says that the statoblasts are broad, but figures them as somewhat elongated (Monograph of the Freshwater Polyzoa, p. 103, pl. vii. fig. 4).

Ireland. Hanitsch's specimens, like my own, were devoid of gemmules; but I think there can be little doubt that his identification is correct. My specimens were found on the lower surface of stones at the edge of Loch Baa, together with the peculiar form of *Spongilla lacustris* described above, and with specimens of the Polyzoon *Fredericella sultana*, some of which were enclosed in the substance of the sponge as far as the base of the colony was concerned, but were not perceptibly modified thereby.

The sponges were in the form of rather thin crusts with a circular or oval outline and not more than about 3 cm. in diameter. The surface was raised at one or more points into conical eminences resembling volcanoes in miniature, on the summit of which the oscula opened; numerous furrows beneath the dermal membrane radiated from each osculum. The mass was moderately soft, although the spicules were abundant, the skeleton being incoherent; the spicules were sharply and rather abruptly pointed, measuring on the average 0·201 by 0·0125 mm.; the shafts were densely covered with short, sharp, straight spines, but the points were smooth; no blunt spicules or developing rotules were seen. Numerous embryos were present in the substance of the sponge.

The identification of a specimen devoid of gemmules is always a little uncertain in the Spongillinæ; but the spicules of *Tubella pennsylvanica*, although several forms of the species have been described as varieties, have a very characteristic appearance, and the external and skeleton characters of my specimens accord well with Potts's description.

Tubella pennsylvanica was one of the three North American forms recorded by Hanitsch (*op. cit.*) from the West of Ireland in 1895, and regarded by him, and later by Scharff *, as evidence of a faunistic connection between that district and America. Of one of these species, however, I have found, both in Calcutta and in the Western Ghats (Bombay Presidency), a very close ally, which may ultimately have to be considered as no more than a local race, namely *Ephydatia indica* †, which is possibly a form of the North American *E. crateriformis*, with which Hanitsch, I think rightly, associated an immature sponge in his Irish collection ‡. Moreover, *Trochospongilla latouchiana*, only known from Calcutta, bears much the same relation to *T. leidyi*, another North American species which has not as yet been recorded from Europe. The retiring habits and small size of *Tubella pennsylvanica* render it liable to be overlooked, and I have

* 'European Animals,' p. 34, 1907.

† Annandale, Journ. Asiat. Soc. Bengal, 1907, p. 21, and 'Records of the Indian Museum,' i. p. 272, 1907.

‡ The distribution of the third form in Hanitsch's Irish collection (*Heteromeyenia ryderi*) is apparently discussed by Miss J. Stephens ('Irish Naturalist,' 1905) in a paper I have not seen.

little doubt that it exists in other British lakes as well as in Loch Baa. In any case, the freshwater sponges, being very easily carried abroad in the form of gemmules, are, like the Phylactolæmatous Polyzoa with their statoblasts, too widely distributed as a rule, although some species are strangely local, to afford a sound basis for argument as to the geological history of any country. In some cases, moreover, environment appears to be a more important feature in their distribution than locality; and we find instances like that of *Ephydatia plumosa*, which is common in Bombay and of which local races have been found in Mexico and in Lake Tanganyika, while closely allied forms occur in the Malay Peninsula and Australia, but a close two years' search has failed to discover any ally in Calcutta.

Although it is in a high degree probable that species other than the two discussed above occur in Scotland, I have been unable to find records that refer certainly to any other than *Spongilla lacustris*. It is possible, however, that such records exist, for our Indian libraries are naturally incomplete as regards the publications of local societies in Scotland and works confined to the local faunas of Great Britain generally. Weltner * in his list of the known species (1895) does not distinguish Scotland from England and Ireland, and I have not seen any reference to later records from Scotland in any of the usual sources of information on such points. I hope, however, that these notes will be of use, if only they assist in calling attention to the fact that the freshwater fauna of the British Isles is very imperfectly known, a fact strikingly illustrated by Mr. Tate Regan's † recent paper on the species of *Coregonus* that occur in the English lakes. The investigations into the fauna of the Scottish lakes undertaken by Sir John Murray and his colleagues are mainly concerned with the plankton; the bottom fauna has remained almost an untrodden field since Allman carried out the classical researches embodied in his Monograph of the Freshwater Polyzoa (1856).

* Wiegmann's Archiv f. Naturgesch. lxvi. p. 114.
† Ann. & Mag. Nat. Hist. (7) xvii. p. 180, 1906.

Note on the Spicules of *Chirodota geminifera*, Dendy & Hindle.

By Prof. ARTHUR DENDY, F.R.S., Sec.L.S.

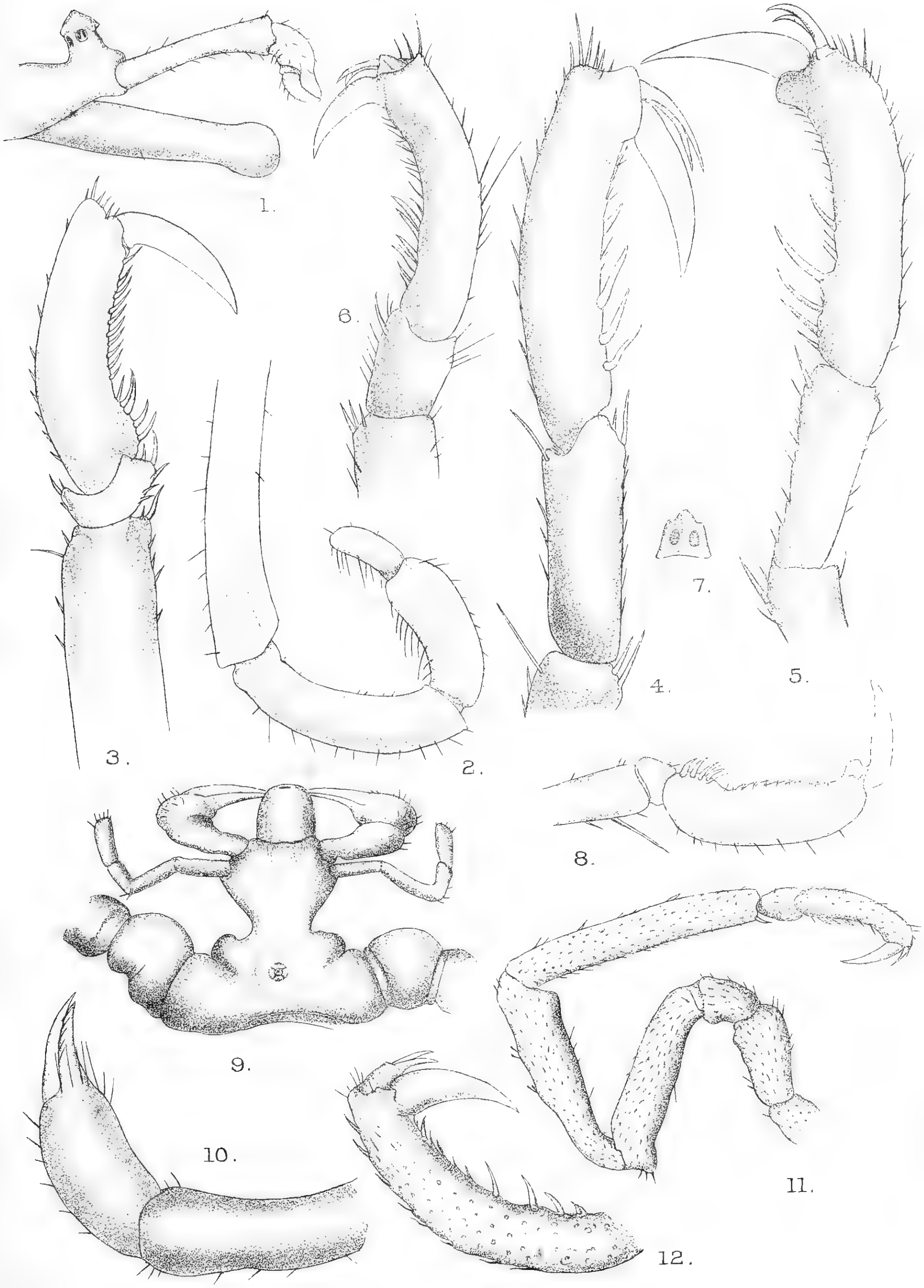
[Read 4th June, 1908.]

THE species, *Chirodota geminifera*, was proposed in 1907 *, for a specimen from New Zealand which had been collected in 1896 and had been preserved for eleven years in alcohol. The supposed distinguishing features of the species were the absence of "wheels" and the presence of sharply pointed sigmoid spicules *apparently* arranged in pairs. I have now found that the peculiar character of the sigmoid spicules is due to erosion. Experiments with *Chirodota dunedinensis* show that when the integument is treated for four or five minutes with 70 % alcohol containing 5 % of hydrochloric acid, the spicules are partially dissolved. The sigmata entirely change their appearance. They become sharply pointed at each end and may even appear double, resembling those figured by us for *C. geminifera*.

Fortunately I have found an old microscopic preparation from the type of *C. geminifera*, made while the specimen was still comparatively fresh and showing the spicules in their natural condition. There are no wheels, but the sigmata closely resemble those of *C. dunedinensis*, the one end being sharply reflexed and sharp-pointed and the other spirally incurved in a plane at right angles to the first. They are, however, a good deal smaller than those of typical *C. dunedinensis*, measuring only about 0·066 mm. from bend to bend as against 0·11 mm.

I have lately received some specimens of *Chirodota*, from one of the Islands lying to the south of New Zealand, whose spiculation is intermediate in type between that of *C. dunedinensis* and that of *C. geminifera*, and which lead me to conclude that the latter is closely related to the former. This question, however, will be discussed in another place.

* Journ. Linn. Soc., Zool. vol. xxx. p. 95.



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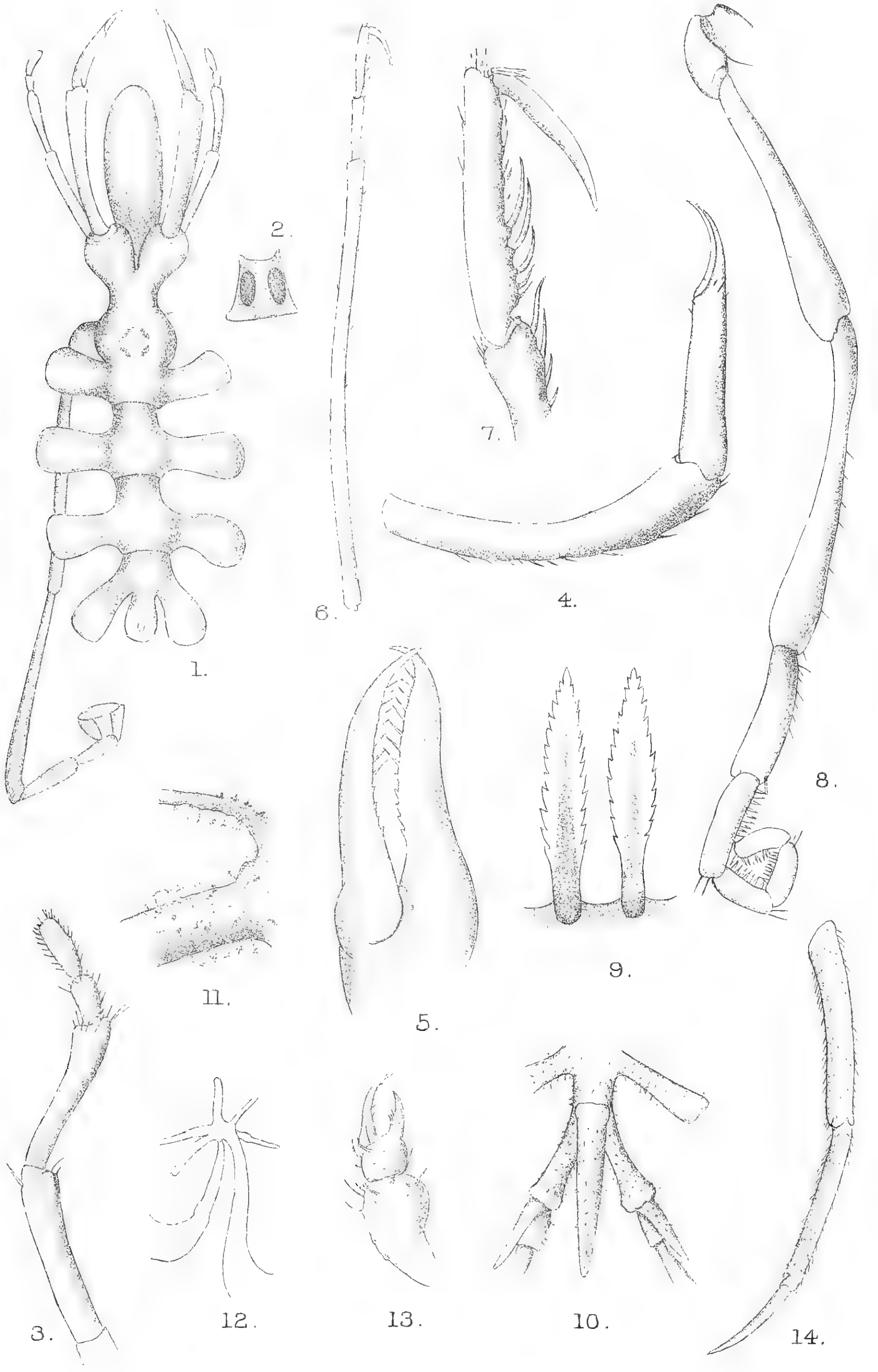
ATLANTIC AND ARCTIC PODOSOMATA.



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[Read 4th June, 1908.]

THE species, *Chirodota geminifera*, was proposed in 1907 *, for a specimen from New Zealand which had been collected in 1896 and had been preserved for eleven years in alcohol. The supposed distinguishing features of the species were the absence of "wheels" and the presence of sharply pointed sigmoid spicules *apparently* arranged in pairs. I have now found that the peculiar character of the sigmoid spicules is due to erosion. Experiments with *Chirodota dunedinensis* show that when the integument is treated for four or five minutes with 70 % alcohol containing 5 % of hydrochloric acid, the spicules are partially dissolved. The sigmata entirely change their appearance. They become sharply pointed at each end and may even appear double, resembling those figured by us for *C. geminifera*.

Fortunately I have found an old microscopic preparation from the type of *C. geminifera*, made while the specimen was still comparatively fresh and showing the spicules in their natural condition. There are no wheels, but the sigmata closely resemble those of *C. dunedinensis*, the one end being sharply reflexed and sharp-pointed and the other spirally incurved in a plane at right angles to the first. They are, however, a good deal smaller than those of typical *C. dunedinensis*, measuring only about 0·066 mm. from bend to bend as against 0·11 mm.

I have lately received some specimens of *Chirodota*, from one of the Islands lying to the south of New Zealand, whose spiculation is intermediate in type between that of *C. dunedinensis* and that of *C. geminifera*, and which lead me to conclude that the latter is closely related to the former. This question, however, will be discussed in another place.

* Journ. Linn. Soc., Zool. vol. xxx. p. 95.

On a new Species of Symphyla from the Himalayas.

By A. D. Imms, B.A., D.Sc., Professor of Biology, Muir College, University of Allahabad. (Communicated by A. E. Shipley, M.A., F.R.S., F.L.S.)

(Plate 31.)

[Read 19th November, 1908.]

During a brief visit in October, 1907, to the native state of Tehri Garhwal, the present writer came across several examples of a new species of Symphyla. On account of the phylogenetic importance connected with this order of Myriapoda, the occurrence is perhaps of more than the average interest attached to the discovery of an isolated new species of the latter class. The state of Tehri Garhwal extends over the south-western declivity of the Himalayas, is to a large extent covered with forests, and has been but little explored biologically. The specimens in question were found beneath moist stones bordering on a mountain stream, near the village of Dhanaulti, at an altitude of approximately 9000 feet. They were met with in company with a species of "earwig," one of Collembola, and also a species of Thysanura. Very possibly the species frequents other situations also, but, owing to an unusually severe drought that prevailed at the time, there were no other moist localities in the neighbourhood, and it is well known that such delicate and fragile animals are unable to survive in very dry situations. Altogether seven individuals were met with, and their occurrence constitutes but the second record of the Symphyla from India. In 1876 Wood-Mason * mentioned the presence of a species of *Scolopendrella* in Bengal but gave no further details.

The specimens here described belong to the genus *Scutigerella* and on the whole are more closely allied to *S. unguiculata*, Hansen, from Venezuela than to any other form.

Scutigerella subunguiculata, sp. nov.

Seven specimens measuring 3–5 mm. in length (excluding the antennæ).

Head.—Just about as broad as long when viewed from above. The posterior angles rounded; a well developed lateral angle at the point of articulation of the mandible. The surface of the head covered with numerous scattered setæ very evenly spaced apart. The longest seta in front of the lateral angle about, or very nearly, as broad as the basal antennal joint.

Antennæ (Pl. **31.** figs. 3, 4, & 5).—The number of joints varies from 21 to 31, and does not appear altogether to be dependent upon the size

* Proc. Asiatic Soc. Bengal, 1876, p. 175.

of the individuals, as may be observed in the table given below. In one specimen, measuring 3·75 mm. long, the left antenna consists of 29 joints while the right antenna has but 27 joints.

The setæ placed on the inner side of the antennal joints are not longer than those disposed on the outer aspect. The first six joints have only three principal setæ visible from above, but on the 7th joint, or thereabouts, a secondary whorl of setæ commences. A whorl of two or three very short setæ takes its origin (on the dorsal side) from about the 8th joint, and is placed in front of the principal or central whorl. The terminal joint is provided with numerous long and prominent setæ and, arising from a median protuberance at its apex, is a large stalked (sense?) organ. Placed near the base of the latter is a smaller organ of similar type but with a shorter stalk. A rudimentary organ (*r.o.* in fig. 3) of very small size is present on

Specimen.	Length in mm.	No. of antennal joints.
1	3	21
2	3·25	28
3	3·75	27 (right ant.) 29 (left ant.)
4	4	30
5	4·45	23
6	4·45	29
7	5	31

each joint, from the third joint onwards, and is placed to the outside of the median dorsal line but situated within the anterior whorl of very short setæ mentioned above.

Scuta (figs. 1 and 2).—The first scutum with the posterior margin more convex than that of the second and the succeeding scuta. The second scutum with its antero-lateral setæ very much longer than the lateral setæ but little more than the breadth of the proximal antennal joint. Two pairs of its lateral setæ but little more than half the length of the antero-lateral setæ, only slightly longer than the remaining setæ, and inclined outwards and backwards. The thirteenth (penultimate) scutum is prominently emarginate posteriorly and with lobes broadly rounded.

Legs (figs. 6, 7, 8, and 9).—The first pair of legs with an elongate, slender, and slightly curved anterior claw. The smaller claw somewhat more strongly curved and reaching to about half the length of the former. The anterior (front) seta (*f.s.* in fig. 7) as long as, or a little longer than, the smaller claw, and very stout and spine-like. The last pair (twelfth) of legs with a slender elongate tarsus, five times longer than deep. The setæ along the anterior dorsal margin of the tibia, metatarsus and tarsus are moderately long and prominent; the tibia with four such setæ, the metatarsus with five and the tarsus with seven. The exopod (*ex.* in fig. 8) very nearly as long as the depth of the metatarsus at its widest part. The anterior claw is long and tolerably slender; the other claw is also slender, strongly curved, and measures ·6 of the length of the anterior one. The front seta is much less strongly developed than that on the first pair of legs.

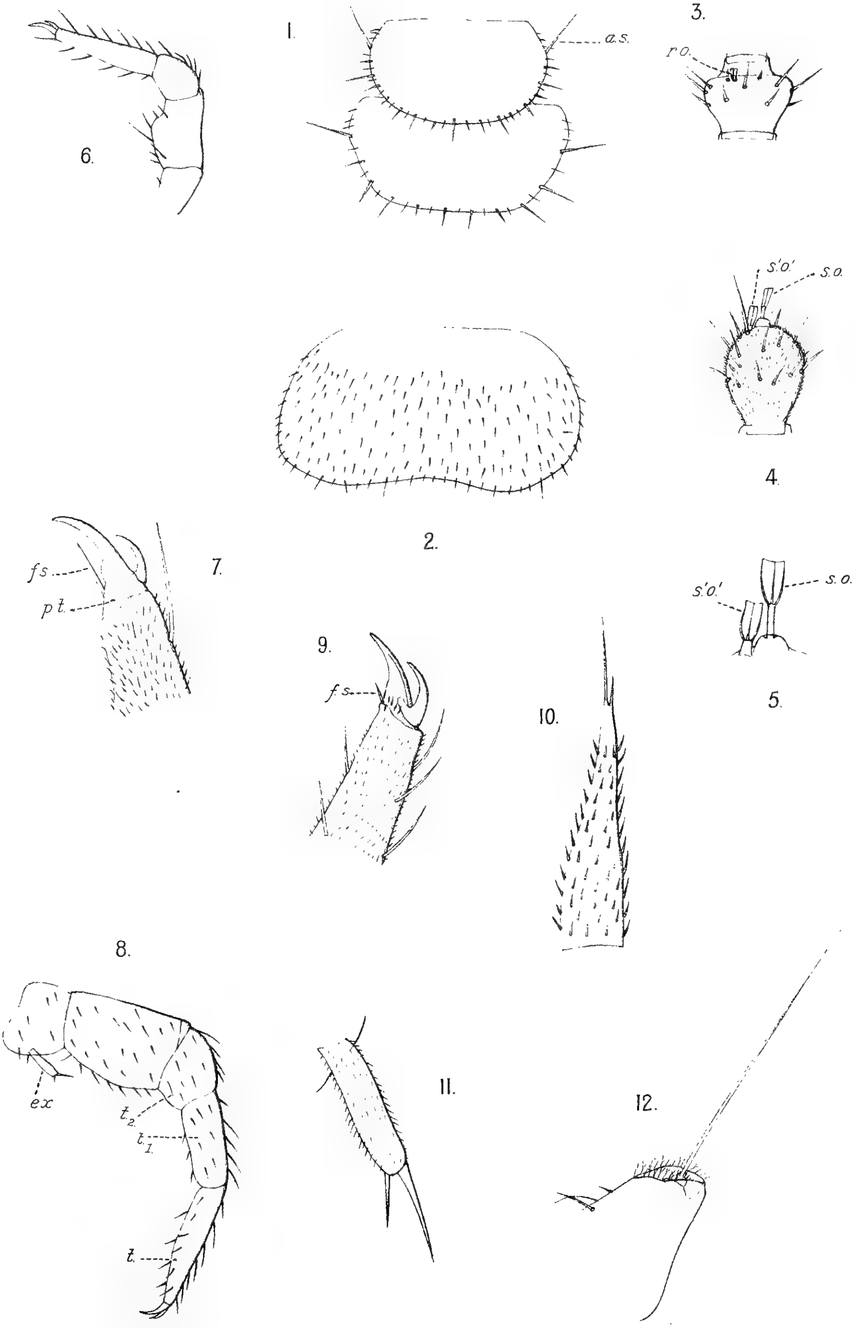
Cerci (fig. 10).—The length of the cercus is four times greater than the depth across the widest part. They are covered with short stout setæ, none of which is as long as half the depth of the cercus at the widest part. The largest of the two apical or terminal setæ longer by about one-sixth than the depth of the cercus.

Sensory Structures on the Last Segment (fig. 12).—These organs, which have been variously referred to as modified vestigial legs, caudal papillæ, &c., do not appear to afford much value as a specific character. In the present species each seta is very long and slender, being about three times as long as the sensory process itself; the calicles are of the form commonly found in *Scutigerella*.

Remarks on allied Species.—*S. subunguiculata* is closely allied to *unguiculata* but differs from it in the following characters. Out of nearly fifty examples of the latter species examined by Hansen, the variation in length is only 3 to 3·6 mm. and the number of antennal joints varies only from thirty to thirty-four. The sinus on the posterior margin of the thirteenth (penultimate) scutum is not so strongly marked as in *S. unguiculata*. Furthermore, the anterior claw on the last pair of legs is not quite so long and slender as is the case in the latter species, and is intermediate in this respect between it and *S. caldaria*, Hansen. The species is easily distinguishable from *S. caldaria* from the fact that the setæ, in the central whorl on the joints of the antennæ, are long and stout and equal in size on both the upper and lower aspects. *S. orientalis*, Hansen, is closely allied to *S. subunguiculata*, but is separable from it on account of possessing a shorter and stouter anterior claw to the last pair of legs, and a smaller expodite to the legs.

Our knowledge of the Symphyla has been greatly extended and placed on a sound basis by Hansen's admirable memoir * on the order. In that work six species are described and recorded from Asia, but none of them have been found in India, and only one up to the present is known from the mainland, viz., *Scutigerella orientalis* from Bangkok. It is also known

* Quart. Journ. Mic. Sci., vol. xlii, 1904, pp. 1–101, pls. 1–7.



A. D Imms. del.

J. T. Rennie Reid, Lith. Edin^r.

Scutigerella subunguiculata, sp. nov.

from Koh Chang (an island in the Gulf of Siam), Sumatra, and Java. *S. plebeia* is described from Mauritius and *S. crassicornis* and *pauperata* from Koh Chang. Of the genus *Scolopendrella* two species, namely *S. simplex* and *S. brevipes*, are recorded from Asia and both from the island of Koh Chang. No additional species have been added up to the present.

EXPLANATION OF PLATE 31.

Reference Lettering.

a.s. Antero-lateral seta.	*s'.o'.* Smaller sense-organ of antenna.
ex. Exopod.	*r.o.* Rudimentary sense-organ.
f.s. Front (or anterior) seta.	*t.* Tarsus.
p.t. Prætarsus (Hansen).	t_1. Metatarsus.
s.o. Principal sense-organ of antenna.	t_2. Tibia.

Fig. 1. *Scutigerella subunguiculata*, first and second scuta showing marginal setæ, × *circa* 60.
Fig. 2. Thirteenth (penultimate) scutum from same specimen, × *circa* 60.
Fig. 3. Thirteenth joint of the antenna of a specimen with thirty-one joints and measuring 5 mm. long, viewed from above, × 95.
Fig. 4. Terminal antennal joint viewed from above, × 95.
Fig. 5. Sense-organs of the same terminal joint, × 400.
Fig. 6. First leg of right side, × *circa* 90.
Fig. 7. Claws of first leg of left side viewed from behind, × 350.
Fig. 8. Last (twelfth) leg of left side, × *circa* 90.
Fig. 9. Claws of last leg of left side, × 350.
Fig. 10. Right cercus seen from the inner aspect, × *circa* 90.
Fig. 11. Exopod of twelfth leg of the left side, × 350.
Fig. 12. Process with sensory calicle and seta seen from the outer side, × 300.

Mimicry in Spiders. By R. I. Pocock, F.L.S., F.Z.S., Superintendent of the Zoological Society's Gardens.

(Plate 32.)

[Read 3rd December, 1908.]

Introductory Remarks.

Although mimicry in Insects has received much attention during the past forty years, mimicry in Spiders has been comparatively speaking neglected. Isolated notices of particular cases, and general statements of the occurrence of the phenomenon in this order of Arachnida, are to be found here and there in zoological literature ; but in very few cases are details given, and as a rule no suggestion is made even as to the family to which the mimetic spider belongs. I have thought it useful, therefore, to collect together such records as are known to me and to make them the subject-matter of a special paper.

It is now nearly twenty years since Mrs. Peckham gave a most useful summary of previously published views and facts connected with this question and recorded some original observations of the highest interest upon two species of mimetic Salticidæ found in North America. But very considerable additions to our knowledge have been made since that time, notably by the publication of Mons. E. Simon's great work, 'Histoire Naturelle des Araignées,' Paris, 1892–1903. Although this work is mainly systematic and deals with the families and genera of Spiders, it also contains brief accounts of their habits ; and amongst the latter are to be found numerous records of ant-mimicry, giving in some cases the name of the model as well as of the mimic. These were based upon the author's own observations during his collecting trips to the tropics of both the Eastern and Western hemispheres. I have borrowed from this volume of Simon's most of the cases of ant-mimicry mentioned in the following pages. My acknowledgment of this fact in this place will save the repetition of references to his work in the text.

Contents of the paper :—

Mimicry of Snails and Beetles by Spiders.

Amongst the Argyopidæ (=Epeiridæ) some species referred to the genus *Cyclosa* resemble small mollusca which, on account of the hardness of the shell, would be eaten by few birds and would certainly be neglected both by Pompilidæ and Ichneumonidæ, the principal enemies of Spiders, as unfit food for their larvæ. One species has been recorded from Ceylon *; another from North America †. The latter, when clinging to the underside of a leaf with its legs drawn up, is almost an exact copy in colour and shape of a small snail which is abundant in similar situations in the same locality during the warm months of the year. The resemblance is enhanced by the complete immobility the spider maintains when forcibly torn from its hold or when the plant is rudely shaken. According to Mr. Shelford ‡, another spider (*Cyrtarachne conica*) belonging to the same family, and recorded from Kuching in Borneo, also mimics a snail and has the habit of adhering to the underside of leaves. Other members of this family mimic ladybirds (Coccinellidæ). These beetles are known to be protected by a nauseous taste. Their short, oval, convex bodies, decorated above with yellow spots on a black ground or black spots on a yellow ground, are closely copied both in form and colour by certain tropical species; *e. g.*, by *Araneus coccinella*, *Paraplectana thorntoni* and *P. walleri* (Pl. **32**. figs. 6, 7, 8), by some East-Indian species of the last-named genus (*P. coccinella* and *P. 12-maculata*), as well as by other species from Brazil and elsewhere. According to Mr. Guy Marshall, *Paraplectana thorntoni* is, when living, coral-red with black spots, and mimics very exactly a Coccinellid (*Chilomenes lunata*) common in Natal §; and it was possibly one of the two above-mentioned Oriental species of the genus *Paraplectana* that Mr. Shelford ‖ cited as mimicking in Borneo the Coccinellid *Caria dilatata*.

It is probable that most if not all hard-shelled beetles, whether nauseous like the Coccinellidæ or not, are avoided by a majority of insectivorous animals; and it is still more probable that they are unsuitable articles of diet for the comparatively weak-jawed larvæ of Pompilidæ and Ichneumonidæ. Hence the reason for the imitation of little beetles by the genera *Coccorchestes*, *Homalattus*, *Rhene*, and other Spiders belonging to the Salticidæ.

The imitation of short, squat, and compact beetles is probably general and not of particular species of these insects. The resemblance to them displayed by the mimetic spiders is due to the coloration or metallic hues of the thickened integument, to a shortening of the legs, and to the expansion of the cephalothorax and abdomen—the one frequently overlapping the other,

* O. P. Cambridge, Encycl. Brit., Arachnida, p. 299 (noted by Col. Yerbury).

† G. F. Atkinson, Amer. Nat. 1888, p. 545.

‡ P. Z. S. 1902, vol. ii. p. 265.

§ See Pocock, Ann. Mag. Nat. Hist. (7) vol. ii. p. 213, 1898.

‖ P. Z. S. 1902, vol. ii. p. 268.

and thus leading in appearance to the partial obliteration of the narrow waist-like constriction between these regions which is so characteristic a feature of most spiders. Modifications of the same kind, accompanied by the acquisition of a yellow and black pattern, are instrumental in producing the likeness to Coccinellidæ, above referred to.

Mimicry of Ants and Mutillas by Spiders.

Apart from beetles, the only insects known to me to be mimicked by spiders are ants; but so numerous and perfect are the instances of ant-imitation that all other examples of mimicry amongst spiders sink into insignificance beside them. It is in this category, indeed, that occur some of the most complete illustrations of mimicry yet discovered.

The structural variations that effect this end take quite a different direction from those presented by the spiders that mimic beetles. Ants as a group are very uniform in build. They are characterized by a peculiar elegance of shape, marking them off from all other animals except their imitators. The head is large, the neck slender and mobile; the thorax and abdomen, often themselves constricted, are connected by a narrow waist; the legs are slender; the antennæ, projecting from the front of the head, long and bent. The movements of these insects are stamped by a certain boldness and intelligence which impart an unmistakable individuality to them. The chief difference in outward form between a spider and an ant lies in the absence of antennæ and the possession of four pairs of legs, instead of three, in the spider, and in the fact that the fore part of the body is covered by a continuous shield or carapace and is not differentiated into "head," "neck," and "thorax." In the more perfect instances of mimicry the last-mentioned difficulty has been met by the formation of a distinct constriction on each side of the spider's carapace, dividing it into an anterior part representing the head, a narrow intermediate part representing the neck, and a posterior part representing the thorax of the insect. In many cases the appearance of slenderness about the neck is increased by a strip of white hairs on each side of the constriction, which has the optical effect of cutting out an extra piece of the integument. The waist of the ant is reproduced by the conversion of the end of the carapace, and often of the anterior end of the abdomen, into a narrow stalk. In some cases the abdomen is itself shallowly constricted, and even the abdominal segments of the insect may be represented by transverse bands of hairs. The legs are always slender, like those of an ant, and one of the anterior pairs is held up in front of the head as a substitute for antennæ. Finally, in many cases where observations of the living animal have been recorded, it has been found that the spiders carry the deception to the extent of copying the manners and gait of the insects. Several observers have testified to this fact. In 1879, the Rev. O. P. Cambridge * pointed out that

* 'Spiders of Dorset,' p. 13; see also H. Donisthorpe, 'The Zoologist,' 1908, p. 424.

the Clubionid, *Micaria scintillans*, presents the closest resemblance to a large black ant [*Formica rufibarbis*] with which it associates.

Two North-American species of Salticidæ (*Peckhamia picata* and *Synemosyna formica*) have been closely studied by Mrs. Peckham *, who states that the former presents a general resemblance to ants of two or three species with which it associates indiscriminately. Like an ant, when hunting for prey, the spider always zigzags from side to side in its walk and holds up the legs of the second pair in front of the head to simulate a pair of antennæ. Instead of standing still while feeding, as most spiders do, this spider keeps up an incessant twitching of the abdomen, pulling about its prey in different directions the while, beating it with its fore legs, and imitating to the life the restless movements of an ant when similarly engaged. *Synemosyna formica* behaves in exactly the same way as *P. picata*, although without mimicking the zigzag walk of the ants.

A few more records may be quoted. In the Oriental Region there is a common red-and-black tree-ant, *Sima rufo-nigra*. It is pugnacious and fearless, attacking without hesitation almost any animal it meets. On human beings the effects of its bite are both painful and lasting. Wherever these insects occur in any numbers, a species of spider [*Myrmarachne providens*], one of the Salticidæ, is to be found running about amongst them. The spider closely resembles the ant in form and colour. It appears to be on the most friendly footing with its formidable associates, moving quickly here and there in their company and copying their busy, hurried actions †. Again, there is in India a spider, of unknown identity, almost indistinguishable from the female of an ant, *Camponotus opaciventris*, whose mode of progression by a series of rushes and pauses the spider imitates closely ; and in the neighbourhood of almost every strong colony of another ant, *Cremastogaster contenta*, a mimicking spider is to be found, moving about at a jog-trot and waving its abdomen in the air in exact imitation of the actions of its model. Again, in South Africa Mansell Weale ‡ discovered two species of Attidæ which bear the closest resemblance to ants. One is smooth, black and shining, and runs rapidly over the ground and on the bark of trees, and resembles an ant that builds its nests on acacia-bushes. The other is larger and has its cephalothorax dull black and its abdomen covered with short yellowish hairs. It is generally found running on the stems of herbaceous plants, and closely imitates an ant found in similar situations. The fore legs in both are frequently held up so that they closely resemble the antennæ of an ant.

As might be expected, ant-mimicry is of much commoner occurrence amongst ground-living species of spiders, belonging to the so-called "wandering tribes" which spin no snare, than it is amongst the snare-spinning sedentary

* Occ. Papers Nat. Hist. Soc. Wisconsin, 1889, pp. 110–113.

† Rothney, J. Bombay Nat. Hist. Soc. vol. v. p. 43, 1890.

‡ 'Nature,' 1871, p. 20.

groups. Instances, however, are not unknown amongst species of the latter kind.

In the Argyopidæ the males of the tropical American genus *Micrathena* (*Acrosoma*) differ strikingly from the large, gaudily (warningly) coloured, spiny females in having the abdomen black, slender, oval and elongated. In the males of *Ildibaha mutilloides* (Pl. **32.** fig. 1) and *myrmicæformis*, belonging to a genus closely allied to *Micrathena*, the abdomen is smooth, unarmed, deeply constricted in the middle, globular behind and oval in front of the constriction, where it meets the carapace which is itself narrowed behind. In an allied species, *I. albomaculata*, the abdomen is simply oval and without constriction. In butterflies it is common for the females alone to mimic a protected model, because being larger and heavier than the males and compelled to alight and remain at rest during oviposition, they are exposed to greater dangers of capture. This is reversed in the case of the spiders above mentioned. The females have a protective armature of spines and live in webs from which they can drop at once into the herbage beneath and lie absolutely still, hidden from the enemy that has startled them. But the males are not only without the spiny armature, but are compelled by the pairing instinct to wander about in search of the webs of the females. Another spider of this family, namely *Melyciopharis cynips*, is said by Simon to resemble ants. The thorax is attenuated behind, the waist is strongly pronounced, and the abdomen is globular. It is a native of the Amazons.

Formicina, one of the Linyphiidæ, a group which should probably be united with the Argyopidæ, has the carapace very narrow and long behind and the cephalic region high and shining; the abdomen is globular but not coriaceous, and the legs are long and slender. The spider lives on the ground and spins a large horizontal web amongst grasses or other low herbage. It occurs in South Europe and has a nearly related ally (*Solenysa*) in Japan. Both are ant-like.

The Theridiidæ furnish a few examples of this phenomenon, all met with in South America. *Formicinoides* has the carapace long, low, and produced far beyond the posterior legs in the form of a narrow cylinder where it passes into a short pedicel or waist connecting it with the abdomen, which is high. *Cerodida* much resembles the foregoing, but has the abdomen short and globular. In *Audifia* the carapace is also long, oval, and narrowed behind, but does not surpass the posterior coxæ; the abdomen is globular, with a hard shining smooth integument.

Coming now to the sedentary species, the Eresidæ furnish an instance analogous to that of *Ildibaha* mentioned above. In most species of this family the secondary sexual characters are well marked, especially as regards colour. But only in the case of the South-African genus *Seothyra* has an explanation of the difference been offered. The females of this spider (*Seothyra schreineri*) live in burrows in sandy parts of the veldt. The immature and moulting males have similar habits and, like the females, have the carapace and legs light brown and the abdomen smoky. But the adult males roam about the veldt by day and are totally different in colour, imitating in this particular as well as in movement the smaller specimens of a large vicious ant (*Camponotus fulvopilosus*) which is common in the locality. This similarity is not apparently effected by any special structural modification, the fore part of the carapace being normally rounded and rather sharply differentiated from the posterior portion, thus giving to the carapace a constricted appearance suggesting the head and thorax of an ant—the narrow waist, small abdomen, and longish slender legs of the spider, carrying the body well off the ground, completing the resemblance to the insect. The latter, like the spider, has the carapace and legs black, and moves in a series of rushes *.

In the Drassidæ two instances of mutilloid mimicry have been noticed in Rhodesia by Guy Marshall †. The species are *Melanophora* (*Prosthesima*) *albomaculata* and *Titus lugens*, which present a general resemblance to Mutillas.

Mutilloid mimics are also found in *Cœnoptychus* and *Graptartia*, two Ceylonese genera belonging to the family Clubionidæ. Both colour and shape combine to effect the likeness. The carapace is red in colour, rounded above and parallel-sided; while the abdomen, like that of the above-mentioned Drassidæ, is black and ornamented with white spots. This family—the Clubionidæ—furnishes some of the most perfect cases of ant-mimicry known, the most specialized forms of all being referable to the South American genus *Myrmecium*. The carapace is marked by a deep constriction behind the point of insertion of the legs of the second pair—the part in front of the constriction representing the head, and the part behind it, which is long and narrow and laterally bilobed, the thorax of the ant. The posterior extremity of the carapace is prolonged into a narrowed neck, which with the pedicel and a similar short prolongation from the abdomen exactly reproduces the waist of the insect. The abdomen is evenly oval or shallowly constricted. The colour varies according to the species of ant that is imitated. *Myrmecium nigrum* (fig. 3), which mimics *Pachycondyla villosa*, is black and clothed with close-set yellowish-green pubescence, and the abdomen is marked behind with transverse bands simulating segmentation. Other species are yellow or red, with the abdomen striped brown or black, to resemble species of *Megalomyrmex*. Others are black with yellow legs, in imitation of ants of the genera *Atta* or *Anochetus*; others, entirely brown and furnished with extra pubescence, reproduce exactly the form and colour of *Dendromyrmex fabricii*.

* C. C. Schreiner, Pop. Sci. Monthly, Dec. 1902, p. 162; Purcell, Ann. S. Afr. Museum, 1903, p. 32.

† Tr. Ent. Soc. 1902, p. 511.

Some species of the genus *Castaneira* (e. g., *C. tenuiformis*) from Paraguay, which mimics *Pachycondyla*, have the carapace very long and marked on each side by a deep groove forming a constriction behind the square cephalic portion. The legs are either spotted or annulated.

Somewhat similar are the species of *Corinomma* from the Oriental Region, which have the constricted carapace of the above-mentioned genera, with the integument black, olive, or red in colour and clothed with variously coloured plumose hairs forming transverse segmental zones on the cylindrical abdomen. The genus *Psellocoptis* contains large and handsome spiders from Venezuela, where they are found running rapidly over the trunks of trees. They are clothed with thick plumose pubescence, forming elegant yellow and white patterns on a black ground. The species of *Apochinomma* also closely resemble ants. The integument is generally black and shagreened and clothed with scaly, plumose, or simple white or yellow hairs, forming segmental belts on the abdomen. The carapace is long, rounded or truncated in front and attenuated behind; the abdomen is sometimes globular, with a long anterior stalk-like prolongation, sometimes cylindrical, with usually a lateral constriction. *Sphecotypus niger* (fig. 2) differs principally from *Apochinomma* in having a deep cephalothoracic constriction. It is a large blackish species common in the forests of tropical America, where it mimics *Pachycondyla villosa* even more closely than does *Castaneira tenuiformis*.

Two striking instances are found amongst the Thomisidæ *. *Aphantochilus* has the integument horny, granular, and black or brown in colour and shining; the carapace is squared and round with a spine on each side in front, and is narrowed and pointed behind, with a shallow lateral constriction. The abdomen is oval, marked with transverse integumental folds and studded with transverse rows of pale bristles which simulate segmentation. The palpi are tucked away beneath the edge of the carapace, and the four pairs of legs representing the antennæ and legs of the ant are long and slender. During life the species of this genus, which occurs in Venezuela and Brazil, offer a striking resemblance to ants of the genus *Cryptocerus*.

Amycicea forticeps (figs. 5–5 *a*) mimics and lives in company with the little red spinning ant, *Œcophylla smaragdina*, a common Oriental species. The colour of the spider is orange-red, relieved by a pair of black spots at the end of the abdomen. The carapace is high and rounded in front, but narrowed and prolonged behind. The abdomen is very different from that of the typical Thomisidæ, being cylindrical and elongated, rounded in front and behind, with a shallow median constriction, and leaves the carapace uncovered in front. The high and rounded cephalothorax of this spider represents the abdomen of the ant, the waists of the two correspond, and the long, constricted abdomen of the spider with the large black spots at the end, imitate the

* These two cases of ant-mimicry were detected by Simon, Hist. Nat. Araignées, vol. i. pp. 957 & 988, 1895.

thorax, head, and two eyes of the ant. Thus the posterior end of the spider corresponds to the anterior end of the ant, an anomaly no doubt connected with the habit, so characteristic of the Thomisidæ, of moving sideways and backwards with almost greater facility and frequency than forwards.

A second species of *Amyciæa*—*A. lineatipes*—has been discovered at Singapore also associated with *Œcophylla smaragdina*. It is a much less perfect mimic than *A. forticeps* because the abdomen is shorter, oval, and not constricted, so that the head and thorax of the insect are much less clearly indicated *.

Amongst the Salticidæ (Attidæ) are found species presenting every grade of ant-mimicry, from forms like *Peckhamia picata* which imitates ants in general, to the numerous species of *Myrmarachne*, in which, in many cases, the mimicry of particular species of these insects is carried to a state of perfection equal to anything found in the Clubionidæ. It is needless to give a complete list of all the genera that furnish illustrations of this phenomenon, since the structural modifications which combine to produce the resemblance are in all essential respects of the same nature in all, and differ in no important respects from those already described in the Clubionidæ and other families. An exception to this, however, is furnished by the males of some of the species of *Myrmarachne*, in which the elongated mandibles share in producing the required effect. For instance, in *M. plataleoides* (fig. 4)—a Ceylonese species which, like *Amyciæa forticeps*, mimics and associates with *Œcophylla smaragdina*—the mandibles, which are stretched straight forwards in front of the head, are narrow in their proximal half and swollen distally, and are furnished with a pair of black spots said to resemble the eyes of the ant. In this species and many others of the genus, both carapace and abdomen are constricted and the pedicel is elongated. In others the abdominal constriction is absent, and the thoracic varies much in depth. The genus *Myrmarachne* contains some seventy or eighty species, and is distributed over all the warmer temperate and tropical countries of the world. The species vary much in colour to accord with that of the models they live with and copy. A tolerably common Oriental species is *M. providens* which mimics *Sima rufonigra*; another in Venezuela mimics *Anochetus emarginatus*. Even in England the genus is represented by *M. formicaria*, which occurs with species of the genera *Myrmica* and *Formica* †. Of the remaining genera the following may be mentioned:—*Bocus* from the Philippines, differing only from *Myrmarachne* in the method of constriction of the sternum, which is expanded between the coxæ of the first and second legs instead of between those of the second and third pairs; the Neotropical *Sarinda*, *Erica*, and *Fluda*, which have the constriction of the carapace some-

* O. P. Cambridge, P. Z. S. 1901, p. 14, pl. 5. fig. 4; also Shelford, P. Z. S. 1902, p. 266.

† H. Donisthorpe, 'The Zoologist,' 1908, p. 424.

what shallow ; *Simonella* and *Synemosyna*, in both of which the carapace is deeply constricted, the abdomen being evenly oval in the latter and very long and deeply subdivided in the former. The species of these genera are said to show special resemblance to ants of the genus *Pseudomyrmex*. In addition, there are the Neotropical *Zuningia* with its allied genera; the European *Synageles* and *Leptorchestes*; *Semora*, *Semorina*, *Bellota*, &c. from South America, and *Agorius* from the Oriental Region—all of which and many others exhibit in various degrees a mimetic similarity to ants, their colours naturally varying in conformity with that of their models, being coppery, black, yellow, or black and red, diversified with hairs of various hues.

A very interesting observation, perhaps throwing some light upon the origin of ant-mimicry, was made many years ago by that keen naturalist Burchell, who, as recorded by Prof. Poulton, affixed a MS. label to a spider—one of the Salticidæ—he collected in South America, stating that its movements were like those of an ant. Now the spider itself, although small and dark-coloured, is not ant-like. This suggests that imitation of the movements of ants may have been the first modification of survival value, at least in some of the many cases of ant-mimicry above recorded.

Explanation of Ant-mimicry in Spiders.

It has been suggested more than once that ant-mimicry in the case of spiders is for purposes of aggression, the spiders being enabled by their resemblance to ants to live without detection in the colony and prey upon the insects, which mistake them for members of their own kind; and Mr. Shelford, in the paper already quoted, speaks of this explanation as the true and accepted one. I cannot bring myself to believe that this is so, in spite of the admitted fact that ant-like spiders have occasionally been seen to kill and eat their insect models.

Ants appear to be guided by other senses than sight in detecting friend from foe; and, as Mrs. Peckham has pointed out in this connection, are not deceived when an individual of their own species, exactly resembling them so far as we can see, but belonging to another colony, is introduced into a nest. That the spiders are permitted to consort with the ants is a puzzling phenomenon, and proves, in my opinion, that the similarity between them is much more deep-seated than we can perceive; but in what the similarity consists, unless it be "feel" and "smell," I am unable to suggest.

It is known, moreover, that insects of various orders—Orthoptera, Homoptera, and Lepidoptera (larvæ)—mimic ants, and it cannot be claimed that in these cases the mimicry is aggressive. If it is protective, as there are very strong grounds for believing, similar mimicry on the part of spiders is also probably protective. At all events the reasons that can be brought forward in support of the view that ant-like grasshoppers, bugs, and caterpillars are protected by their resemblance to these Hymenoptera, can be used with equal cogency to explain the ant-mimicry of spiders. There is no proof that ant-like spiders habitually feed upon the insects they mimic; but if this be shown in the future to be the case, I must still think that it is a secondarily acquired habit that has arisen subsequently to and independently of the superficial similarity in shape, colour, and gait between the two groups of arthropods.

Apart from the evidence supplied by the independent attainment of an ant-like form by a large number of spiders belonging to widely divergent families, strong testimony in favour of the protective usefulness of the resemblance can be brought forward.

An item of indirect evidence pointing to this conclusion is the fact that at least some of the spiders thus modified are known to produce at birth a very small number of young. According to Mrs. Peckham the ant-like spiders of North America have lower fecundity than any other group of spiders. *Peckhamia picata*, for example, lays only three eggs at a time. Since fertility is a measure of mortality, this exceptionally low birth-rate proves that the species is especially protected in some way; and since the spider is small, weak, and unprovided with special means of defence, it is justifiable to regard its survival, despite its infertility, as due to its likeness to ants. On the other hand, it may be asked, is there any direct evidence that ants are immune to the attacks of the enemies of spiders? A confident answer in the affirmative can be given. Ants are believed to be partially protected by an acid taste and are known to be able to bite and sting. They are also protected by their numbers and pugnacity, and are small, wiry, comparatively innutritious, and not worth the taking where other insects are to be had for food, except indeed by the comparatively small number of specialized vertebrate ant-eaters which are alleged to lick them up by the score *.

But whatever may be the reason, it is nevertheless a fact that ants are not preyed upon to any great extent at all events by other insects. Mrs. Peckham †, too, found that of the large numbers of Salticidæ kept by her in captivity none would touch ants, though they quickly devoured other insects and also spiders even of their own kind.

Most important of all is the fact that the solitary digger- or mason-wasps, the most inveterate enemies of spiders, scarcely ever, so far as I can ascertain, provision their cells with ants ‡. Some species, indeed, have been stated to evince a positive aversion to these insects. Horne §, for example, says that

* In this connection it is very necessary to bear in mind the confusion that is commonly made between ants and white-ants (Termitidæ). I suspect that many of the so-called "ant-eaters" like *Myrmecophaga*, *Manis*, and *Orycteropus*, have been so styled largely on account of their termite-eating propensities.

† Occ. Papers Nat. Hist. Soc. Wisconsin, 1889, p. 107.

‡ One of the Crabronides (*Fertonius luteicollis*) preys upon ants in Algeria—see D. Sharp, Insects, pt. ii. (Cambr. Nat. Hist.) p. 130, 1899.

§ Trans. Zool. Soc. vii. p. 171, 1872.

in India the red spinning ant (*Œcophylla smaragdina*), which I may add is mimicked in Singapore by two, possibly by three species of spiders and also by the larva of a Noctuid moth, attacks the wasps of the genus *Polistes*, to which it has great antipathy ; and to this Rothney * adds that these two kinds of Hymenoptera are never found inhabiting the same tree. Again, writing of *Pompilus fuscipennis*, Mr. & Mrs. Peckham † say that it "was one of the most fearless of the wasps .... the approach of an ant would throw her into a perfect panic, and seizing her spider she would make off with every sign of terror. It is difficult to understand why wasps of this species, as well as *P. biguttatus*, never offer combat to the ants, which rob them right and left, but invariably seek safety in retreat."

Now many of these wasps feed their larvæ solely upon spiders. When the time for egg-laying approaches, the female, aided sometimes by the male, starts hunting for spiders, flying in and out amongst the bushes and scouring every inch of ground, every nook and corner in her eager search. Few spiders when once found have much chance of escape from an enemy so swift of wing, so keen of sight, strong enough to carry many times her own weight, clad in a coat of horny mail and armed with a dagger-like sting and virulent poison. Some spiders succumb with scarcely a struggle ; some trust to speed of foot and run for their lives ; some when caught fight to the last. But the end is always the same. The wasp rises from the encounter victorious, and bears away her spoil in triumph to the mud-cell or burrow specially prepared for the purpose. When the receptacle is filled with carcases, the wasp lays an egg amongst them, closes up the mouth of the tomb, and starts afresh to provide for the rest of her brood in a similar manner. The number of spiders sacrificed for each larval wasp varies according to their size from one, as in the case of the large Aviculariidæ and some Lycosidæ, to many. In the United States, for example, *Sphex cyanea* commonly encloses from twenty to thirty or even forty in a single cell ‡. In West Africa Monteiro § counted as many as twenty, and found that there were seldom fewer than three cells together and often as many as eight or ten, all apparently made by the same wasp. Evidence of a like kind might be quoted without end from the works of travellers and naturalists. Nothing, however, more forcibly attests the extent of the destruction of spiders by these wasps than the following observation by G. W. Peckham ||, which may be quoted verbatim :—"Years ago, when we found that many of the Epeiridæ [Argyopidæ] laid enormous numbers of eggs (*Argyope cophinaria* from 500 to 2000), we wondered what

* Journ. Bombay Nat. Hist. Soc. v. p. 51.

† 'The Solitary Wasps,' p. 142.

‡ Hentz, 'Spiders of the United States,' p. 122.

§ 'Angola and the River Congo,' p. 324.

|| 'The Solitary Wasps,' p. 87.

became of the thousands of spiderlings. An acquaintance with *Trypoxylon* has shown us their fate, and has given us an illustration of how closely the two groups are related. To make a very modest estimate there must have been twenty wasps at work in our straw stack. During the six weeks which make the busiest part of their working season each of these must have stored, at the very least, thirty cells, putting an average of ten spiders into each cell. It may then be considered certain that the straw stack was the mausoleum of six thousand spiders, and it is very probable that twice as many were interred within its depths. It must be remembered, too, that before the spiders have grown large enough to be interesting to *Trypoxylon rubrocinctum*, *T. bidentatum* has had her turn at them, and that those that are allowed to grow too large for *T. rubrocinctum* are preyed upon grade after grade by *T. albopilosum* and finally by *Pelopæus*, *Pompilus*, and other genera." The conclusions embodied in this passage were based, be it noted, upon observations made in a small and circumscribed area in temperate North America. It is justifiable to conclude that persecution at least as dire and destructive in its effects has been carried on season after season probably for many thousand years in all tropical and temperate countries where Pompilidæ and Spiders occur ; and setting aside the frigid zones of the world, the distribution of the two groups is practically cosmopolitan. This being so, it seems to be absolutely certain that wasp-persecution has had perhaps a greater effect in moulding and developing the structure and protective instincts in spiders than any other factor in organic nature ; and I am convinced it supplies the clue to many otherwise puzzling facts in spider economy. However that may be, the ascertained facts that the Pompilidæ do not provision their nests with ants, and that some of the species that persecute spiders have special antipathy to these little insects, furnish convincing evidence of the survival value of ant-mimicry to spiders *.

Let me not be misunderstood to suggest that it is only from the Pompilidæ that spiders are saved by this form of mimicry. I have no doubt that it protects them also from the attacks of other enemies, notably from Ichneumon flies of the genera *Hemiteles*, *Polysphincta*, *Acrodactylus* and others, as well as from various insectivorous mammals, birds and reptiles. But although the annual mortality in the spider-world caused by these enemies, especially by the Ichneumonidæ, is no doubt considerable, it probably sinks into insignificance beside that brought about by the mason and digger wasps. The view here advocated that ant-mimicry in spiders is protective was long ago insisted upon by Belt as well as by H. H. Smith †. But I am not aware

* Since some species of the solitary wasps prey upon grasshoppers and other insects, this suggested explanation of the value to spiders of their resemblance to ants applies also to the ant-imitators found amongst Orthopterous, Homopterous, and other insects.

† See Peckham, Occ. Papers Nat. Hist. Soc. Wisconsin, 1889, p. 108.

that the special advantage the mimetic species derive from being avoided by Pompilidæ and Ichneumonidæ has hitherto been pointed out *.

Two conclusions appear to me to emerge very clearly from a study of the genuine cases of mimicry in Spiders.

1. There is no reason to suppose that any of the mimetic species are themselves specially protected in any way or inedible. Therefore their imitation of other animals that are avoided by the enemies of spiders is mimicry in the Batesian and not in the Müllerian sense of the word. In other words it is true mimicry.

2. Since it can be shown that the mimicry has in every case a survival value, the modifications that have brought it about fall within the scope of Natural Selection.

Doubtful cases of Mimicry in Spiders.

The instances of mimicry already cited in this paper cannot in my opinion be questioned. The same assurance cannot, however, be held about the following cases.

A possible case of protective mimicry in nest-building is furnished by the burrow of *Dolichoscaptus inops*, a species of the Cyrtaucheniinæ that lives in Algeria. Round the aperture of the burrow is erected a low chimney rising to half an inch or more in height, and consisting of silk stiffened with débris of various kinds which conceals the silk and makes the burrow resemble those formed by the solitary bees *Odynerus* or *Anthophora* †.

The advantage the spider derives from this resemblance, it may be suggested, lies in the immunity these bees enjoy to the attacks of mason-wasps, for the latter, mistaking the spider-burrows for those of the bees, would pass them by without further enquiry. But until it is definitely established that the nests of the bees occur in the same locality, the evidence for the view above stated remains unsatisfactory.

* Although not strictly speaking belonging to the subject-matter of the present paper, the following observation is, I think, worth putting on record.

While watching one of the solitary digger-wasps at work last summer hunting for spiders with which to provide her larvæ, I saw her dislodge from a cranny between two stones an immature specimen of a species of *Phalangium*, possibly *P. cornutum*. She ran swiftly in chase of the Arachnid, but the moment she touched it with her antennæ turned aside and let it go. Although it is well known that the Phalangidæ possess stink-glands opening one on each side of the cephalothorax, which have been held to be of protective significance, I am not aware of any recorded evidence of their being rejected by the enemies of spiders. Certainly no instance of this has previously come under my own notice. It is possible of course that the wasp may have rejected the *Phalangium* for other reasons; but I think the escape of the Arachnid may be regarded as probably due to its inedibility owing to the smelling secretion it exudes.

† Simon, Actes Soc. Linn. Bordeaux, xlii. p. 394, pl. 12. fig. 5, 1887.

Prof. Poulton * long ago suggested that the larvæ of two British species of Hawk-Moths (*Chærocampa elpenor* and *porcellus*) are protected by the likeness to the heads of snakes presented by their anterior extremities which are ornamented with large eye-like spots. The correctness of this surmise has been subsequently substantiated in the case of these two species by Weismann and Lady Verney, and the interpretation has been extended to other species of the genus *Chærocampa*, namely, to *C. osiris* by Mr. Guy Marshall † in S. Africa, and to *C. myodon* by Mr. Shelford ‡ in Borneo. The experimental proof of the truth of Prof. Poulton's view justifies the acceptance as a working hypothesis of the suggestion put forward by Mr. Saville Kent § that the Australian Argyopid, *Pœcilopachys bispinosa*, is protected from attack by the similarity its abdomen presents to a reptile's head. The cephalothorax of this spider is small; but the abdomen is of large size, wide, subtriangular in form, broad in front, gradually narrowed behind and flattened above. Its integument is a delicate mottled lilac hue, with a pair of pale yellow circular eye-like prominences, set one on each side of the broad anterior part of its upper surface. These in conjunction with the flattened subtriangular-shaped abdomen impart to this region, according to the observer, a singular similarity to the head of a small snake or goggle-eyed, gecko-like lizard. Lurking at the bottom of its silken tube with nothing but its abdomen visible, this spider suggests to a prospective enemy that it is trespassing upon the home of a reptile and running the risk of being itself destroyed. A similar appearance may be seen in a few other spiders of this family; in *Cyrtarachne lactea* from East Africa for example ||.

Mr. Saville Kent's ingenious suggestion is worth recording so that it may hereafter be refuted or substantiated by experiment.

In all the cases of mimicry real or imaginary hitherto considered, the resemblance to the model appeals to the enemies' sense of sight. In one possible case amongst spiders the appeal is made to the auditory sense. In South Africa there is a fairly large spider, *Sicarius*, belonging to the Scytodidæ, which is furnished with a stridulating organ consisting of a series of short thick spines on the inner surface of the femur of the palp and of a finely-ridged area on the adjacent outer surface of the mandible. A species found by Simon in the Transvaal lives under stones, lying flattened with legs extended upon the soil. Its movements are extremely slow; and instead of attempting to escape when seized, it lies still and stridulates, giving out a sound resembling the buzzing of a bee. The behaviour of this spider

* 'Colours of Animals,' p. 261; see also 'Essays on Evolution,' pp. 367–368, 1908.

† Trans. Ent. Soc. London, 1902, p. 397.

‡ Proc. Zool. Soc. 1902, pt. ii. p. 253.

§ 'Naturalist in Australia,' p. 257, 1897.

|| Pocock, Ann. Mag. Nat. Hist. (7) ii. p. 446, 1898.

is like that of a protected species. Were this so its stridulation would come, like that of the Aviculariidæ, under the category of warning (aposematic) characters. But the resemblance of the stridulation to that of a bee may be pseudaposematic and suggest to would-be aggressors that the spider itself, although harmless, is in reality, like a bee, dangerous to meddle with *.

A possible and oft-quoted instance of aggressive mimicry in spiders was suggested long ago by Trimen, who stated that some Salticidæ imitate crawling flies in their movements and are enabled thereby to approach the insects without alarming them. This view, however, is not in keeping with my own observations upon the visual powers of flies ; nor do the hunting methods of the Salticidæ bear it out. For no sooner do they sight a fly than they suspend the alleged deceptive crawling movement, and substitute stillness, followed by a stealthy cat-like creep and a lightning leap over the intervening space. This method would be unnecessary were Mr. Trimen's hypothesis true. If there be, as is possible, mimicry in this case, I suspect it is also protective; and that the spiders benefit by deceiving wasps which, mistaking them for flies, perhaps pass them by as difficult or impossible to catch.

EXPLANATION OF PLATE 32.

Fig. 1. *Ildibaha mutilloides*, Sim., ♂ (after Simon) (p. 260).
2. *Sphecotypus niger*, Perty, ♀ (after Simon) (p. 262).
3. *Myrmecium nigrum*, Perty, ♂ (after Simon) (p. 261).
4. *Myrmarachne plataleoides*, O. P. Cambr., ♂ (after Simon) (p. 263).
5. *Amyciæa forticeps*, O. P. Cambr., ♂ (after Cambridge) (p. 262).
5 *a*. „ „ „ Lateral view with legs removed to show the ant-like profile and the eye-like spot at the end of the abdomen.
6. *Paraplectana thorntoni*, Blackw. (after Simon) (p. 257).
7. „ *walleri*, Blackw. (after Simon) (p. 257).
8. *Araneus coccinella*, Poc. (after Pocock) (p. 257).

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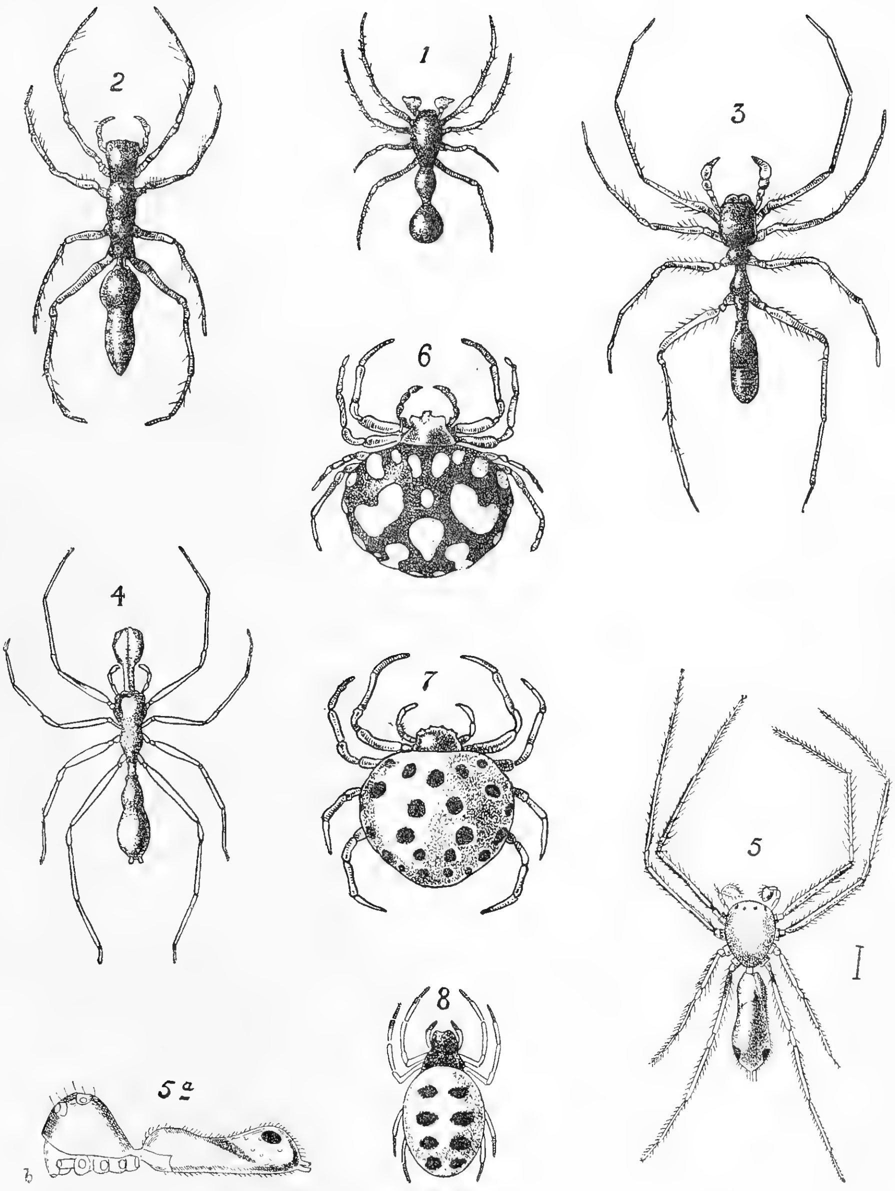
* Pocock, 'Natural Science,' vi. p. 49, 1895.

Probably owing to his writing from memory of this suggestion as to the stridulation of *Sicarius*, Mr. G. A. K. Marshall unintentionally misrepresents me as believing that the stridulation of Scorpions and Mygale Spiders (Aviculariidæ) is pseudaposematic, recalling the shrill, angry buzz of wasps (Trans. Ent. Soc. London, 1902, p. 403). As a matter of fact, I have always believed, and frequently stated the belief, that the stridulation in these two groups of Arachnida is aposematic in exactly the same sense as is the rattle of the rattle-snake. Scorpions can sting and the Aviculariidæ have a poisonous bite and urticating bristles.



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MIMICRY IN SPIDERS.

Observations on the Œconomy of the *Ichneumon manifestator*, Marsham (*nec* Linn.). An Historical Note. By Claude Morley, F.E.S. (Communicated by E. A. Cockayne, F.L.S.) (With text-figure.)

[Read 4th February, 1909.]

So long ago as the year 1794 a former Hon. Secretary of the Linnean Society, Thomas Marsham, author of the earliest work exclusively devoted to British beetles *, read before this Society a Memoir † upon "Œconomy of the *Ichneumon manifestator*, Linn."; and this has subsequently been oft-quoted as the most complete account we have had, even to the present time, of the habits of the genus *Ephialtes*, Schr., though the identity of the species referred to with that described by Linnæus has frequently been doubted and never satisfactorily established. Marsham's description of it: "Corpore atro immaculato, abdomine sessili cylindrico, pedibus rufis," might be applied with equal accuracy to all the members of this genus, in such a manner that, in my 'Ichneumonologia Britannica' ‡, I was obliged to place these most valuable observations generically, for to append them to any specified species would be invidious, excepting in the case of *Ephialtes manifestator*, Linn., itself; and that Marsham's insect differed from the last named species is made abundantly plain by his drawings on pl. iv. p. 29. These agree, as I have remarked (*op. cit.* p. 32), very much better with *Ephialtes carbonarius* than the species indicated, and none of them are more than 17 mm. in length, whereas the actual species never attains maturity at a smaller size than 21 mm.

It may not be out of place, perhaps, to notice the interesting habits of the species given by Marsham. He says that he first observed the insect, of which the male was unknown to him, sitting on an old post in Kensington Gardens on 9th June, 1787. It was feeling over the wood with its curved antennæ and, on finding the burrow of some insect, they were thrust into it up to their bases §; the horns were withdrawn and again inserted, until the insect was assured that the victim, for whom she destined her eggs, was present and in a fit condition to receive them. Then her position was reversed and the long ovipositor intruded into the hole, in one or two instances so far that the body was also concealed,

* Entomologia Britannica—Coleoptera. 1802.

† Trans. Linn. Soc. iii. (1797) pp. 23–29 et figg.

‡ 'The Ichneumons of Britain,' vol. iii. pp. 31–33 (MM. Brown, 20 Fulham Road, S.W.), 1908.

§ *Cf.* Kirby, 'Monographia Apum Angliæ,' i. p. 186, et ii. p. 251.

leaving only the head, wings, anterior legs, and apices of the terebral valvulæ visible. On the 16th of the same month many were observed at work in this manner: they appeared to pierce the solid wood with their ovipositor, but in reality it was inserted into a previously bored and filled-in hole, through the fine white sand closing the burrows of a bee, *Apis maxillosa*, now known as *Chelostoma florisomne*, Linn. In October, he saw another female on a post at Lessness Heath, near Erith; this had its ovipositor fixed in a hole, and he himself had to withdraw it. He noticed the same species at work annually (showing they were much commoner then than now, when no member of the genus is frequently met with, and after ten years collecting I have captured but some half dozen of the single species, *E. carbonarius*, Christ.); and on 23rd July, 1791, he saw one standing directly over the burrow of *Apis maxillosa*, with the ovipositor in the burrow and its hind femora steadying the abdomen. It frequently withdrew its ovipositor a quarter or three-eighths of an inch and then plunged it in again with great force, with a pulsatory movement of the anus, as though through the passage of an egg.

This last remark so closely relates the parasite with its host, that it is only on account of the utter lack of all subsequent* observation, both here and abroad, of the oviposition of *Ephialtes* or any member of the subfamily *Pimplinæ*, to which this genus belongs, in other species of Hymenoptera that we are led to suspect Marsham of having been in error in supposing the host to have been *Chelostoma*. Mr. Fred. Smith first suggested † that some mistake had crept in; and this is by no means impossible, for no mention is made of the host having been examined: it was simply inferred from the shape and size of the orifice, and the manner in which it was filled in. Smith remarks that, where colonies of this bee are met with in posts and rails, there are usually also two Coleopterous insects, *Melandrya caraboides* and *Clytus arietis*, depositing their eggs; and that it is, perhaps, upon one or other of these that the ichneumon preys. But though certainly more probable, I can hardly suspect so good an entomologist as Marsham ‡ of mistaking the distinctly elongate borings of the Longicorn for the circular burrows of the bee.

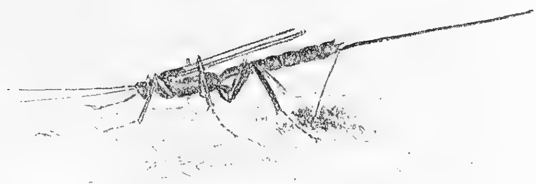
* It must, however, not be lost sight of that Réaumur (Mémoires pour servir à l'histoire des Insectes, vi. (1741), p. 304; quoted by James Rennie, 'Insect Transformations,' 1830, p. 57) had noticed "*Pimpla manifestator*, Grav.," ovipositing through the barricadoed orifice of the nest of the Mason Wasp (*Odynerus murarius*, Linn.); though there is something bizarre about the parasite "waiting patiently till the wasp, having laid in a store of caterpillars for the young one, closes up the doorway, in order to find a nest ready prepared and stocked with provisions for her own progeny"!

† 'Catalogue of British Bees,' p. 188.

‡ See the "Journal of Mr. Kirby's Excursion with Mr. Marsham to Northamptonshire," in 'Life of the Rev. William Kirby, M.A., F.R.S., F.L.S., etc., Rector of Barham,' by John Freeman, M.A. Longmans, 1852, pp. 79–112.

And this was the position arrived at, at the time of publication of my volume on the Pimplinæ*.

Mr. E. A. Cockayne, F.L.S., F.E.S., has recently sent me a specimen of *Ephialtes extensor*, Tasch., a common Continental species which had not hitherto been noticed in Britain, for determination; and subsequently generously presented me with the specimen. His notes upon it are so extremely similar to those of a hundred and twenty years ago that I quote them *in extenso*. Near the Round Pond in Kensington Gardens at 5.45 P.M. on September 7th, 1908, he saw this ichneumon fly sitting on the trunk of an old oak. It appeared at first sight to be at rest, but on closer examination was found to be engaged in oviposition. The head was depressed and the abdomen slightly raised with the sheath of the ovipositor sticking straight out behind. The



ovipositor itself was pushed through a small congregation of dark brown frass on the bark, and pointing forward (see figure) at an acute angle with the body †. The insect kept gently and slowly pushing its ovipositor further in and then withdrawing it again, but never pushing it very deeply nor entirely withdrawing it: as if feeling for a larva. Sometimes it held it quite still for a second or two, as though very softly investigating with its tip. After about one minute or two it drew out its ovipositor entirely, and he then secured it. Upon investigating the burrow he discovered a larva of the clear-wing moth, *Sesia cynipæformis*; it was about a quarter of an inch below the frass in a small chamber in the bark. It appeared to be about 10 mm. in length.

* 'The Ichneumons of Britain,' vol. iii. pp. 31–33 (MM. Brown, 20 Fulham Road, S.W.), 1908.

† *Cf.* Marsham's drawings, 3 et 4.

Three interesting questions present themselves: Was Marsham's insect *Ephialtes extensor*, Tasch., now for the first time recorded as British? has it existed and propagated in Kensington Gardens ever since it was mentioned as found there so long ago? and, supposing *Ichneumon manifestator*, Msh. (*nec* Linn.) to be *Ephialtes extensor*, Tasch., have we determined whether it has predilections for a hymenopterous, coleopterous, or lepidopterous diet? Taschenberg * quotes Panzer as the author of his species, but *Ichneumon extensorius*, Panz. †, is regarded by Dalla Torre ‡ as a synonym of *Ichneumon primatorius*, Forster §, belonging to a very different group of insects. As regards its Continental hosts, nothing at all reliable can be stated, since none have yet been instanced for the actual species; but two insects described under the allied genus *Pimpla* by Ratzeburg ‖ have been doubtfully synonymized with it ¶, and these were originally bred from, respectively, *Cynips* (*Biorrhiza*) *terminalis* (*aptera*, Bosc) and *Tortrix* (*Grapholitha*) *dorsana*, Rtz. (*pactolana*, Zll.); but these very hosts are so dissimilar as to render the synonymy extremely doubtful.

* Zeitschrift für die gesammten Naturwissenschaften, Berlin, 1863, p. 255.

† 'Faunæ Insectorum Germaniæ Initia,' ii. (1794) p. 19, t. 10.

‡ 'Catalogus Hymenopterorum,' iii. (1901) p. 972. Dalla Torre is very certainly in error in regarding (*op. cit.* iii. p. 447) *Ephialtes extensor*, Tasch., as synonymous with *Pimpla roborator*, Fab.; and consequently the hosts he gives are valueless.

§ J. R. Forster, 'Novæ Species Insectorum,' London, 1771, p. 81.

‖ 'Die Ichneumonen der Forstinsekten': (1) *Pimpla caudata*, Ratz., ii. 92; and (2) *Pimpla longiseta*, Ratz., i. 117.

¶ By Schmiedeknecht, 'Opuscula Ichneumonologica,' iii. (1907) p. 1134.

The Polyzoa of Madeira and neighbouring Islands.

By Canon A. M. Norman, M.A., D.C.L., LL.D., F.R.S., F.L.S.

(Plates 33–42.)

[Read 4th February, 1909.]

My late friend Mr. J. Yate Johnson was well known on account of his researches into the Fauna and Flora of Madeira, and especially with respect to the Marine Vertebrates and Invertebrates. For fully forty years he collected the Polyzoa, depending chiefly on fishermen who brought to him the refuse from their lines. I am not aware that he ever dredged, but it is not unlikely that the Rev. R. Boog Watson, when superintending dredging for the sake of the Mollusca, gave him Polyzoa which were procured. From time to time during those forty years Mr. Johnson submitted his specimens for determination and description to Professor George Busk, the Rev. Thomas Hincks, and Mr. Arthur W. Waters; but shortly before his death he himself published a short paper on a few Cyclostomous species. The following is a list of the literature which relates to the Polyzoa of the Madeiran fauna :—

Busk (Prof. George).—"Zoophytology." Quart. Journ. Micros. Sci. vol. vi. 1858, pp. 124–130, pls. 18, 19.

—— "On some Madeiran Polyzoa." Ibid. vol. vi. 1858, pp. 261–263, pl. 20.

—— "On some Madeiran Polyzoa." Ibid. vol. vii. 1859, pp. 65–69, pls. 22, 23.

—— "Catalogue of the Polyzoa collected by J. Y. Johnson, Esq., at Madeira in the years 1859 and 1860." Ibid. vol. viii. 1860, pp. 280–285, pl. 31.

—— Id. (*continued*). Ibid. vol. ix. 1861, pp. 77–80, pls. 32, 33.

Hincks (Rev. Thomas).—"Contributions towards a General History of the Marine Polyzoa: I.—The Madeiran Polyzoa." Ann. & Mag. Nat. Hist. ser. 5, vol. vi. pp. 70–80, pl. 9 & pl. 10. figs. 1–4.

Waters (A. W.).—"Observations on the Membraniporidæ." Linn. Soc. Journ., Zool. vol. xxvi. 1898, p. 654. In this paper eight species were recorded from Madeira, of which four were new to that fauna.

—— "Bryozoa from Madeira." Journ. Roy. Micros. Soc. 1899, pp. 6–16, pl. 3.

Johnson (J. Yate).—"New Cyclostomous Bryozoa found at Madeira." Ann. & Mag. Nat. Hist. ser. 6, vol. xx. 1897, p. 60.

Having been ordered to the south after a very severe illness, I went to Madeira in March 1897, stayed there ten weeks, and returned in May. Weather permitting, I dredged westwards as far as Praya Formosa, and eastwards to Labra Bay. But my chief work was nearer to Funchal itself. Here I found good ground in the neighbourhood of the coaling-ship, and among the material was the coal which had fallen to the bottom, to which many erect and creeping forms attach themselves. Still richer ground, and that to which I devoted my chief attention, was in 50 to 70 fathoms off the

Lazaretto and thence to Cabo do Garajão. I had with me a hand-winch, which so immensely lessens the labour of hauling in the dredge. Aided by this I had dredged without difficulty in the Norwegian fiords down to nearly 400 fathoms, and at Madeira—given fair weather—I found no difficulty in working at the previously mentioned depths of 50–70 fathoms. I therefore determined to try deeper water. Success so far attended the effort that a small quantity of the bottom was brought up from between 200–300 fathoms *. Unfortunately, at the second attempt the dredge caught on a rock, and a breeze having sprung up, it was lost. I suppose that this was the first time such a depth had been worked from an open four-oared boat in the Atlantic Ocean. The little material which had been procured was a revelation. Here were so many old friends that I might have imagined that I was again dredging in a Norwegian fiord. There were present *Arca pectunculoides*, *Portlandia messanensis*, *Cuspidaria rostrata*, *Pulsellum quinquangulare*, &c., together with the Polyzoon *Tessarodoma boreale* and the Foraminifer *Cyclammina cancellata* of large size and in great abundance, as well as other species of Mollusca, all new to the Madeiran fauna. The shores of Madeira are for the most part precipitous, and there are not many spots where shore-hunting can be carried out, but at Gorgulho I found profitable ground.

It remains for me to thank kind friends who have rendered me assistance.

I am greatly indebted to Padre Schmitz, who has got together such an excellent museum of the local fauna at the Seminario, where also are now to be found the collections of Mr. J. Yate Johnson. In the spring of 1908, when I was on a short second visit to the island, Padre Schmitz not only allowed me to examine at my leisure the whole of the Polyzoa named and unexamined which were contained in the museum, but also permitted me to bring away with me certain type specimens for closer examination and comparison. I am also further indebted to him for the gift of many interesting specimens.

At this same visit to the island I made the acquaintance of Senhor Adolpho Cæsar De Noronha, a most enthusiastic zoologist and geologist, who has during the past year sent to me several consignments of Polyzoa, collected by himself not only at Madeira but also from the islands of Porto Santo and the Salvages, of the marine fauna of which we have been up to the present time in almost absolute ignorance.

I have to thank Mr. R. Kirkpatrick, of the British Museum, for the valuable assistance which he has given me by enabling me to examine many types of

* It must be understood that the depths given in this paper are merely approximate as no soundings were taken. They are estimated first by use of the chart, and secondly by the amount of line employed. In the dredging here referred to nearly 600 fathoms of line were let out.

Busk's and of Hincks's species, and also for very kindly consulting for me two works which were not in my own library.

Dr. S. F. Harmer, who has made a special study of *Tubulipora*, has kindly examined for me the two or three specimens I had belonging to that somewhat difficult genus, the species of which have been so greatly confused.

The total number of species of Polyzoa contained in this catalogue is 139. Of these Professor Busk had included 45 species in his papers of 1858–1861 Mr. Hincks enumerated 24, of which 21 were additions to the fauna. Mr. Waters named 52, of which 28 had not previously been recorded; and Mr. Johnson described 7, of which 6 were not previously known. This paper contains 39 species new to Madeira, making up the total number previously mentioned—139, of which 114 are recorded on my own authority.

In the catalogue of species which follows, the capitals B., H., W., or J., after the name of the Polyzoon indicate that it has previously been recorded from Madeira by Busk, Hincks, Waters, or Johnson, as the case may be.

POLYZOA.

Subclass I. ENTOPROCTA.

Ascopodaria gracilis (*M. Sars*).

The Madeiran specimens are of larger size than those from more northern habitats, but not nearly so large as *Ascopodaria* (*Barentsia*) *major*.

Subclass II. ECTOPROCTA.

Order **Gymnolæmata**.

Suborder I. **CYCLOSTOMATA**.

Crisia eburnea (*Linné*).

Common, tide-marks and shallow water.

Crisia elongata, *H. M.-Edwards*.

In 40–70 fathoms, but not common.

Crisia fistulosa, *Heller*. (Pl. **35**. fig. 6.)

1867. *Crisia fistulosa*, Heller, Bryoz. Adriat. Meeres, p. 118, pl. 3. fig. 5.

1879. *Crisia fistulosa*, Waters, "Bryoz. Bay of Naples," Ann. & Mag. Hist. ser. 5, vol. iii. p. 268, pl. 23. fig. 3.

1906. *Crisia tenella*, Calvet, Bull. Mus. Hist. Nat. p. 218, and 1906. Expéd. Scient. 'Travailleur' et 'Talisman,' Bryozoaires, p. 460, pl. 30. figs. 1, 2.

A few small pieces from deep water. The specimens have been compared with a cotype in my collection received from Professor Heller. This is not the *Crisia fistulosa* of Busk (Cat. Marine Polyzoa Brit. Mus.: III. Cyclostomata, p. 5).

Stomatopora granulata (*H. M.-Edwards*). J.

1897. *Alecto simplex*, J. Y. Johnson, "New Cyclostomous Bryozoa found at Madeira," Ann. & Mag. Nat. Hist. ser. 6, vol. xx. p. 60.

I have examined Johnson's type, and have found specimens of it in deep water, but can see no specific difference from *S. granulata.*

Tubulipora aperta, *Harmer*.

1898. *Tubulipora aperta*, Harmer, Quart. Jour. Micr. Sci. new ser. vol. xli. p. 101, pl. 8. figs. 2, 3.

A single specimen only obtained, which appeared to be this species, but to make certain I sent it to Dr. Harmer, who confirmed my identification.

Tubulipora druidica, *Busk*. B.

1859. *Tubulipora druidica*, Busk, Quart. Journ. Micr. Sci. vol. vii. p. 67, pl. 22. fig. 9.

I have been unable to find the type specimens of this species. I leave it in *Tubulipora*, as placed by its describer ; but it can scarcely belong to that genus as now understood.

Idmonea liliacea (*Pallas*).

This is *I. serpens* of authors. Dr. Harmer has placed it in *Tubulipora.* It is not uncommon at Madeira.

Idmonea atlantica, *E. Forbes*. B. (Pl. **33.** figs. 1, 2.)

Two or three small specimens in deep water. A portion of one of these is figured for comparison with the species which follow and to show the oœcium.

Idmonea Meneghinii, *Heller*. (Pl. **33.** figs. 3–5.)

1867. *Idmonea Meneghinii*, Heller, Bryoz. Adriat. Meeres, p. 44, pl. 3. figs. 6, 7.
1880. *Idmonea Meneghinii*, Waters, "Ovicells of Cyclostomous Bryozoa," Linn. Soc. Journ., Zool. vol. xx. p. 278, pl. 14. fig. 2.

The *Idmonea* which I here name *I. Meneghinii* is certainly figured very badly by Heller, but a comparison with a small fragment received from him at the time of the publication of his memoir establishes the identity with certainty. As developed at Madeira it is an elegant and beautiful form. It consists of very slender branches, the lower portions of which scarcely exceed the upper in breadth, which is usually less than half a millimetre. The growth of the whole zoarium has an upward tendency, and the division of the branches is usually at a very acute angle. The cells are generally arranged two or three together, and their lower portion, which is united with the branch itself, is strongly arched, while their apices are projected at the sides almost at a right angle ; the free portion is short, generally not exceeding half the diameter of the branch. The frontal surface is sparingly punctured ;

on the back the zoœcia are marked out by ribbed sculpture, and there is almost an entire absence of punctation. A fine specimen measures 20 mm. high and 12 mm. wide.

Dredged in about 70 fathoms, and I found very fine specimens in the Funchal Museum.

Idmonea fragilis, Calvet (Expéd. Scient. 'Travailleur' et 'Talisman,' Bryozoaires, 1906, p. 470, pl. 30. fig. 10), would seem to be this species with the cells longer than usual.

IDMONEA CONCAVA, *Reuss*. (Pl. **33**. figs. 10–12.)

1879. *Idmonea concava*, Waters, "Bryozoa from Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 274.

Clusters of zoœcial tubes usually consisting of three; the clusters are more widely separated from each other than is usual, their lower portion attached to the branch straight; free portion very little raised and not extending beyond the sides of the branch; surface with scattered punctures. Back remarkably flat or even slightly concave, sculptured with longitudinal lines and punctate. The examples found agreed with Neapolitan specimens given me by Mr. Waters. Dredged in 50–70 fathoms.

IDMONEA PEDATA, n. sp. (Pl. **33**. figs. 6–9.)

Zoarium small, very rarely branched, usually consisting of a single stout stem 10–12 mm. long, which, when looked at laterally, has a wavy outline, bending down here and there are curious foot-like supports. These pedicels are 2–4 in number to each specimen, and are apparently used for attachment to some object, but although I have examined about 200 specimens, I have only found one actually attached; this example was situated on the Foraminifer *Polytrema miniaceum* of Pallas. The zoœcial clusters contain normally three tubes, which are of moderate length. The under surface is slightly punctated, and sculptured longitudinally and also with transverse curved lines.

Dredged abundantly in about 70 fathoms to the east of Funchal, off the coast between the Lazaretto and Cabo do Garajäo.

FILISPARSA IRREGULARIS (*Meneghini*). (Pl. **34**. figs. 1–7.)

1844. *Idmonea irregularis*, Meneghini, Polipi della Fam. dei Tubuliporiani, [sep.] p. 12.
1867. *Idmonea irregularis*, Heller, Bryoz. des Adriat. Meeres, p. 121, pl. 3. fig. 6.
1875. *Idmonea irregularis*, Busk, Cat. Marine Polyzoa Brit. Mus., iii. Cyclostomata, p. 13, pl. 12.
1882. *Tervia Folini*, J. Jullien, "Drag. 'Travailleur,' Bryoz.," Bull. Soc. Zool. France, vol. vii. p. 5 (separate copy), pl. 13. figs. 8, 9.
1882. *Tervia superba*, J. Jullien, ibid. p. 4, pl. 17. figs. 74, 75.
1888. *Idmonea irregularis*, Waters, "Ovicells of Cheilostomous Bryoz.," Linn. Soc. Journ., Zool. vol. xx. p. 279, pl. 14. figs. 5, 6 (as *Filisparsa irregularis*).

1896. *Tervia Folini*, Calvet, Camp. du 'Caudan,' Bryozoaires, p. 265, pl. 7. figs. 1–3.
1906. *Filisparsa irregularis*, Calvet, Expéd. Sci. 'Travailleur' et 'Talisman,' Bryozoaires, p. 472.

Zoarium branching at wide angles of 45° or more; zoœcia in groups usually of three (2–5); other zoœcia are scattered on the face of the branches; punctured both above and below, and dorsally marked by pellucid lines indicating the margins of the zoœcial chambers.

Var. 1, typical. Zoarium stout, groups of zoœcia shorter than the diameter of the branch, not united closely together in wing-like arrangement (Pl. **34.** figs. 1–3).

Var. 2, *pennata*, var. nov. Zoœcia united in pretty wing-like groups of usually five tubes of considerable length, equalling the diameter of the branch (Pl. **34.** figs. 4, 5).

Var. 3, *superba*, J. Jullien. Branches very slender; zoœcia very long, exceeding in length the diameter of the branch, rarely in groups of more than three, often of only two, the outermost the longest (Pl. **34.** figs. 6, 7).

This is a very variable species, to which I feel confident that the foregoing forms should be referred, and I am also disposed to believe that the two species of J. Jullien, *Tervia solida* and *T. discreta*, are also only conditions of *F. irregularis*.

Dredged in 50–70 fathoms off Madeira (*A. M. N.*); Porto Santo to the south of Cima in 90 fathoms (*De Noronha*).

HORNERA PECTINATA, *Busk*. B., J.

1861. *Hornera pectinata*, Busk, Quart. Jour. Micr. Sci. vol. ix. p. 79, pl. 33. figs. 4–6.
1897. *Hornera pectinata*, Johnson, Ann. & Mag. Nat. Hist. ser. 6, vol. xx. p. 61.

I saw several specimens in the museum at Funchal, and Padre Schmitz was so kind as to give me one of them; but it was not until after an examination of the type specimen in the British Museum that I was satisfied as to the correctness of my determination. The fact is that the mouths of the zoœcia are not strongly pectinated as in Busk's figure, and indeed in the type specimen itself the indications of such irregular margins are only slight.

ENTALOPHORA PROBOSCIDEA (*H. M.-Edwards*). (Pl. **35.** figs. 1–3.)

1838. *Pustulipora proboscidea*, H. M.-Edwards, "Mém. sur les Crisies, &c.," Ann. des Sci. Nat. ser. 2, vol. ix. p. 27, pl. 12. fig. 2.

Common and very fine. A specimen is figured for comparison with the following species. Senhor de Noronha has also sent it to me from Porto Santo.

ENTALOPHORA ELEGANS, nom. nov. (Pl. **35**. figs. 4, 5.)

1906. *Entalophora subverticillata*, Calvet, Expéd. Sci. 'Travailleur' et 'Talisman,' Bryozoaires, p. 175, pl. 30. figs. 5, 6.

Distinguished from the preceding by its more spreading habit of growth and its very short zoœcial tubes, which are less than a quarter of the diameter of the branch in length. This gives the species, when seen by the naked eye, an entirely different aspect to that of *E. proboscidea*. Calvet's enlarged figure agrees fairly with my specimens, but that of the natural size indicates a larger and stouter growth than I have seen. Calvet's name cannot be used, as Busk's *Pustulopora subverticillata* of the Crag is an *Entalophora*.

A few specimens only obtained.

ENTALOPHORA DEFLEXA (*R. Q. Couch*). (Pl. **34**. figs. 8–13.)

1844. *Tubulipora deflexa*, Couch, Cornish Fauna: III. The Zoophytes, p. 107, pl. 19. fig. 4.

1859. *Pustulipora clavata*, Busk, Crag Polyzoa, p. 107, pl. 17. fig. 1.

1880. *Entalophora clavata*, Hincks, Brit. Marine Polyz. p. 456, pl. 65. figs. 5–8.

The Madeiran specimens from deep water show very great variation; figures of three specimens are given. *Pustulipora deflexa* of Hincks may or may not be this species.

FRONDIPORA VERRUCOSA (*Lamouroux*). J.

1897. *Frondipora maderensis*, J. Y. Johnson, "Cyclostomous Bryozoa found at Madeira," Ann. & Mag. Nat. Hist. ser. 6, vol. xx. p. 64.

An examination of Johnson's specimens in the Funchal Museum shows them to be the well-known Mediterranean species. I also dredged several pieces.

LICHENOPORA RADIATA (*Audouin*). J.

1897. *Diastopora catillus*, J. Y. Johnson, l. c. p. 61.

Johnson's types belong to this species, which is common off Madeira.

LICHENOPORA HISPIDA (*Fleming*). J.

1897. *Lichenopora spinata*, J. Y. Johnson, Ann. & Mag. Nat. Hist. ser. 6, vol. xx. p. 62.

The type in the Johnsonian collection appeared to me to be a very fine condition of *L. hispida* such as is sometimes developed in very sheltered situations (compare Hincks, pl. lxviii. fig. 2); the zoœcia terminating in spines, and their basal portion often angulated, that is furnished with a longitudinal rib. The species is subject to very great variation. The zoœcia are usually short, but sometimes very long when in an entirely protected place.

Lichenopora irregularis (*Johnson*). J.

1879. *Radiopora pustulosa*, Waters, "Bryozoa Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 277, pl. 24. fig. 15.

1897. *Radiopora irregularis*, J. Y. Johnson, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 63.

Mr. Johnson's *irregularis* is undoubtedly the species well figured by Waters and referred by him to *Radiopora pustulosa*, d'Orbigny (Paléont. Fran., Crétacé, p. 994, pl. dcxlix. figs. 1–5), but I have thought best to use Johnson's name rather than that of the Chalk fossil, which bears a general resemblance to it. It is quite distinct from the British *Lichenopora hispida*, var. *meandrina*, Peach.

Diastopora pulchella, *J. Y. Johnson*. J.

1897. *Diastopora pulchella*, Johnson, Ann. & Mag. Nat. Hist. ser. 6, vol. xx. p. 61.

I know nothing of this species.

Suborder II. CTENOSTOMATA.

Alcyonidium effusum, n. sp. (Pl. 35. figs. 7–9.)

Encrusting foreign substances completely with the coating zoarium. The zoarium is thickly beset with zoœcia. These zoœcia consist of a peduncle about three times as high as broad, and a crown of 18–20 slender tentacles. This species differs from all the others of the genus known to me in the very slow or the unwilling contractility of the tentacles. The two specimens found were picked out of the sieve and dropped into a bottle of spirit; and they both still have the mass of their zoœcia in a state of fullest expansion, hence the origin of the specific name I employ, *effusum*. I am not sure what the object is which they clothe, but I think it is a portion of *Antipathes*. I figure one of these of the natural size; the second is almost exactly like it except that attached to the *Antipathes* (?) is a young shell of *Ostrea cochlear*, and this also is entirely clothed with the Alcyonidium.

Dredged in deep water.

Lobiancopora hyalina, *Pergens*.

1888. *Lobiancopora hyalina*, Pergens, "Deux nouveaux types des Bryozoaires Cténostomes," Ann. Soc. Roy. Malac. de Belgique, vol. xxiii. pl. 14. figs. 4–7 (separate copy).

1906. *Lobiancopora hyalina*, Calvet, Expéd. Sci. 'Travailleur' et 'Talisman,' Bryozoaires, p. 372.

Dredged by the 'Travailleur' at Madeira in 400 metres, numerous colonies.

Suborder III. CHEILOSTOMATA.

ÆTEA ANGUINA (*Linné*).

Common on weed.

ÆTEA SICA (*Couch*). H.

This is *Ætea recta*, Hincks. Not uncommon on shells.

ÆTEA TRUNCATA, *Landsborough*. B.

Recorded by Busk.

PASITHEA EBURNEA, *Smitt*. W.

Recorded by Waters.

GEMELLARIA LORICATA (*Linné*).

A very small fragment dredged. This requires confirmation, since the fragment was so small, that it is *possible* that it might have been clinging in a crevice of the sieves and have been derived from a more northern habitat.

SCRUPOCELLARIA REPTANS (*Linné*).

A small fragment between tide-marks, Funchal.

Var. BERTHOLLETII (*Audouin*). (Pl. **36**. figs. 1, 2.)

1826. *Acamarchis Bertholletii*, Savigny's Egypte, pl. 11. fig. 3.

1867. *Scrupocellaria capreolus*, Heller, Bryozoër Adriat. Meeres, p. 11, pl. 1. fig. 1.

Small specimens taken off Funchal. One specimen, which agrees in all other respects, is totally devoid of scuta.

SCRUPOCELLARIA SCRUPOSA (*Linné*).

Dredged in 15–40 fathoms.

SCRUPOCELLARIA INCURVATA, *Waters*.

1897. *Scrupocellaria incurvata*, Waters, "Notes on Bryozoa from Rapallo," Linn. Soc. Journ., Zool. vol. xxxi. p. 9, pl. 1. figs. 16, 17.

1903. *Scrupocellaria aquitanica*, Jullien & Calvet, Résultats Camp. sci. Prince de Monaco, Bryozoaires provenant des campagnes de l' 'Hirondelle,' p. 35, pl. 3. figs. 2 *a*, 2 *b*.

The remarkable large arcuate vibracular cells of this *Scrupocellaria* are peculiarly distinctive. Several specimens were dredged in 50–70 fathoms at Madeira. The types of Mr. Waters were from Naples, and the examples procured by the Prince de Monaco were from 134 metres in the Bay of Biscay.

Scrupocellaria Delilii (*Audouin*). B., W.

1826. *Crisia Delilii*, Audouin, Savigny's Egypte, pl. 3. fig. 3.
1859. *Scrupocellaria Delilii*, Busk, Quart. Journ. Micr. Sci. vol. vii. p. 65, pl. 22. figs. 1, 2.

Fine specimens from the Telegraphic Cable (*De Noronha*).

Scrupocellaria Macandrei, *Busk*. B.

1852. *Scrupocellaria Macandrei*, Busk, Cat. Marine Polyzoa Brit. Mus. p. 25, pl. 24. figs. 1–3.
1860. *Scrupocellaria Macandrei*, Busk, "Cat. Polyzoa Madeira," Quart. Journ. Micr. Sci. vol. viii. p. 281.
1884. *Scrupocellaria Macandrei*, Busk, 'Challenger' Polyzoa, p. 23, pl. 11. fig. 4.

Off Funchal (*A. M. N.*), Salvages (*De Noronha*). As first described and figured by Busk this species was said to be distinguished from *S. scrupea* by the fact that it had only a single minute spine at the outer angle of the orifice : but in the 'Challenger' Report it assumes an entirely different aspect. As compared with the *S. scrupea* of our southern coasts, it is more slender in all its parts and of less porcellanous appearance. The oral opening is shorter and more round in outline, with the hinder margin flattened, and sometimes finely granulated ; the marginal spines are commonly six, four on the outer and two on the inner margin ; the scutum is nearly round, with its pedicel attached to the middle of its side ; the lateral avicularia are of somewhat larger size than in *S. scrupea* ; and median small avicularia often occur situated by the base of the scutum. I have not seen the oœcia.

In *S. scrupea* the spines are usually two or three on the outer, and one or two on the inner margin of the oral aperture. The scutum is distinctly reniform, and the pedicel is attached in front of the middle. My observations agree with those of Hincks, who states that he has not seen frontal avicularia when no oœcia are developed, but that when oœcia are present there is usually a small avicularium seen immediately above them.

Scrupocellaria maderensis, *Busk*. B.

1860. *Scrupocellaria maderensis*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 280, and vol. ix. 1861, p. 77, pl. 32. fig. 1.

I have not seen any specimen exactly corresponding with Busk's figure ; but with the amended characters of *S. Macandrei* it would certainly seem that *S. maderensis* can scarcely be kept apart from it.

Scrupocellaria hirsuta, *Jullien & Calvet*.

1903. *Scrupocellaria hirsuta*, Jullien & Calvet, Résult. Camp. sci. Prince de Monaco, fasc. xxiii. Bryozoaires, p. 35, pl. 3. fig. 3.

No scutum ; mouth spines four or five, and on young cells at the extremity of a branch even six; frontal avicularia of large size; lateral avicularia very small, only visible when the zoœcia are viewed from the side; vibracular cells oblong, the grasping-organ with the extremity digitate. Oœcia covered with scattered pustules.

One small specimen found at Madeira creeping on what appeared to be a fragment of the root of a seaweed, where it was accompanied by *Ætea anguina*. Jullien and Calvet did not notice the very small lateral avicularia.

CABEREA BORYI (*Audouin*). B.

Porto Santo and Telegraphic Cable, Madeira (*De Noronha*).

BUGULA NERITINA (*Linné*).

Off Funchal, especially near the coaling ship.

BUGULA AVICULARIA (*Linné*). B.

Funchal Bay (*De Noronha*).

BUGULA PLUMOSA (*Pallas*).

A small fragment, Porto Santo (*De Noronha*).

BUGULA DITRUPÆ, *Busk*. B., W.

1858. *Bugula flabellata*?, var. *biseriata* s. *ditrupæ*, Busk, Quart. Journ. Micr. Sci. vol. vi. p. 125.
1858. *Bugula ditrupæ*, id. ibid. p. 261, pl. 20. figs. 7, 8.
1886. *Bugula ditrupæ*, Hincks, "Polyzoa of the Adriatic," Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 260, pl. 9. figs. 3, 4.
1897. *Bugula ditrupæ*, Waters, "Polyzoa from Rapallo, &c.," Journ. Linn. Soc., Zool. vol. xxvi. p. 12, pl. 2. figs. 2, 3.

This small species is by no means rare in 40–70 fathoms a little to the east of Funchal. It would seem to be a true commensal. All the specimens I have seen were attached to the anterior end of *Ditrupæ*, as represented in Busk's figure. Hincks and Waters, however, do not make any allusion to this peculiar habitat, so probably the specimens examined by them were detached from their base.

BUGULA DENTATA (*Lamouroux*). (Pl. **36**. fig. 3.)

1852. *Bugula dentata*, Busk, Cat. Marine Polyzoa Brit. Mus. p. 46, pl. 59.

I am indebted to Senhor de Noronha for a very fine specimen of this species taken at Porto Santo, which measures 2 inches high and $3\frac{1}{2}$ broad. I also saw a Madeiran specimen in the museum of the Seminario at Funchal, which was erroneously named. It is an interesting addition to the Madeiran fauna; its previously known range was Australia, New Zealand, Tasmania, and South Africa. The slaty colour of the zoarium is a very distinctive characteristic, which at once catches the eye.

Bugula gracilis, *Busk*. B. (Pl. **36.** figs. 4–6.)

1858. *Bugula gracilis,* Busk, Quart. Journ. Micr. Sci. vol. vi. p. 125, pl. 19. fig. 1.

A single and small specimen of this very delicate and slender species dredged off Funchal.

Beania hirtissima, *Heller*. W.

On weeds between tide-marks. Gorgulho, Madeira.

Mollia patellaria (*Moll*). W.

1867. *Diachoris simplex,* Heller, Bry. Adriat. Meeres, p. 18, pl. 1. fig. 4.

Lamouroux (Hist. Poly. Coral. flex. 1816, p. 115) established the genus *Mollia*, with *Mollia patellaria*, Moll, as the type and only species given. The generic name has been much misapplied, but must by every right be used for this and such other forms as may be regarded as congeneric.

Senhor De Noronha sent me two large round masses of Nullipore from the Salvages, and *M. patellaria* was coating the rough surface in great profusion.

Hincksina flustroides (*Hincks*). W.

1880. *Membranipora flustroides,* Hincks, Brit. Marine Polyz. p. 151, pl. 19. fig. 1.
1880. *Membranipora nodulifera,* Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 71, pl. 9. fig. 2.
1903. *Hincksina flustroides,* Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xi. p. 385.

I found specimens of this species undetermined in the Johnsonian collection, and also a specimen exactly as *M. nodulifera*, Hincks, which I agree with Waters in regarding as a worn specimen of this species.

Hincksina maderensis (*Waters*). W.

1898. *Membranipora maderensis,* Waters, "Notes on the Membraniporidæ," Linn. Soc. Journ., Zool. vol. xxvi. p. 677, pl. 49. figs. 2–6.

In 40–70 fathoms on shells (e. g. *Avicula*), and on the coral *Madracis asperula* but rare.

Membranipora membranacea (*Lamk.*).

I found a specimen in the Johnsonian collection.

Membranipora tuberculata (*Bosc*). B.

1802. *Flustra tuberculata,* Bosc, Hist. Nat. des Vers, vol. iii. p. 118.
1839. *Flustra tehuelcha,* D'Orbigny, Voy. dans l'Amér. Mérid. vol. v. pt. 4, p. 17, pl. 8. figs. 10–14.

1858. *Membranipora tuberculata,* Busk, Quart. Journ. Micr. Sci. vol. vi. p. 126, pl. 18. fig. 4.

1898. *Membranipora tehuelcha,* Waters, "On Membraniporidæ," Linn. Soc. Journ., Zool. vol. xxvi. p. 674, pl. 48. figs. 6–8.

Specimens of this species are in the Johnsonian collection, and others collected at Porto Santo have been sent to me by Senhor De Noronha. In all cases they are encrusting the Gulf-Weed (*Sargassum*), especially the round air-bladders, and they would seem to have drifted to the locality where they occurred.

Mr. Waters would reject Bosc's name on account of insufficient description and a reference to *Flustra dentata*, Müller (Zool. Dan.). With regard to the reference, when so little was known in 1802, it is not surprising that it should be thought that any species having spines on the margin might be a synonym. Bosc's description is: "*Flustra tuberculata.* Incrustée, les cellules ovales avec chacune trois dents et un bourrelet à leur ouverture"; but it appears to me that the habitat given settles the matter, for he states that it is found "en immense quantité sur les fucus nageans dans l'Atlantique," for this species is essentially the Polyzoon of the Gulf Weed.

MEMBRANIPORA TRICHOPHORA, *Busk.* B.

1858. *Membranipora trichophora,* Busk, Quart. Journ. Micr. Sci. vol. vi. p. 126, pl. 18. fig. 2.

The type specimen of this curious species is in the British Museum. Not knowing where to place it, it is here left in *Membranipora.* There are in reality six spines on the anterior part of the zoœcium, but of the central pair I was only able to see the stumps, while the two lower pair, when present, are of extraordinary length as figured by Busk. The oral bar, as figured by Busk, does not exist, so that the front is truly Membraniporiform.

CALLOPORA LINEATA (*Linné*). B.

Busk gives this species, without any observation, as Madeiran. I have not seen it. If not again met with, it may be presumed that *Hincksina maderensis* was the species found.

CALLOPORA DUMERILEI (*Audouin*). W.

1905. *Membranipora Guernei,* J. Calvet, Résult. Camp. sci. Prince de Monaco, xxiii. Bryozoaires, p. 4, pl. 5. fig. 3.

I found one small specimen in 1897.

CRASSIMARGINATELLA CRASSIMARGINATA (*Hincks*). B., H., W.

1860. *Membranipora Lacroixii* (?), Busk, Quart. Journ. Micr. Sci. vol. viii. p. 282.

1861. *Membranipora irregularis,* Busk, ibid. vol. ix. p. 77, pl. 33. fig. 3 (nec d'Orbigny).

1880. *Membranipora crassimarginata*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 71, pl. 9. fig. 1.
1900. *Crassimarginatella crassimarginata*, Canu, "Revis. Bryoz. de Crétacé figurés par d'Orbigny," Bull. Soc. Géol. France, p. 369.
1903. *Oochilina crassimarginata*, Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xi. p. 595.

On stones between tide-marks, and dredged on shell, Madeira (*A. M. N.*); Salvages, on nullipore, and also at Porto Santo (*De Noronha*).

Crassimarginatella tenuirostris (*Hincks*). H.

1879. *Membranipora Flemingii*, Waters, Ann. & Mag. Nat. Hist. ser. 3, vol. iii. p. 122, pl. 13. fig. 2.
1880. *Membranipora tenuirostris*, Hincks, Ann. & Mag. Nat. Hist. ser. 5 vol. vi. p. 70, pl. 9. fig. 3.

On stones between tide-marks at Gorgulho, and also dredged.

Antropora granulifera (*Hincks*). H.

1880. *Membranipora granulifera*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 72, pl. 9. fig. 4.
1903. *Antropora granulifera*, Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xii. p. 87.

Not uncommon on shells, stones, and *Madracis asperula* in 50–70 fathoms. The examples on the coral referred to are commonly associated with *Onychocella angulosa*, to which species, when seen with the naked eye, it bears a remarkable resemblance (*A. M. N.*). Porto Santo in 60 fathoms (*De Noronha*).

Rosseliana Rosselii (*Audouin*). B.

1880. *Membranipora Rosselii*, Hincks, Brit. Marine Polyz. p. 166, pl. 22. fig. 4.
1888. *Rosseliana Rosselii*, Jullien, Mission Sci. du Cap Horn, Bryozoaires, p. 78.

Some small typical fragments occurred, and also a very large example on stone, differing from all other specimens I have seen in having the openings occupying a less portion of the zoœcium than usual, or in other words the covered portion longer than usual.

Membraniporella nitida (*Johnston*). H., W.

This species has been recorded both by Hincks and Waters, but I have not myself seen any typical Madeiran *nitida*, but only the form described below.

Var. intermedia. (Pl. **36**. fig. 7.)

In all respects except the front wall this form agrees with *M. nitida*; but whereas in all the varieties of that species seen by me from northern localities the radiating ribs are separated during their length and are only united on the median line, there joining the extremities of those from the opposite side, and thus constituting the longitudinal central rib; in this var. *intermedia* the radiating ribs coalesce with each other by crossbars, so as to form roundish openings or "lateral lacunes," * as I have termed them. In fact this Madeiran form in its structure is in all respects a true *Cribrilina.*

MEMBRANIPORELLA SCELETOS (*Busk*). B., H., W. (Pl. **36.** fig. 8.)

1858. *Membranipora sceletos,* Busk, Quart. Journ. Micr. Sci. vol. vi. p. 262, pl. 60. fig. 3.

1880. *Membranipora sceletos,* Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 73.

1898. *Membranipora sceletos,* Waters, "On Membraniporidæ," Linn. Soc. Journ., Zool. vol. xxvi. p. 677, pl. 49. figs. 2–6.

1903. *Membraniporella neptuni,* J. Calvet, Résult. Camp. sci. Prince de Monaco, xxiii. Bryozoaires, p. 38, pl. 5. fig. 2.

The form of the spines arching over the zoœcium in this species, instead of being horizontally compressed and widened as is the case in *M. nitida*, are vertically, that is laterally, compressed ; so that, to use Mr. Waters's words, "under the microscope we are looking down upon the narrow edge of the flattened spines." These spines usually remain isolated from each other ; even although they may cross in the centre. But this is not always the case. In several examples which have come under my observation, they are coalesced (see right-hand zoœcium in figure here given), though in consequence of the ribs meeting each other at different angles, they may still be separately distinguished, the union not being so absolute as in *M. nitida.* Yet it would seem that we must regard *M. sceletos* as a member of the genus to which I here remove it.

CUPULARIA GUINEENSIS, *Busk.* B. (Pl. **37.** figs. 2–6.)

1854. *Cupularia guineensis,* Busk, Cat. Marine Polyzoa, p. 98, pl. 114.

1859. *Cupularia canariensis,* Busk, Quart. Journ. Micr. Sci. vol. vii. p. 66, pl. 23. figs. 6–9.

1859. *Cupularia canariensis,* Busk, Crag Polyzoa, p. 87, pl. 13. fig. 2.

1873. *Membranipora canariensis,* Smitt, Floridan Bryozoa, p. 10, pl. 2. figs. 69–71.

1884. *Cupularia guineensis,* Busk, 'Challenger' Polyzoa, p. 206, pl. 14. fig. 6.

Waters unites also with this species *C. stellata*, Busk (Brit. Mus. Cat.) and *C. monotrema*, Busk ('Challenger').

Zoarium only slightly raised, saucer-shaped ; zoœcia narrowly lozenge-shaped, calcareous margin simple, without any inward projecting developments. Lower side divided into more or less regular quadrate portions, each of which would seem to represent a zoœcium ; these divisions contain pores, usually four in number, but occasionally only two or three. The divisions, though normally four-sided, are occasionally five or six-sided, more especially towards the centre, as figured by Busk in *C. guineensis* (Cat. Polyzoa).

Common in 50–70 fathoms.

* *Vide* Norman on the structure of Cribrilinidæ in "Notes on the Natural History of East Finmark," Ann. & Mag. Nat. Hist. ser. 7, vol. xii. 1903, pp. 90–99.

CUPULARIA LOWEI, *Gray*. B. (Pl. **37**. figs. 7–12.)

1854. *Cupularia Lowei*, Busk, Cat. Marine Polyzoa, p. 99, pl. 116.
1869. *Cupularia umbellata*, Manzoni, "Bryoz. Plioc. Ital.," Sitz. d. k. Akad. Wissensch. vol. lix. p. 10, pl. 2. fig. 16.

This is most conspicuously distinct from its Madeiran allies. Unlike in growth to them, it does not consist of a round zoarium taking its origin from a central point, and developing equally round that centre so as to form a circular organism; but in *Lowei*, even when the zoarium is circular in form, it is only irregularly so and is made up of distinct radial segments, but more generally only a certain number of segments being developed, the zoarium is more or less fan-shaped. The under surface is quite white and porcellanous, with only faint lines usually apparent. Seen from above the zoœcia are broad in proportion to their length, the oral aperture is marked off by a *well-developed band to constitute the lower lip*, and the vibracular cells encroach on the following zoœcium. The appearance when dead is also very distinct, the lower lip being very characteristic.

Common in 50–70 fathoms off the coast near the Lazaretto, in company with the other species.

CUPULARIA JOHNSONI, *Busk*. B. (Pl. **38**. figs. 1–6.)

1859. *Cupularia Johnsoni*, Busk, Quart. Journ. Micr. Sci. vol. vii. p. 67, pl. 23. figs. 1–6.
1869. *Cupularia Reussiana*, Manzoni, "Bryoz. Plioc. Ital.," Sitz. d. k. Akad. d. Wissensch. vol. lix. p. 11, pl. 2. fig. 19.
1873. *Cupularia doma*, Smitt, South Floridan Bryoz. ii. p. 15, pl. 3. figs. 81–84.

Zoarium conical, in the form of a little dome. The zoœcium is somewhat narrowly lozenge-shaped, and has an important specific character in the fact that from the sides in the position of the lower lip calcareous processes are developed inwards so as to present an interrupted bar. The underside is profusely studded with small tubercles (fig. 3). In a variety which is smaller and less raised than the type (fig. 5) the radiating ridges are greatly developed, and bear two rows of tubercles regularly placed and of much larger size than those of the type (fig. 6).

In 40–70 fathoms in company with the two preceding species, and on ground which is very rich in Polyzoa and Mollusca.

CUPULARIA OWENI, *Gray*. B.

1828. *Cupularia Oweni*, Gray, Spicilegia Zoologica, pt. i. p. 8, pl. 3. fig. 15.
1854. *Cupularia Oweni*, Busk, Cat. Marine Polyzoa, p. 99, pl. 115.

Busk records this species from Madeira. It is unknown to me as Madeiran.

CRIBRILINA RADIATA (*Moll*). B., H., W.

1803. *Eschara radiata*, Moll, ("Die Seerinde") Eschara, p. 63, pl. 4. fig. 17.
1826. *Flustra Pouilletii*, Audouin, Savigny's Egypte, pl. 9. fig. 12.
1858. *Lepralia radiata*, Busk, Quart. Journ. Micr. Sci. vol. vi. p. 263, pl. 20. figs. 4, 5.
1859. *Lepralia Pouilletii*, id. ibid. vol. vii. p. 66, pl. 22. fig. 6.
1864. *Lepralia scripta*, Reuss, "Fauna des deutschen Oberoligocäns," Sitz. k. Akad Wiss., Math.-naturwis. Cl. i. Bd. i. p. 641, pl. 15. fig. 3.
1869. *Lepralia scripta*, Manzoni, "Bryoz. foss. Ital.," Sitz. k. Akad. Wissensch. vol. lx. p. 4, pl. 1. figs. 1, 2.
1871. *Lepralia scripta*, Manzoni, "Suppl. alla fauna dei Bryozoi Mediterranei," Sitz. k. Akad. Wissensch. vol. lxiii. p. 5, pl. 1. fig. 6.
1871. *Lepralia scripta*, Manzoni, Brioz. Plioc. ant. di Castrocaro, p. 18, pl. 2. figs. 25, 25 *a*
1873. *Lepralia scripta*, Reuss, Foss. Bryoz. Österreich-Ungarisch. Miocäns, i. p. 165, pl. 1. fig. 7, pl. 6. fig. 1.
1880. *Cribrilina radiata*, Hincks, Brit. Marine Polyz. p. 185 (partim). Var. *tenuirostris*, pl. 25. figs. 3, 6.

The above references, which might be greatly multiplied, are selected to show the characters of the species as distinguished from *C. innominata*, Couch. The latter is a common species in the British Seas, which I have found at Guernsey and round the western coasts up to Shetland, and it is most abundant in the West of Ireland. But the true *C. radiata*, Moll, is rare on our coasts, and I have only seen two specimens from Guernsey and one from Birturbuy Bay, Ireland. The ribs in *C. radiata* are usually 16–18 and little elevated, so that the lacunes between them are wide open, and commonly more conspicuous to the eye than the ribs themselves; large, elongated sharply pointed avicularia are scattered among the zoœcia. The suboral pore, commonly present in both *radiata* and *innominata*, is subject to great variation; sometimes a boss rises immediately behind the pore and completely conceals it; sometimes two, three, or more smaller openings take the place of the pore, and occasionally it is entirely absent. *C. radiata* is common off Madeira at various depths, on shell, coral, &c.

Var. FOLIATA, var. nov.

I am indebted to Padre Schmitz for portions of a remarkable variety which grows erect from a base attached to a deep-sea Alcyonarian, and consists of foliaceous expansions with zoœcia on both faces.

CRIBRILINA INNOMINATA (*Couch*). W.

1847. *Lepralia innominata*, Johnston, Brit. Zooph. p. 31, pl. 55. fig. 12.
1871. *Lepralia innominata*, Manzoni, "Suppl. fauna Bryoz. Mediterr.," Sitz. k. Akad. Wissensch. vol. lxiii. p. 4, pl. 1. fig. 5.
1873. *Cribrilina innominata*, Smitt, Floridan Bryoz. p. 23, pl. 5. fig. 110 (but not I think fig. 109).
1880. *Cribrilina radiata*, Hincks, Brit. Marine Polyz. p. 185 (partim), pl. 25. figs. 1, 2, 4, 5, 7.

1899. *Cribrilina setosa*, Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 8.
1902. *Cribrilina radiata*, Harmer, Quart. Jour. Micr. Sci. n. s. vol. xlvi. p. 326, pl. 15. fig. 7.
1903. *Cribrilina innominata*, Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xii. p. 96, pl. 9. fig. 3.

In this species the ribs are usually 10–12 in number, but sometimes fewer; they are almost always more prominent than in the last species, and are frequently greatly raised and often crowned with spines. This elevation of the ribs much obscures the sight of the intercostal lacunes. The large interzoœcial oblique and very acute avicularia of *C. radiata* are absent, but rarely here and there avicularia are found of the same general characters as those just mentioned but not so produced and acute. On each side just below the oral opening is a slender forward projecting slender papilla or seta which is very easily abraded. The suboral pore or its substitute presents just the same variations as in the last species. The foregoing observations apply to the forms of *C. innominata* found on the British coasts. At Madeira I found this species between tide-marks at Gorgulho with the ribs very slightly elevated, and consequently the interstitial openings (lacunes) are conspicuous; suborally several minute pores are present; no interzoœcial avicularia were observed.

Cribrilina punctata (*Hassall*). H.

Recorded by Hincks.

Cribrilina Balzaci (*Audouin*). W.

1826. *Flustra Balzaci*, Audouin, Savigny's Egypte, pl. 9. fig. 8.
1879. *Lepralia cribrosa*, Waters (*nec* Heller), "Bryozoa Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 36, pl. 9. fig. 4.
1899. *Cribrilina Balzaci*, Waters, "Bryozoa from Madeira," Jour. Roy. Micros. Soc. p. 9, pl. 3. figs. 31, 32.
1903. *Cribrilina Balzaci*, Norman, "Nat. Hist. East Finmark," Ann. & Mag. Nat. Hist. ser. 7, vol. xii. p. 98, pl. 9. fig. 6.

The mouth-spines are four; the lip is strongly pouting, as in *C. punctata*. There are usually no lateral avicularia, but sometimes they are present on one or both sides. The oœcium bears concentric lines, and is sparingly punctured; there is sometimes an avicularium above it; but whole zoaria may be totally devoid of this apically placed organ.

Common on stones between tide-marks; less frequently on shell.

Cellularia fistulosa (*Linné*).

Two or three small fragments in deep water, apparently drifted there.

In Ann. & Mag. Nat. Hist. ser. 7, vol. xi. 1903, p. 577, I have shown the necessity of restoring the original name of that most admirable naturalist, Pallas, *Cellularia*, for the unwarrantably introduced synonym *Cellaria*, Lamouroux. Mr. Waters has recently dissented (Voyage 'Belgica,' Bryozoa, 1894, p. 34), writing: "As *Tubocellaria opuntioides* was the first mentioned, this would be the type; and the only genus to which according to the law of priority the name could be applied is *Tubocellaria*," but the laws of nomenclature state differently (Rules Zool. Nomenc. Brit. Assoc. 1873, § 3 and 4). No type was intimated by Pallas, and Lamouroux was not compelled to take the first species named by Pallas, and he chose *C. salicornaria* as his first-named species, and which has ever since been regarded as the type, but his whim led him to substitute the spelling *Cellaria* for *Cellularia* of Pallas: there was no justification for this, and the former must lapse in the latter older name.

CELLULARIA JOHNSONI (*Busk*). B.

Dredged occasionally. It never grows in clusters in the way in which its allies *C. fistulosa* and *C. sinuosa* are found.

CELLULARIA NODOSA, n. sp. (Pl. **42**. figs. 4, 5.)

The zoarium in this species is contracted at intervals, and the zoœcia of the more swollen and of the more contracted parts are quite different. Those of the former are ovate, arranged in quincunx, those in the same row touching, or, as shown in figure, nearly touching each other, margins well raised; lower margin of oral opening very slightly arched, and not much above the centre of the zoœcium; the pore of the oœcium is transversely elongated. In the constrictions of the zoarium the zoœcia are longer and narrowed, those in the same line very distantly separated from each other, so that in this part there is a near resemblance to *C. Johnsoni*.

Growing on *Sertullarellæ* which were attached to the telegraphic cable when taken up. Many specimens were found, but none larger than that figured (*De Noronha*).

MICROPORA CORIACEA (*Esper*). W.

J. Jullien (Miss. Sci. Cap Horn, 1888, p. 78) instituted a genus *Peneclausa*, with this species as the type, forgetful that this same species was the type of *Micropora*, Gray.

Common in Labra Bay and occasionally elsewhere at Madeira (*A. M. N.*). Salvages, common on *Ostrea cochlear* (De Noronha).

ONYCHOCELLA ANGULOSA (*Reuss*). B., W. (Pl. **37**. fig. 1.)

1848. *Cellepora angulosa*, Reuss, Foss. Polyp. Wiener Tertiärbeckens, p. 75, pl. 11. fig. 10.

1858. *Membranipora antiqua*, Busk, Quart. Journ. Micr. Sci. vol. vi. p. 262, pl. 20. figs. 1, 2.

1870. *Membranipora angulosa*, Manzoni, "Bryoz. foss. Ital.," Sitz. k. Akad. Wissensch. p. 9, pl. 2. fig. 10.
1875. *Membranipora angulosa*, Reuss, Bryoz. österreich. Miocäns, pl. 10. fig. 11.
1875. *Membranipora angulosa*, Manzoni, Brioz. Plioc. antico di Castrocaro, p. 8, pl. 1. fig. 11.
1879. *Membranipora angulosa*, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 122, pl. 13. fig. 3.
1880. *Membranipora antiqua*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 88, pl. 11. fig. 7.
1881. *Onychocella Marioni* and *O. antiqua*, J. Jullien, "Nouvelle Div. des Bryoz.," Bull. Soc. Zool. France, pp. 7, 9, and woodcuts.

Very abundant in 50–70 fathoms off coast between the Lazaretto and Cabo do Garajão on shells, Ditrupæ, and coral (*A. M. N.*); Porto Santo, 60 fathoms (*De Noronha*). Jullien, Waters, and Hincks have figured the remarkable large avicularia of this genus.

SETOSELLA VULNERATA (*Busk*). B.

In 70 fathoms, the same ground as the last, chiefly on Ditrupæ and shell ; whereas in the Shetland Sea I invariably found it on very small pebbles.

CALPENSIA IMPRESSA (*Moll*).

1888. *Calpensia calpensis*, Jullien, Miss. Sci. Cap Horn, Bryoz. p. 78.
1907. *Micropora impressa*, Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xx. p. 207, pl. 9. figs. 1–3, and synonyms there given.

A single specimen dredged in 1897.

ONCHOPORELLA LIGULATA (*Busk*). B.

1860. *Carbasea ligulata*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 282, pl. 31. fig. 2.

I have not seen this species, but Dr. Levinsen informs me that he would place it in the genus *Onchoporella*, Busk (' Challenger ').

The Genera CATENICELLA, CATENARIA, *and* ALYSIDIUM.

1. Savigny never used the generic name *Catenaria.* Under Savigny's plate (Savigny's Egypte, pl. 13) we find the French word " Catenaires," but in the description of the plate by Audouin the two species are assigned to the genus *Eucratea.*
2. Blainville, Man. d'Actinologie, 1834, p. 462, establishes the genus *Catenicella* in this curious fashion : " Nous avons trouvé ce genre, indiqué par Savigny dans les planches du grande ouvrage sur l'Egypte sous le nom de *Catenaria,* que nous avons modifié en celui de *Catenicella.*" Here is given a name *Catenaria* which *does not really exist.* There is a reference to Savigny's figures, parts of which are reproduced, but he is unacquainted with the description of the

plates and names the species *Catenicella Savignii*, instead of *C. Contei*, which it should have been.

3. D'Orbigny at last establishes a genus *Catenaria* (Paléont. Fran., Crétacé Bryoz. 1850, p. 42) and his first species is *Eucratea Lafontii*, Aud.
4. Busk (Cat. Polyz. Brit. Mus. 1852, p. 13) established a genus *Alysidium*, in which he placed two species, *A. parasiticum* and *A. Lafontii*. If the genus is retained it will be with *A. parasiticum* as its type, and *A. Lafontii* omitted from it.
5. Busk, 'Challenger' Report, 1884, p. 14, gives "*Catenaria*, Savigny. . . . The typical species I have assumed for this genus is the *Eucratea Lafontii* of Audouin." Read "*Catenaria*, d'Orbigny," and the type is right, but other species placed by Busk under the name in this report can scarcely be considered congeneric with the type.

CATENICELLA CONTEI (*Audouin*). B. (Pl. **42**. figs. 1–3.)

1828. *Eucratea Contei*, Audouin, Savigny's Egypte, pl. 13. fig. 1.
1834. *Catenicella Savignyii*, Blainville, Man. d'Actin. p. 462, pl. 78. fig. 5.
1860. *Catenicella elegans*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 280 (nec *Cat. elegans*, Busk, Brit. Mus. Cat. Polyz. p. 10, pl. 9).

I figure two primary zoœcia which I found growing on a *Lepralian* at Madeira, and also a portion of a specimen from the Johnsonian Collection at Madeira labelled *C. elegans*; moreover, Busk's own specimen from Madeira, now in the British Museum, is similarly named. It is obvious that a mistake was made, and that the species is really *C. Contei*, Audouin, the type of the genus; but it is curious that the artist did not figure the vittæ which are present, and, moreover, are characteristic of all allied forms.

CATENARIA LAFONTII (*Audouin*). B., W.

1828. *Eucratea Lafontii*, Audouin, Savigny's Egypte, pl. 13. fig. 2.
1850. *Catenaria Lafontii*, d'Orbigny, Paléont. Fran., Crétacé, p. 43.
1852. *Alysidium Lafontii*, Busk, Cat. Marine Polyz. Brit. Mus. p. 14, pl. 14. figs. 1–4.
1884. *Catenaria Lafontii*, Busk, Report 'Challenger,' Polyz. p. 14.

In records from Madeira Busk called it *Eucratea Lafontii*, and Waters *Alysidium Lafontii*. I found small pieces attached to *Lagenipora Costazei*, and the Funchal Museum was well supplied with the species, which was found growing on a fisherman's basket.

Genus HALYSISIS *, n. g.

Zoarium chain-like, each zoœcium forming a separate link, jointed to the

* ἅλυσις a chain; many genera having been formed from this root has necessitated the form of the last syllable.

one preceding at the back of the oral opening; zoœcia elongated, simple; oral aperture round or ovate; oœcia as yet unknown.

HALYSISIS DIAPHANA, *Busk*. B.

1860. *Scruparia diaphana*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 281, pl. 31. fig. 1.
1884. *Catenaria diaphana*, Busk, Report 'Challenger,' Polyzoa, p. 14, pl. 2. fig. 3.

Busk in his 'Challenger' Report corrects his previous statement as regards the shape of the oral opening; and he figures the raised lines which are on each side of the zoœcium and extend throughout its length. The appearance of the dead zoarium is striking from its almost black colour.

I dredged this mingled with *Crisia eburnea*; and in the Johnsonian Collection it was freely covering a valve of *Avicula tarentina*.

REPTADEONELLA VIOLACEA (*Johnston*).

1884. *Reptadeonella violacea*, Busk, Report 'Challenger,' Polyz. p. 180.

On coal dredged near the coaling ship at Funchal.

ADEONELLOPSIS COSCINOPHORA (*Reuss*). B.

1848. *Eschara coscinophora*, Reuss, Foss. Polyp. Wiener Tertiärbeckens, p. 67, pl. 8. fig. 20.
1858. *Lepralia distoma*, Busk, Quart. Journ. Micr. Sci. vol. vi. p. 127, pl. 18. fig. 1.
1859. *Eschara distoma*, id. ibid. vol. vii. p. 66, pl. 22. figs. 10–12.
1862. *Eschara coscinophora*, Stoliczka, "Oligocäne Bryoz. von Latdorf," Sitz. k. Akad. Wissensch. p. 89, pl. 2. fig. 11, pl. 3. figs. 1, 2.
1864. *Eschara coscinophora*, Reuss, "Fauna deutsch. Oberoligocäns," Sitz. k. Akad. Wissensch. vol. i. p. 649, pl. 12. figs. 1, 2.
1865. *Eschara coscinophora*, Reuss, Foram., Anthoz. u. Bryoz. deutschen Septarienthones, p. 186, pl. 11. figs. 1–4.
1877. *Eschara polystomella*, Manzoni, Brioz. foss. Miocene Austria e Ungheria, p. 14, pl. 8. fig. 25.
1884. *Adeonella distoma*, Busk, 'Challenger' Polyzoa, p. 187, woodcuts 56, 57.

It is true that Reuss's original figure could not be supposed by itself to represent the species as observed by Busk, yet illustrated subsequently as it has been by the figures of Stoliczka and Manzoni, the former of which have been acknowledged by Reuss to represent his species, I have no hesitation in regarding the species which I have dredged in about 70 fathoms at Madeira, and of which Senhor De Noronha has sent me a young specimen taken from the telegraphic cable off Funchal, as referable to the fossil form. At the suggestion of Dr. Levinsen I have placed the species in the genus *Adeonellopsis* of Macgillivray, who has found several allied forms in the Australian seas.

FENESTRULINA MALUSII (*Audouin*). H.

1888. *Fenestrulina Malusii*, J. Jullien, Miss. Sci. du Cap Horn, p. 37, pl. 15. figs. 1-8.

Recorded by Hincks.

MICROPORELLA MARSUPIATA (*Busk*). B. (Pl. **38**. fig. 7.)

1860. *Lepralia marsupiata*, Busk, Quart. Jour. Micr. Sci. vol. viii. p. 284, pl. 31. fig. 4.
1867. *Lepralia appendiculata*, Heller, Bryoz. Adriat. Meeres, p. 31, pl. 2. fig. 8.

Professor Heller kindly sent me cotypes of some of the species described by him soon after his work was published. Among them was *L. appendiculata*, which agrees in every particular with Busk's *L. marsupiata*. The species is a strongly characterised form, the stout oral spines *with their black bases*, and the *outermost pair forked* (but not trifid as represented by Heller); the long black vibracula, which directed upwards overtop the semiglobose imperforate oœcium, and the basal portion of which bears a complete bar; the rough surface of the zoœcium, and the pore set in a distinct cup, which is either complete below the oral lip, or incomplete, being united with the sides of the oral opening, are characters very different from any other species known to me. Busk's figure is very good. There are sometimes no vibracula, at others two to every cell.

The species is not rare off Madeira in 40–70 fathoms, usually in company with such species as *Onychocella angulosa* and *Lepralia peristomata*.

MICROPORELLA DECORATA (*Reuss*). H. (Pl. **39**. figs. 2, 3.)

1848. *Cellepora decorata*, Reuss, Foss. Polyp. Wiener Tertiärbeckens, p. 89, pl. 10. fig. 25.
1873. *Lepralia decorata*, Reuss, Foss. Bryoz. Österr.-Ungar. Miocäns, i. p. 154, pl. 5. fig. 2.
1875. *Lepralia decorata*, Manzoni, Brioz. Pliocene antico di Castrocaro, p. 15, pl. 2. figs. 18 *a–b*.
1880. *Microporella decorata*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 74.

A few specimens in about 40 fathoms. Hincks, as above, was the first to record it as a recent species. To his description may be added that there are eight mouth-spines, and that six of these are still visible in front of the oœcium, which is usually girdled with two ribs. I give illustrations from a living and from a dead example.

MICROPORELLA CORONATA (*Audouin*). (Pl. **39**. fig. 4.)

1826. *Flustra coronata*, Audouin, Savigny's Egypte, pl. 9. fig. 6.
1826. *Flustra umbracula*, id. ibid. pl. 9. fig. 7.

Zoœcia moderately tumid, surface granular and punctate; a crescentic pore a little below the lip; two vibracula of moderate length, held stiffly, situated far forwards on a line with the pore or even in advance of this close to the lip. Oral opening with a straight lip, above with six spines. Oœcium subglobose, its surface granulated. Audouin's *F. umbracula* is evidently simply *F. coronata* with oœcia. In my specimens the oœcia do not so much cover the zoœcium which they overlap; but Audouin's fig. 7 shows that the cluster had only a small space on which to extend itself.

Two specimens dredged at Madeira.

MICROPORELLA NUTRIX (*J. Jullien*). (Pl. **39**. fig. 1.)

1888. *Inversula nutrix*, J. Jullien, Miss. Sci. Cap Horn, Bryozoaires, p. 44, pl. 4. fig. 8.

Zoœcia of large size, as will be seen by comparison with the other figures on the plate which are drawn under the same power; the surface is coarse and roughly pitted, with pores at the bottom of the pits. The frontal pore is situated well forwards, and is sometimes connected with the oral opening. Small lateral openings are usually present on each side, almost on a level with the lower lip, and probably represent the base of vibracula. There are eight mouth-spines. The oœcium is not large, nor so high and globose as is usual in the genus.

A single specimen was dredged in deep water encrusting a shell of *Ditrupa*.

MICROPORELLA VERRUCOSA (*Peach*).

1880. *Diporula verrucosa*, Hincks, Brit. Marine Polyz. p. 220, pl. 30. figs. 1, 2.

I cannot see any grounds for regarding this as generically distinct from *Microporella*.

single small specimen dredged in about 40 fathoms.

TESSARODOMA BOREALE (*Busk*). (Pl. **38**. fig. 10.)

1851. *Pustulipora gracilis*, M. Sars, "Beretning Somm. 1849, Zool. Reise i Lofoten og Finmarken," Nyt Mag. for Naturvid. p. 26 (separate copy).

1860. *Onchopora borealis*, Busk, "Shetland Polyzoa," Quart. Jour. Micr. Sci. vol. viii. p. 214, pl. 29. figs. 1, 2.

1863. *Quadricellaria gracilis*, M. Sars, "Beskv. over nogle norske Polyz.," Videnskabs. Forhand. p. 15 (separate copy).

1864. *Quadricellaria gracilis*, Alder, Jour. Micr. Soc. vol. iv. p. 7, pl. 2.

1868. *Anarthropora borealis*, Smitt, Œfvers. K. Vet.-Akad. Förhand., Bihang, p. 8, pl. 24. figs. 25–29.

1869. *Tessarodoma gracile*, Norman, "Last Report Dredging Shetland," Report Brit. Assoc. for 1868, p. 309.

1873. *Tessarodoma boreale*, Smitt, Floridan Bryoz. pt. ii. p. 32, pl. 6. figs. 143–145.

1880. *Porina borealis*, Hincks, Brit. Marine Polyz. p. 229, pl. 31. figs. 4–8.

A single small specimen taken in 200–300 fathoms.

TRYPOSTEGA VENUSTA (*Norman*). H., W.

1880. *Schizoporella venusta*, Hincks, Brit. Marine Polyz. p. 276, pl. 30. figs. 6, 7.
1902. *Trypostega venusta*, Levinsen, "Studies on Bryozoa," Vid. Medd. f. d. naturf. Foren. i. Kjöbenhavn, p. 23.

Common on stones and shells in shallow water.

CHORIZOPORA ANNULATA (*Lamouroux*). H.

1821. *Berenice annulata*, Lamouroux, Exp. Méth. Ordre des Polyp. p. 81, pl. 80. figs. 5, 6.*

This is *Chorizopora Brongniartii* of Hincks. It is not infrequent on stones and shells in shallow water, and down to at least 40 fathoms.

HIPPOTHOA DIVARICATA (*Lamouroux*). W.

Frequent.

HIPPOTHOA FLAGELLUM, *Manzoni*.

A few specimens off Madeira (*A. M. N.*); Salvages, on *Ostrea cochlear* (*De Noronha*).

PORELLA CONCINNA, *Busk*. B.

I have not seen this.

PORELLA MINUTA, *Norman*, var. PUNCTATA, *Waters*. W.

I have examined the specimen thus named by Mr. Waters in the Funchal Museum. It is very like *P. minuta* in size and general structure, but the front of the zoœcia is punctate and the suboral boss only slightly developed. In a Greenland variety in my collection the surface differs from the usual type in being adorned with ribs radiating from the suboral boss.

PORELLA TUBULATA (*Busk*). B. (Pl. 38. fig. 8.)

1861. *Eschara tubulata*, Busk, Quart. Jour. Micr. Sci. vol. ix. p. 78, pl. 33. fig. 1.
1896. *Smittia Kœhleri*, L. Calvet, Camp. du Caudan, p. 259, pl. 7. figs. 4–8.
1903. *Cryptella Kœhleri*, L. Calvet, Résult. Camp. sci. Prince de Monaco, fasc. xxiii. Bryoz. prov. camp. de l' 'Hirondelle,' p. 77, pl. 7. fig. 4.

Small pieces dredged in 40–70 fathoms. Of ramose growth, the branches are oval in section, being somewhat flattened, with zoœcia all round; the orifices are elevated in tubular form, and are longer than broad or nearly

* By some extraordinary lapsus in Ann. & Mag. Nat. Hist. ser. 7, vol. xi. 1903, p. 569, I referred to the wrong figures and name in Lamouroux, giving those of *prominens* instead of *annulata*, which latter was of course intended.

round at different stages of growth; a round avicularium is situated within the lower lip. The surface is slightly rough, imperforate and very glossy in the living state; when dead a row of pores can be made out round the margin. I have not seen oœcia, and Calvet writes in the 'Caudan' paper: "Oœcies invisibles extérieurement, mais très apparentes sur les coupes dans le zoarium; elles sont globuleuses et communiquent avec l'orifice tubulaire." They are thus buried oœcia such as I have found in other species and designated 'cryptic oœcia' (Ann. & Mag. Nat. Hist. ser. 7, vol. xii. 1893, p. 115).

Porella torquata (*J. Calvet*). (Pl. **39**. figs. 5–8.)

1903. *Cryptella torquata*, L. Calvet, Résult. Camp. sci. Prince de Monaco, fasc. xxiii. Bryoz. prov. camp. de l' 'Hirondelle,' p. 77, pl. 7. fig. 5.

Fragments of this species were dredged by me in about 70 fathoms at Madeira in 1897. Last spring Senhor De Noronha kindly gave me a very fine specimen which he had procured from about 60 fathoms at Porto Santo. This specimen measures one and a half inches high and slightly more in breadth, and consists of very numerous dichotomously dividing branches, which all curve with the tips slightly inward, and while their inner faces are devoid of zoœcia, the outer sides are thickly studded with them. The zoœcia are smooth, with a row of punctures round the margin, and generally a few scattered on the face, and here and there an occasional minute ovate avicularium, situated sometimes by the side of the oral opening, at others on the face of the zoœcium. The oral opening is subquadrate, with a small rounded avicularium just within the lower straight lip. The oœcium is tumid, as wide as the zoœcium and imperforate. The dorsal side is mapped out into divisions by impressed lines, and is studded with numerous small pores. When oœcia are developed and partially overhang the oral opening, the lower lip is at the same time often raised so as to conceal the oral avicularium.

This *P. torquata* with its frondose but not bushy growth, and its zoœcia confined to one face of the branches, recalls to my mind that form of *P. lævis* which is found in some of the western fiords of Norway. This variety instead of, as typically, forming a little bush and with zoœcia developed round its diverging branches and rosy in colour, has its branches developed almost on one plane, zoœcia on one face only, while the other is entirely without them and the colour is white. This variety (or possibly species) I have named *P. lævis* var. *gymnonoton*. The zoœcia of this northern form are in general characters similar to those of *P. torquata*; but the zoarium is much more strongly built, and in many minute details there is evidence of specific distinction.

PORELLA NITIDISSIMA, *Hincks.* H., W.

1880. *Porella nitidissima,* Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 78, pl. 9. fig. 2.

I dredged a few specimens of this strongly characterised species. When dead the front wall of the zoœcia appears as a complete network. This should be removed I think into the genus *Escaropsis*, Verrill (= *Escharoides*, auct. (*nec* Milne-Edwards and Gray).

RHYNCHOPORA BISPINOSA (*Johnston*). W.

I have seen the specimens in the Funchal Museum determined by Mr. Waters, but have not myself found the species.

RETEPORA COUCHII, *Hincks.* W.

A few specimens dredged (*A. M. N.*); on telegraphic cable (*De Noronha*).

Var. BIAVICULATA, *Waters*, "Medit. and New Zealand Reteporæ," Linn. Soc. Journ., Zool. vol. xxv. 1895, p. 262, pl. 6. fig. 18. This variety was also dredged.

RETEPORA MEDITERRANEA, *Smitt.* W.

Numerous fragments dredged (*A. M. N.*); very young specimens not yet reticulate in growth on Hydroids growing on the telegraphic cable (*De Noronha*).

RETEPORA JULIENNI, *Calvet.* W.

1883. *Retepora arborea,* J. Jullien, Dragages du 'Travailleur,' Bull. Soc. Zool. France, vol. vii. p. 21 (separate copy), pl. 16. figs. 49, 50.

1895. *Retepora Solanderia,* Waters, "Medit. and New Zealand Reteporæ," Linn. Soc. Journ., Zool. vol. xxv. p. 264, pl. 6. figs. 1–4.

1902. *Retepora Solanderia,* Calvet, Bryoz. marines des Côtes de Corse, p. 35, pl. 2. figs. 5–8.

1906. *Retepora Jullieni,* Calvet, Expéd. Sci. 'Travailleur' et 'Talisman,' Bryoz. p. 453.

J. Jullien named this non-reticulated species *Retepora arborea*, but that name was preoccupied by Risso. Waters referred it to the *Retepora Solanderia*, Risso, but I cannot find anything in that author's description by which to identify the species, and I therefore employ the name which Calvet has applied to it.

Specimens are in the Funchal Museum.

PSILESCHARA MADERENSIS, *Busk.* B.

1861. *Psileschara maderensis,* Busk, Quart. Jour. Micr. Sci. vol. ix. p. 79, pl. 32. fig. 2.

Busk's type specimen from Madeira is preserved in the British Museum.

SMITTINA LANDSBOROVII (*Johnston*). W.

The specimen, named by Waters, is in the Funchal Museum, and is quite the typical form.

SMITTINA MARMOREA (*Hincks*). H.

In deep water, two or three examples.

SMITTINA TRISPINOSA (*Johnston*). W.

On coal in the neighbourhood of the coaling ship (*A. M. N.*) ; Porto Santo and the Salvages (*De Noronha*).

ESCHARINA VULGARIS (*Moll*). B., W.

1867. *Lepralia Botterii*, Heller, Bryoz. Adriat. Meeres, p. 30, pl. 2. fig. 4.

Very common ; dredged on stone, coals and shell (*A. M. N.*); Porto Santo and Grand Salvages (*De Noronha*).

A cotype of *L. Botterii*, given to me by Professor Heller, is undoubtedly the present species.

ESCHARINA PES-ANSERIS (*Smitt*). B., W. (Pl. **40**. fig. 7.)

1860. *Lepralia Woodiana*, Busk, Quart. Jour. Micr. Sci. vol. viii. p. 284 (not *L. Woodiana* of the Crag).
1873. *Hippothoa pes-anseris*, Smitt, Floridan Bryozoa, ii. p. 43, pl. 7. figs. 159, 160.
1899. *Schizoporella pes-anseris*, Waters, "Bryozoa from Madeira," Jour. Roy. Micr. Soc. p. 11, pl. 3. figs. 7, 8.

In about 70 fathoms on shell and coral in small zoaria. Dead specimens which I at first found, were taken to be a variety of *L. Dutertrei* (see fig. 7); and it seems clear that Busk fell into the same mistake, for the observations which he makes on the Madeiran specimens which he called *L. Woodiana* (= *L. Dutertrei*) exactly accord with the present species.

ESCHARINA HYNDMANNI (*Johnston*). H.

Common in 40–50 fathoms and deeper. Among the specimens a curious variety had a series of large pits all round the zoœcia just within the outer margin (*A. M. N.*). South of Cima, Porto Santo, in 90 fathoms, and Grand Salvages (*De Noronha*).

ESCHARINA JOHNSTONI (*Quelch*).

1880. *Schizoporella simplex*, Hincks, Brit. Marine Polyz. p. 246, pl. 35. figs. 9, 10.
1884. *Schizoporella Johnstoni*, Quelch, Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 217.

Four specimens from deep water ; three of these show no sign of the usual suboral umbo ; the fourth, on *Ditrupa*, has some of the zoœcia without the umbo, others with it, and others with the umbo of gigantic size.

SCHIZOPORELLA UNICORNIS (*Johnston*). B., W.

I have shown elsewhere that the genus *Escharina* must be used with *E. vulgaris* as the type. *S. linearis* may stand as the type species of *Schizoporella*, if that genus, contrary to strict rule, is to be maintained; but some of the species here included are scarcely congeneric, and will probably find another place when the work of Dr. Levinsen is published.

This species is a common one between tide-marks and down to 15–20 fathoms.

SCHIZOPORELLA SANGUINEA (*Norman*). H., W.

1871. *Lepralia pertusa*, Manzoni, "Suppl. fauna Bryoz. Mediterr.," Sitz. k. Akad. Wissensch. vol. lxiii. p. 7, pl. 2. figs. 5, 6.

Large patches encrusting coal dredged near the coaling ship at Funchal.

SCHIZOPORELLA AURICULATA (*Hassall*). H., W.

Specimens received from Prof. Heller as his *Lepralia spongites* are what has been known as *S. auriculata* var. *ochracea*, Hincks (pl. xxix. fig. 7) with spatulate avicularia mingled with those of ordinary form.

The species is not rare at Madeira in shallow water.

SCHIZOPORELLA BIAPERTA (*Michelin*). H., W. (Pl. **40.** figs. 3, 4.)

Var. DIVERGENS, *Smitt*.

1873. *Hippothoa divergens*, Smitt, Floridan Bryoz. p. 47, pl. 9. figs. 177, 179.
1880. *Schizoporella biaperta*, var. *divergens*, Hincks, Brit. Marine Polyz. p. 256, pl. 40. figs. 7–9.

Senhor De Noronha has sent to me the variety *divergens* agreeing closely with Guernsey specimens, from Porto Santo.

SCHIZOPORELLA ARMATA, *Hincks*. H., W. (Pl. **40.** figs. 5, 6.)

I have not seen Madeiran specimens; but I figure an Algerian specimen, which Dr Levinsen kindly gave me, for comparison with *S. biaperta* var. *divergens*.

SCHIZOPORELLA DISCOIDEA (*Busk*). B., W.

1859. *Lepralia discoidea*, Busk, Quart. Jour. Micr. Sci. vol. vii. p. 66, pl. 22. figs. 7, 8.

Frequent in deep water. Madeira (*A. M. N.*); Porto Santo, 20–60 fathoms (*De Noronha*).

SCHIZOPORELLA NORONHAI, n. sp. (Pl. **41.** fig. 1.)

The zoœcia are broader than long, widest in the middle, contracted behind and before, and much so in the position of the oral opening; oral aperture small with a sinus on the lower lip, and eight marginal spines. Surface of zoœcium punctate, and a few scattered punctures larger than the rest. Avicularian (or vibracular) openings on each side below the aperture with a central bar. Oœcium remarkably small as compared with the breadth of the zoœcium, well raised and distinctly punctated. Colour of dead specimen pure white.

A single specimen attached to the telegraphic cable, sent to me by Senhor De Noronha, after whom I name the species, in the spring of 1908.

This comes perhaps near to *Schizoporella Richardi*, Jullien and Calvet (p. 140, pl. xvi. fig. 6), but in that species there is only a single avicularium and that central just below the sinus, and the oœcium is quite different in sculpture.

Schizoporella Schmitzi, n. sp. (Pl. **41**. fig. 2.)

Zoœcia somewhat longer than broad, only moderately convex, surface smooth with scattered conspicuous pores. Oral opening as broad or broader than long (exclusive of sinus), sinus not narrow but sharply defined at the corners, spines on the narrow margin apparently about four. Avicularium of large size on one side a little below the lower lip; the bar not persistent but in one instance it is still to be seen perfect.

One specimen pure white and the whole texture delicate, apparently not long dead on a shell of *Pectunculus*.

Named after Padre Schmitz, who has done so much to promote the study of Natural History among the Portuguese at Madeira.

This species is somewhat like *Lacerna hosteensis*, Jullien (Miss. Sci. Cap Horn, Bryoz. 1888, p. 48, pl. i. fig. 2), but in that species the pores are represented as confined to the sides of the zoarium, and there is no avicularium.

Escharoides coccinea (*Abildgaard*). W.

This is *Lepralia appensa,* Hassall. For this use of *Escharoides* see Norman, Ann. & Mag. Nat. Hist. ser. 7, vol. xii. 1903, p. 116.

Two small specimens on shell.

Escharella obscura, n. sp. (Pl. **40**. fig. 8.)

A curious species of which I have only found a single specimen. It consists of a basal layer, slightly granulated, and marked with very fine microscopic crescentic lines. On this basal layer there is no indication of separate zoœcia further than that from it rise papillæ surmounted by an oral orifice looking directly upwards; the orifice is irregularly round in form, and the lower lip is characterised by a well pronounced denticle just within it. In some instances the back of the papillæ is swollen in a manner which may indicate the presence of the oœcium there. The type of the genus *Escharella* is *E. immersa*, Fleming (=*Membranipora Peachii*, Johnston).

LEPRALIA PALLASIANA (*Moll*). H.

I have called attention elsewhere to the fact that the name *Lepralia* cannot possibly be retained in use in the sense in which Hincks employed it, because :

1st. The genus as used by Hincks did not include a single species assigned to it by Johnston in the first edition of his work when he instituted the genus.

2nd. Because Hincks included in his *Lepralia*, *Eschara foliacea*, and therefore all species congeneric with that species should have been embraced under that old name. But until Dr. Levinsen's forthcoming work is published I think it best to leave things as they are.

Senhor De Noronha sent me *Lepralia Pallasiana* from Porto Santo growing in free foliaceous form with zoœcia on one face only. It exactly resembled English specimens in its zoœcia, and had no oœcia.

LEPRALIA PERTUSA (*Esper*). H.

Unknown to me as Madeiran.

LEPRALIA PERISTOMATA, *Waters*. B., W.

1860. *Lepralia Mangnevilla*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 284, pl. 31. fig. 5.

1899. *Lepralia peristomata*, Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 10, pl. 3. fig. 20 (the operculum).

Busk renamed *L. Mangnevilla*, Busk (*nec* Savigny) in the 'Challenger' Report, p. 159, *Mucronella canalifera*, but the species figured from the 'Challenger' Expedition appears to have no connection with that which lives at Madeira.

Lepralia peristomata is very common at Madeira, where I have met with it in depths from 15 to 70 fathoms.

LEPRALIA PORCELLANA, *Busk*. B., W. (Pl. **40**. figs. 1. 2.)

1860. *Lepralia porcellana*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 283, pl. 31. fig. 3.

1873. *Lepralia cleidostoma*, Smitt, Floridan Bryoz. ii. p. 62, pl. 11. figs. 217–219.

1899. *Lepralia cleidostoma*, Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 10, pl. 3. fig. 16 (the operculum).

Examination of the type of *L. porcellana* in the British Museum proves it to be a somewhat overgrown specimen of Smitt's *L. cleidostoma* : the former name is as appropriate to the porcelain-like look of the zoœcia, as the latter is to the very marked key-like oral opening.

Not rare on stones between tide-marks.

Lepralia collaris *J. Jullien*. W. (Pl. **41**. figs. 3, 4.)

1888. *Lepralia collaris*, J. Jullien, Miss. Sci. du Cap Horn, Bryozoaires, p. 57, pl. 3. fig. 7.

1899. *Lepralia Pallasiana*, var. *strumata*, Waters, "Bryoz. from Madeira," Journ. Roy Micr. Soc. p. 10, pl. 3. figs. 33, 34.

This species, for thus I regard it, is very abundant on stones between tide-marks at Gorgulho, Madeira, and probably therefore all along the coast. I fail to see the connection with *L. Pallasiana*. It seems to be very constant in its characters. There are four mouth-spines, two on each side of the orifice.

Lepralia contracta, *Waters*. W. (Pl. **41**. figs. 5. 6.)

1899. *Lepralia contracta*, Waters, "Bryoz. from Madeira," Journ. Roy. Micr. Soc. p. 11 pl. 3. fig. 21.

A remarkable species especially characterised by its curious oœcium, with the door-like frontal portion (see Waters's figure, lower zoœcium). When this is broken away, as it is apparently to give exit to the embryos, the aspect of the zoarium with the remaining portion of the oœcia still *in situ* is very striking. I have found two or three specimens which have been compared with the type preserved in the Funchal Museum.

Lepralia mucronelliformis, *Waters*. W.

1899. *Lepralia mucronelliformis*, Waters, "Bryoz. from Madeira," Journ. Roy. Micr. Soc. p. 11, pl. 3. fig. 21.

I have seen the type in the Funchal Museum but no other specimen.

Lepralia lata, *Busk*. B., H.

1856. *Lepralia lata*, Busk, Quart. Journ. Micr. Sci. vol. iv. p. 309, pl. 20. figs. 1–3.

1867. *Lepralia Kirchenpaueri*, Heller, Bryoz. Adriat. Meeres, p. 29, pl. 2. fig. 11.

1869. *Lepralia lata*, Manzoni, "Bryoz. Plioc. Ital.," Sitz. k. Akad. Wissensch. vol. lix. p. 4, pl. 1. fig. 6.

1870. *Lepralia cuspidata*, id. ibid. vol. lxi. p. 5, pl. 1. fig. 3.

1871. *Lepralia lata*, id. "Suppl. fauna Bryoz. Mediterr.," ibid. vol. lxiii. p. 8, pl. 3. fig. 2.

1879. *Lepralia lata*, Waters, "Bryoz. Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5 vol. iii. p. 42, pl. 15. figs. 12, 13.

1880. *Lepralia adpressa*, Hincks, Brit. Marine Polyz. p. 307, pl. 33. figs. 5–7.

I do not refer this species to the *L. adpressa* of Busk, because I have not seen or heard of any specimen from the Atlantic which has sculpture corresponding with that found in *L. adpressa* from the Pacific at Chiloe Island. It is under this last name, however, that Busk recorded the species from Madeira.

The orifice is very slightly contracted below the middle and then widens out before the sides join the straight line of the lower lip. The surface is punctated in an early stage, and granulated at a later. On each side just below the corners of the lower lip a boss of greater or less size is generally developed. In examples where these bosses are of considerable size, the oœcium is also elevated into a high mound. In other cases where the lateral bosses are slightly developed or altogether absent, the oœcium though still raised centrally is sculptured down its sides with little ribs.

I have found this species at Madeira, Naples, and Guernsey, and have received it from the Adriatic (Heller as *Lepralia Kirchenpaueri*).

The specimens dredged at Madeira were encrusting small univalve shells, *Bellardiella gracilis*, *Nassa limata*, and *Calliostoma Montagui*.

Lepralia Poissonii (*Audouin*). W. (Pl. **41.** figs. 7, 8.)

1826. *Flustra Poissonii*, Audouin, Savigny's Egypte, pl. 10. fig. 5.
1880. *Lepralia Kirchenpaueri*, var. *teres*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. v. p. 77, pl. 9. fig. 7.
1885. *Lepralia Poissonii*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 256.
1888. *Lepralia Poissonii*, Kirkpatrick, Ann. & Mag. Nat. Hist. ser. 6, vol. i. p. 78, pl. 8. fig. 1.

Mr. Waters has included this species in his paper on Madeiran Polyzoa; the specimen in the Funchal Museum is dead. I dredged similar dead examples in 1897, but lately Senhor De Noronha has sent me beautiful examples from Porto Santo and the Grand Salvages. These have both the vibracula and the wonderful long encircling setose spines in the finest order. I figure both the living and dead state. In Audouin's figure what should have been vibracula are represented by boss-like swellings such as occur in *L. lata*.

Escharella setosa, Smitt (Floridan Bryoz.) has been referred to *L. Poissonii*, but I have the species from lat. 18° 22′ N., long. 89° 21′ W., 'Blake' Expedition, and it is quite distinct.

When dead, *L. Poissonii* bears a strong resemblance to *L. lata*, but the orifice is narrower, especially below the constriction of the sides and that constriction is more marked than in *L. lata*, while the places of the lateral bosses of *L. lata* are here occupied by vibracula or the rounded openings which they occupied. The front of the zoœcia is imperforate and nearly smooth. The oœcium subglobose, and originates very far down on the sides of the oral opening, nearly down to the lower lip, but upon the aperture itself it does not at all encroach either at the sides or above, in fact it takes the form of a night-cap with an arched band in front, but it has not the centra boss characteristic of the oœcium of *L. lata*.

In the living condition there are two vibracula which are directed usually downwards and inwards. There are no mouth-spines; but the lower margins of the zoœcia are surrounded by about fourteen exceedingly long setiform spines, which may be presumed to be connected with the ovicells. They are extremely fragile, and are very easily abraded.

HEMICYCLOPORA MULTISPINATA, *Busk.* B., H.,W. (Pl. **42.** figs. 6, 7.)

1861. *Lepralia multispinata*, Busk, Quart. Journ. Micr. Sci. vol. ix. p. 78, pl. 32. fig. 5.

1903. *Lepralia discrepans*, Jullien & Calvet, Résult. Camp. sci. Prince de Monaco, xxiii. Bryozoaires, p. 72, pl. 10. fig. 1.

This species is very closely allied to *H. polita,* Norman (=*Discopora emucronata*, Smitt) of northern seas. The genus is allied to *Escharella* (=*Mucronella*) but is without the denticle (*lyrula*) within the lower lip. As compared with *H. polita,* the lip is more pouting, especially in fertile cells. The mouth-spines are more numerous, usually eight ; small hinge denticles are present, and the oral opening itself is horse-shoe shaped ; the upper portion of the zoœcium is semi-erect ; and the globose oœcium inclines backwards ; the surface of the zoœcium is finely granular, but in dead specimens looks smooth. There are usually no avicularia, but in a single case large spatulate organs (fig. 7) are developed under very remarkable circumstances. The zoarium is on a flat surface over the edge of which it makes its way almost at a right angle. On the brow of the descent stand right outwards four large spatulate avicularia. It would seem as if they had been developed in order that they might investigate and report if it was safe that zoœcia should make their way over the precipice. They curiously reminded me of what I had seen from my window a short time before, when beams of wood were projected outwards from the parapet of the church tower, in order that a platform might from them be suspended to enable the dial of the clock to be gilded. There is a small peculiarity in the oral opening of *H. polita* which distinguishes it from that of the present species ; at the corners of the lower lip the surface of the zoœcium is raised in a little fold (see my original figures, Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. pl. xi. fig. 1, and Hincks, Brit. Marine Polyz. pl. xxxii. fig. 5).

H. multispinata is a deep-water form, dredged in about 70 fathoms.

PHYLACTELLA LABROSA (*Busk*). H., W. (Pl. **38.** fig. 9.)

1899. *Phylactella labrosa,* Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 15, pl. 3. fig. 14.

1899. *Phylactella punctigera,* id. ibid. p. 15, pl. 3. fig. 13.

I think that Mr. Waters is mistaken in supposing that two species have been confused under the name *P. labrosa.* Busk's original figure represents the ovicell imperforated and shows no oral denticle ; his type specimen came from off Belfast. Now I have the species from the same locality, and it would seem that the oœcia are punctated in the younger state, but that the punctures are closed up at a later stage, and occasionally the oral denticle (*lyrula*) is seen in the throat exactly as in the next variety. What Waters has named *P. punctigera* has a freely punctured oœcium and a denticle within the throat, such are examples in my collection from Wick (*Peach*) and from Madeira. All the sixteen specimens I possess from the last locality are what Waters names *P. punctigera.* But among them is one which presents an entirely new and unexpected feature, for some of its zoœcia have a nearly round avicularium developed on the lower lip (fig. 9). In British examples there seems to be always a tendency of the zoœcia to run out into straight lines, but this is not the case in those from Madeira. A marked counterpart of these two modes of propagation occurs in *Schizoporella Barleei* and its variety in chain-like development, var. *Alderi.*

PHYLACTELLA COLLARIS (*Norman*).

One specimen and some fragments from deep water.

LAGENIPORA COSTAZEI (*Audouin*).

1858. *Cellepora Hassalii,* var. *a,* Busk, Quart. Journ. Micr. Sci. vol. vi. p. 263, pl. 20. fig. 6.

1899. *Lagenopora Costazei,* Waters, Journ. Roy. Micr. Soc. p. 13.

1906. *Lekythopora laciniosa,* Calvet, Expéd. Sci. 'Travailleur' et 'Talisman,' Bryozoaires, p. 443, pl. 29. figs. 13, 14.

This is a very variable species; which at Madeira is common on stones between tide-marks, or forms little clusters on the fronds of *Corallina* in rock-pools and shallow waters, or wraps itself in little rolls round such things as the stems of *Antipathes.* Busk's figure of what he calls "var. *a*" illustrates fairly the tide-mark form. The processes which are surmounted by avicularia vary greatly both in size and elevation. Senhor De Noronha has sent it to me from Porto Santo and the Salvages.

LAGENIPORA LUCIDA (*Hincks*). H., W.

1899. *Lagenopora lucida,* Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 13 pl. 3. figs. 25–30.

On shell from deep water.

Mr. Waters, in the paper above referred to, gives what he considers to be the full synonymy of the species.

LAGENIPORA IGNOTA, n. sp. (Pl. **42.** figs. 10–13.)

Rising in papilliform, round branches to a height of about half an inch (fig. 10). Zoœcia generally suberect, so that the oral opening looks directly upwards, and as much of the zoœcium is behind it as there is in front;

surface imperforated. Oral opening with two small round avicularia, usually almost sessile, but sometimes raised on a pedicil of moderate length ; often there is only a single oral avicularian and this seems to be generally the case when an oœcium is present. Oœcium having a frontal punctated area. Large spatulate avicularia (fig. 13) are scattered freely over the zoarium, and are often present in extraordinary numbers. The operculum is figured (fig. 12). The oral avicularia are easily abraded and dead specimens will often show no sign of them.

Dredged not uncommonly at Madeira in about 70 fathoms.

This species is evidently allied to *C. rudis* of Busk ('Challenger' Polyzoa, p. 199, pl. xxviii. fig. 7, and pl. xxxvi. fig. 7), which was dredged in 600 fathoms, lat. 37° 17′ S., long. 53° 52′ W. ; but it would seem to differ in the much smaller size of the oral avicularia.

Cellepora ramulosa (*Linné*). B., W.

Common in rather deep water, but only small specimens occur, never large clusters such as are found on the British coast.

Cellepora dichotoma, *Hincks*. W.

Recorded by Waters as Madeiran. In the Johnsonian collection I found some specimens named *C. dichotoma,* which were a delicate, slender form of *C. ramulosa.*

Cellepora ampullacea, *Busk*. B.

1861. *Cellepora ampullacea,* Busk, Quart. Journ. Micr. Sci. vol. ix. p. 78, pl. 32. fig. 4.

I have not succeeded in finding the type specimen, but I should very much doubt its being a mature form.

Cellepora armata, *Hincks.*

Common, growing in an erect form with branches, the whole massive. Found down to 70 fathoms (*A. M. N.*); Porto Santo (*De Noronha*).

Cellepora sardonica, *Waters*. W.

1879. *Cellepora sardonica,* Waters, "Bryozoa Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 196, pl. 14. figs. 2, 5, 5 *a*, 6.

1885. *Cellepora sardonica,* Waters, "Use of Avicularian Mandible in determination of species," Quart. Journ. Micr. Sci., Zool. ser. 2, vol. viii. pl. 14. fig. 33.

1899. *Cellepora sardonica,* Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. p. 12.

Recorded by Waters.

None of the following species can remain, I think, in the genus *Cellepora.*

CELLEPORA MARGARITACEA (*Pourtalès*). (Pl. **42**. fig. 14.)

1867. *Vincularia margaritacea*, Pourtalès, "Contrib. Fauna Gulf Stream," Bull. Soc. Comp. Zool. vol. i. p. 110.

1873. *Cellepora margaritacea*, Smitt, Floridan Bryoz. pt. ii. p. 53, pl. 9. figs. 187–192.

1879. *Cellepora margaritacea*, Waters, "Bryozoa Bay of Naples," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 199, pl. 24. figs. 8–10.

Mr. Waters gives *Buskia nitida*, Heller, as a synonym, but he does not state that he has seen a type; without such a specimen, I cannot quote that Adriatic species as identical with the present. Again, he says that his Neapolitan examples have "two avicularian chambers, which overlook the mouth." In my specimens from Naples and Madeira I only see one avicularium of large size as figured by Smitt. I dredged it at Madeira; Senhor De Noronha procured it on Hydroids from the telegraphic cable; and in the Funchal Museum I found two unnamed specimens in a pill-box with the following note: "'Brittannia,' do Cabo," the longer, the shorter "'Scotia'," apparently therefore procured from the telegraphic cable.

CELLEPORA ROTUNDORA, nom. nov. W. (Pl. **42**. figs. 8, 9.)

1899. *Cellepora ianthina*, Waters, Journ. Roy. Micr. Soc. p. 14, pl. 3. figs. 1–3 (nec *Cellepora edax*, var. *ianthina*, Smitt).

I fail to recognise the species which Waters described from Madeira, and of which I have found numerous examples in about 70 fathoms, on small shells and especially on *Ditrupæ*, as Smitt's *Cellepora edax*, var. *ianthina*. Smitt's drawings may be relied upon as accurate, and the *Lepralia*-like orifice shown in his figure is entirely different from the perfectly round oral opening (*rotundus* and *ora*, an edge) of the Madeiran species. The rim is quite circular without any constriction of the margin, but in the throat a little projecting point on each side indicates the place of attachment of the operculum. The oœcium is remarkable with the lower portion of the front quite open, it is very thin, and the oœcia are generally broken down, as represented on the right hand in the figure here given. I leave the species where Waters placed it, but it cannot remain in *Cellepora*. The operculum is of unusual form (fig. 9).

CELLEPORA SEXSPINOSA, *Waters*. W.

1899. *Cellepora sexspinosa*, Waters, "Bryozoa from Madeira," Journ. Roy. Micr. Soc. pl. 3. fig. 12.

?1906. *Lepralia Watersi*, Calvet, Bull. Mus. Hist. Nat. p. 216.

?1906. *Lepralia Watersi*, id. Expéd. Sci. 'Travailleur' et 'Talisman,' Bryozoaires, p. 412, pl. 27. fig. 11.

The type specimen of Waters, which is in the Museum at Funchal, is the only example I have seen. It certainly is no *Cellepora*, nor do I see its connection with *Lepralia*.

EXPLANATION OF THE PLATES.

Plate 33.

Fig. 1. *Idmonea atlantica,* Forbes, natural size.
2. " " Portion magnified, seen from the side.
3. " *Meneghinii,* Heller. Natural size.
4. " " Portion magnified.
5. " " Back of branch.
6. " *pedata,* n. sp. Natural size.
7. " " From above.
8. " " From the side.
9. " " Back of branch.
10. " *concava,* Reuss, natural size.
11. " " From above.
12. " " From below.

Plate 34.

Fig. 1. *Filisparsa irregularis,* Meneghini, natural size.
2. " " Portion magnified.
3. " " Back of branch.
4. " " Var. *pennata,* nom. nov., natural size.
5. " " " Portion magnified.
6. " " Var. *superba,* J. Jullien, natural size.
7. " " " Portion magnified.

Figs. 8, 9, 10. *Entalophora deflexa,* Couch. Three specimens, natural size.
11, 12, 13. " " The same specimens, magnified.

Plate 35.

Fig. 1. *Entalophora proboscidea* H. M.-Edwards, natural size.
2. " " Portion magnified.
3. " " Portion of another specimen, magnified.
4. " *elegans,* nom. nov., natural size.
5. " " Portion, magnified.
6. *Crisia fistulosa,* Heller, natural size, and magnified.
7. *Alcyonidium effusum,* n. sp., natural size.
8. " " Portion, enlarged.
9. " " Polyps, more highly magnified.

Plate 36.

Fig. 1. *Scrupocellaria reptans,* var. *Bertholletii,* Audouin.
2. " " " The back.
3. *Bugula dentata,* Lamouroux.
4. " *gracilis,* Busk, natural size.
5. " " Portion magnified.
6. " " Avicularium.
7. *Membraniporella nitida,* var. *intermedia,* nov. var.
8. " *sceletos,* Busk.

PLATE 37.

Fig. 1. *Onychocella angulosa*, Reuss, showing the large avicularia.
2. *Cupularia guineensis*, Busk, natural size.
3. ,, ,, Zoœcia.
4. ,, ,, Under surface.
5. ,, ,, Dead zoœcia.
6. ,, ,, Under surface, dead specimen.

Figs. 7, 8, 9. *Cupularia Lowei*, Gray. Three specimens, natural size.

Fig. 10. ,, ,, Living zoœcia.
11. ,, ,, Under surface.
12. ,, ,, Dead zoœcia.

PLATE 38.

Fig. 1. *Cupularia Johnsoni*, Busk. Specimens, natural size.
2. ,, ,, Zoœcia from living specimen.
3. ,, ,, Zoœcia, under surface.
4. ,, ,, Zoœcia from dead specimen.
5. ,, ,, Variety, natural size.
6. ,, ,, Under surface of foregoing variety.
7. *Microporella marsupiata*, Busk.
8. *Porella tubulata*, Busk.
9. *Phylactella labrosa*, Busk, with avicularia.
10. *Tessarodoma boreale*, Busk, natural size and magnified.

PLATE 39.

Fig. 1. *Microporella nutrix*, J. Jullien.
2. ,, *decorata*, Reuss.
3. ,, ,, with oœcium.
4. ,, *coronata*, Audouin.
5. *Porella torquata*, Calvet. Fragment, natural size.
6. ,, ,, Portion, magnified.
7. ,, ,, Zoœcia, more magnified.
8. ,, ,, Back of branch.

PLATE 40.

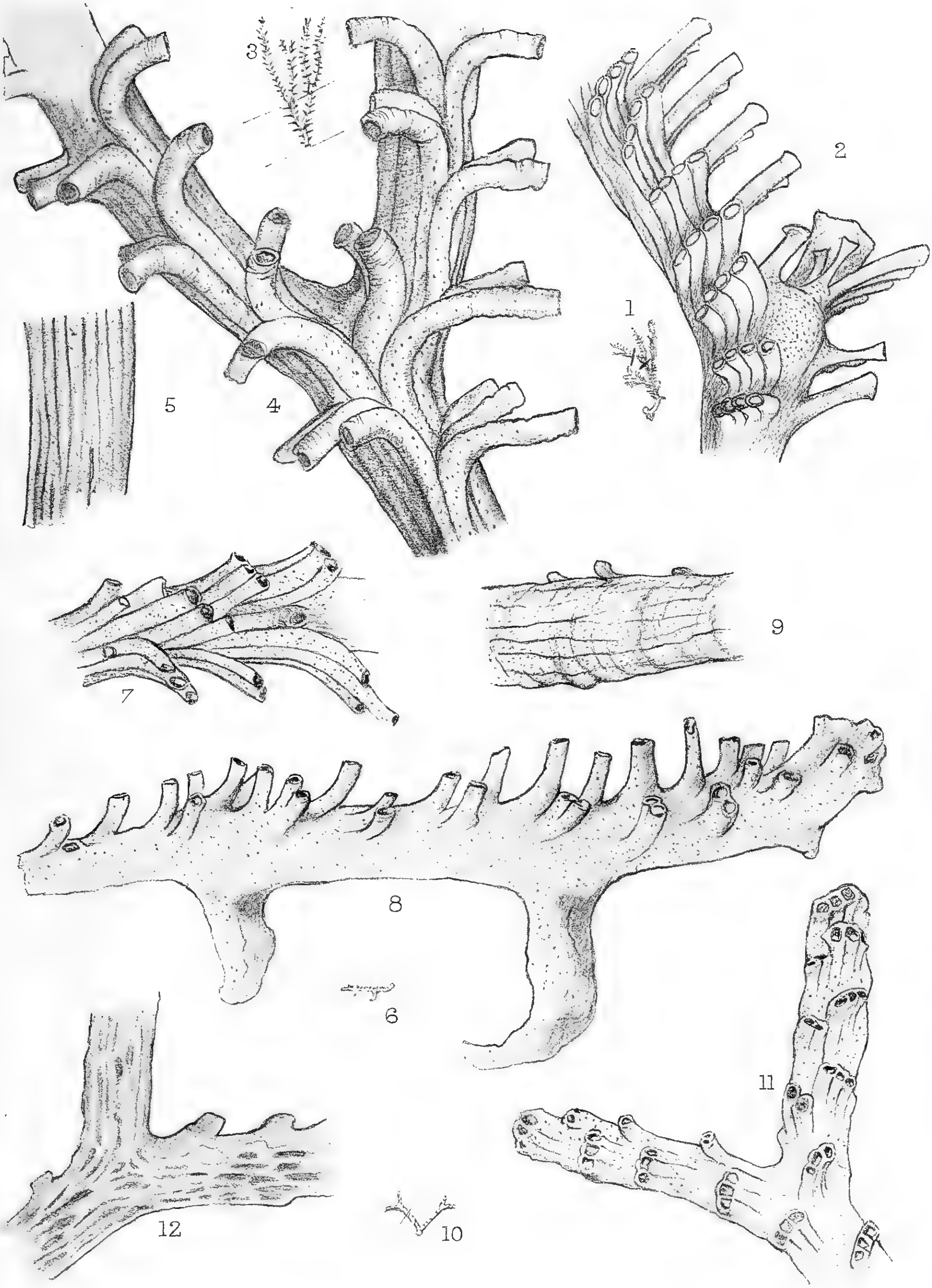
Fig. 1. *Lepralia porcellana*, Busk.
2. ,, ,, The operculum.
3. *Schizoporella biaperta*, var. *divergens*.
4. ,, ,, ,, The operculum.
5. ,, *armata*, Hincks. From a Mediterranean specimen.
6. ,, ,, The operculum.
7. *Escharina pes-anseris*, Smitt. Dead zoœcium.
8. *Escharella obscura*, n. sp.

PLATE 41.

Fig. 1. *Schizoporella Noronhai*, n. sp.
2. ,, *Schmitzi*, n. sp.
3. *Lepralia collaris*, J. Jullien.
4. ,, ,, The operculum.
5. ,, *contracta*, Waters.
6. ,, ,, Oral opening, more enlarged, to show serrated edge of upper margin.
7. ,, *Poissonii*, Audouin.
8. ,, ,, Dead specimen.

PLATE 42.

Fig. 1. *Catenicella Contei*, Audouin. Young specimen, from the front.
2. ,, ,, ,, from the side.
3. ,, ,, Zoœcia and oœcium.
4. *Cellularia nodosa*, n. sp.
5. ,, ,, natural size.
6. *Hemicyclopora multispinata*, Busk.
7. ,, ,, Remarkable specialised avicularia.
8. *Cellepora rotundora*, nom. nov.
9. ,, ,, Operculum.
10. *Lagenipora ignota*, n. sp. Erect form.
11. ,, ,, Portion of same, magnified.
12. ,, ,, The operculum.
13. ,, ,, Spatulate avicularium.
14. *Cellepora margaritacea*, Pourtalès, natural size and magnified.



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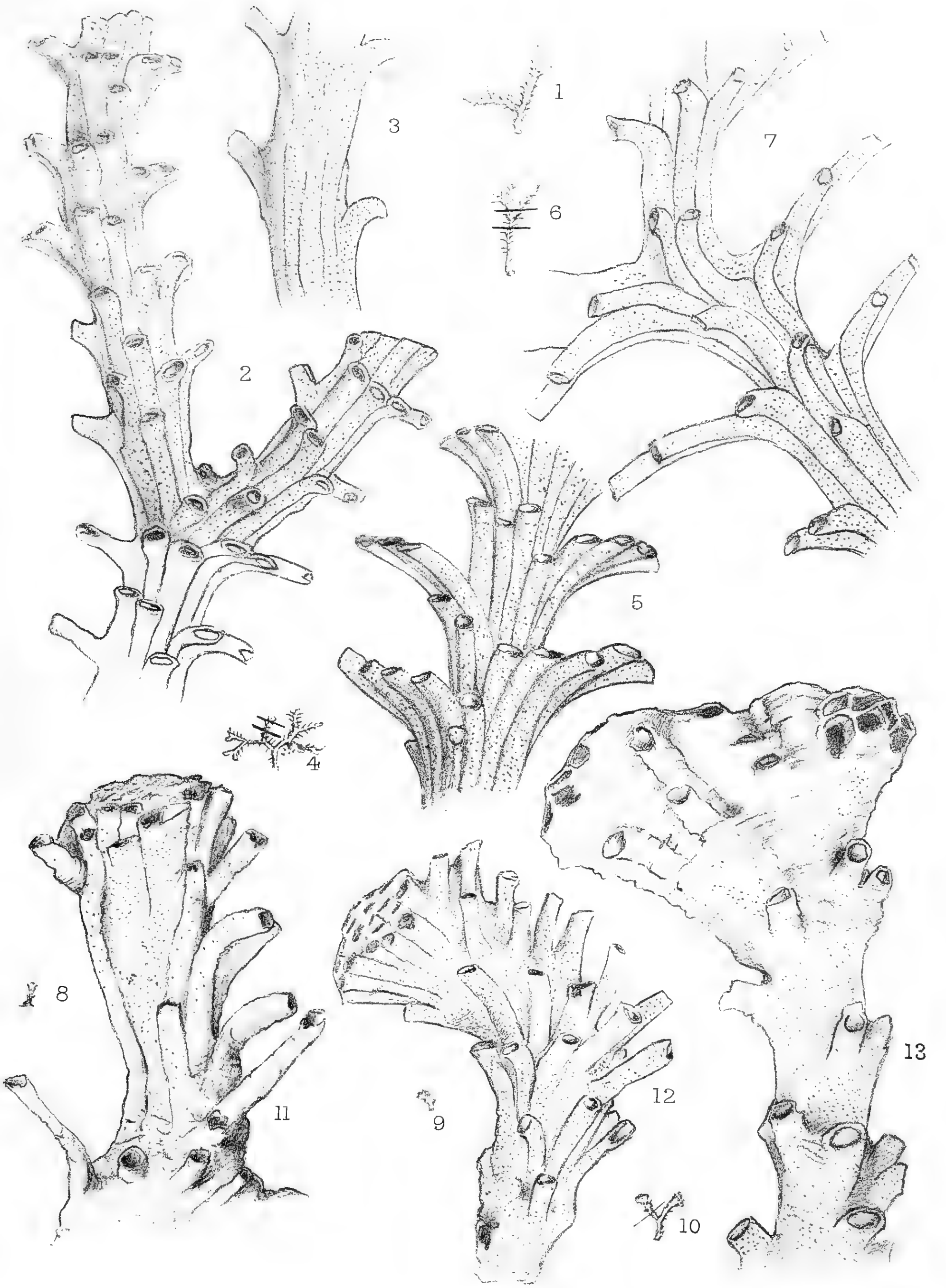

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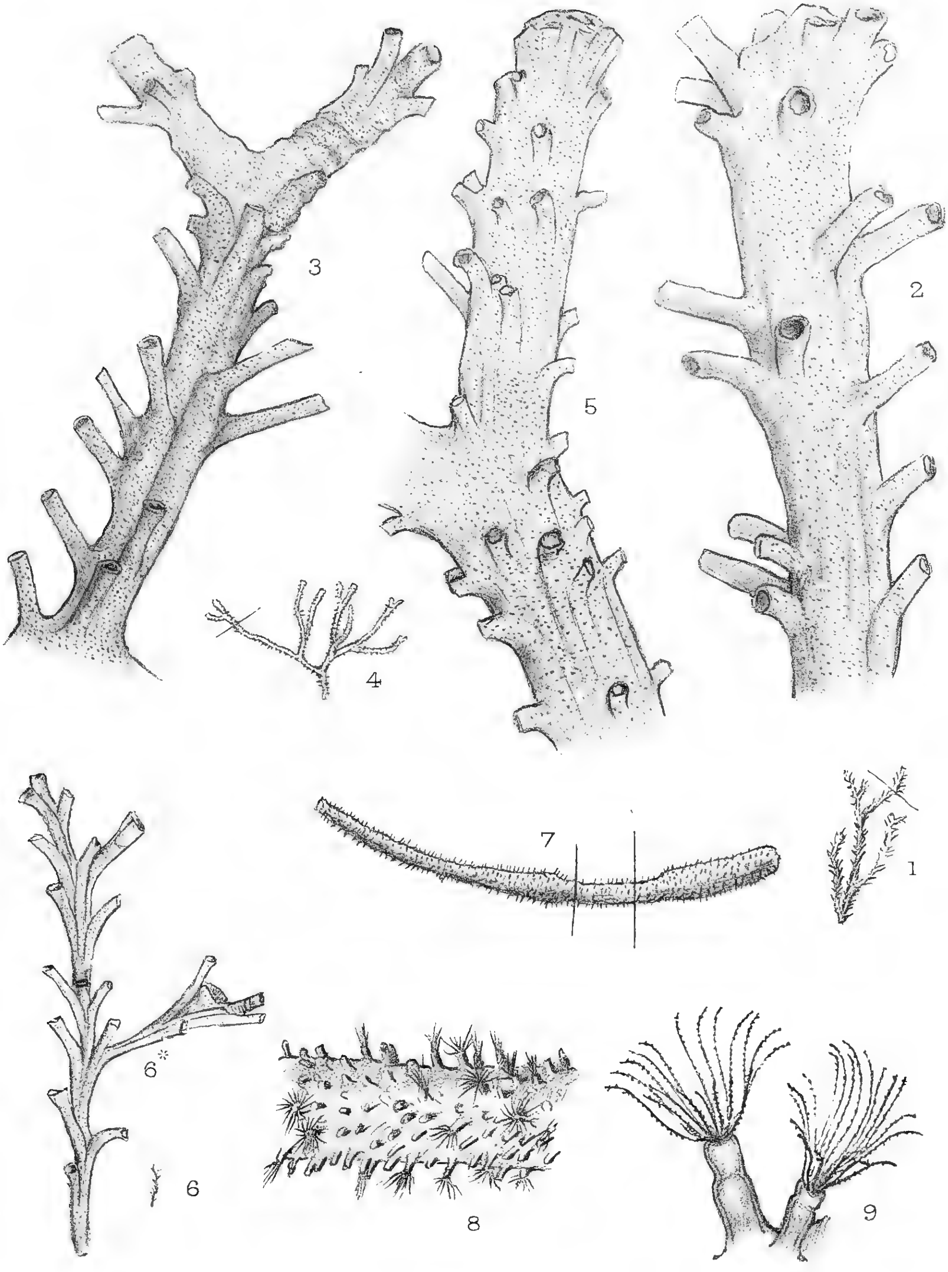

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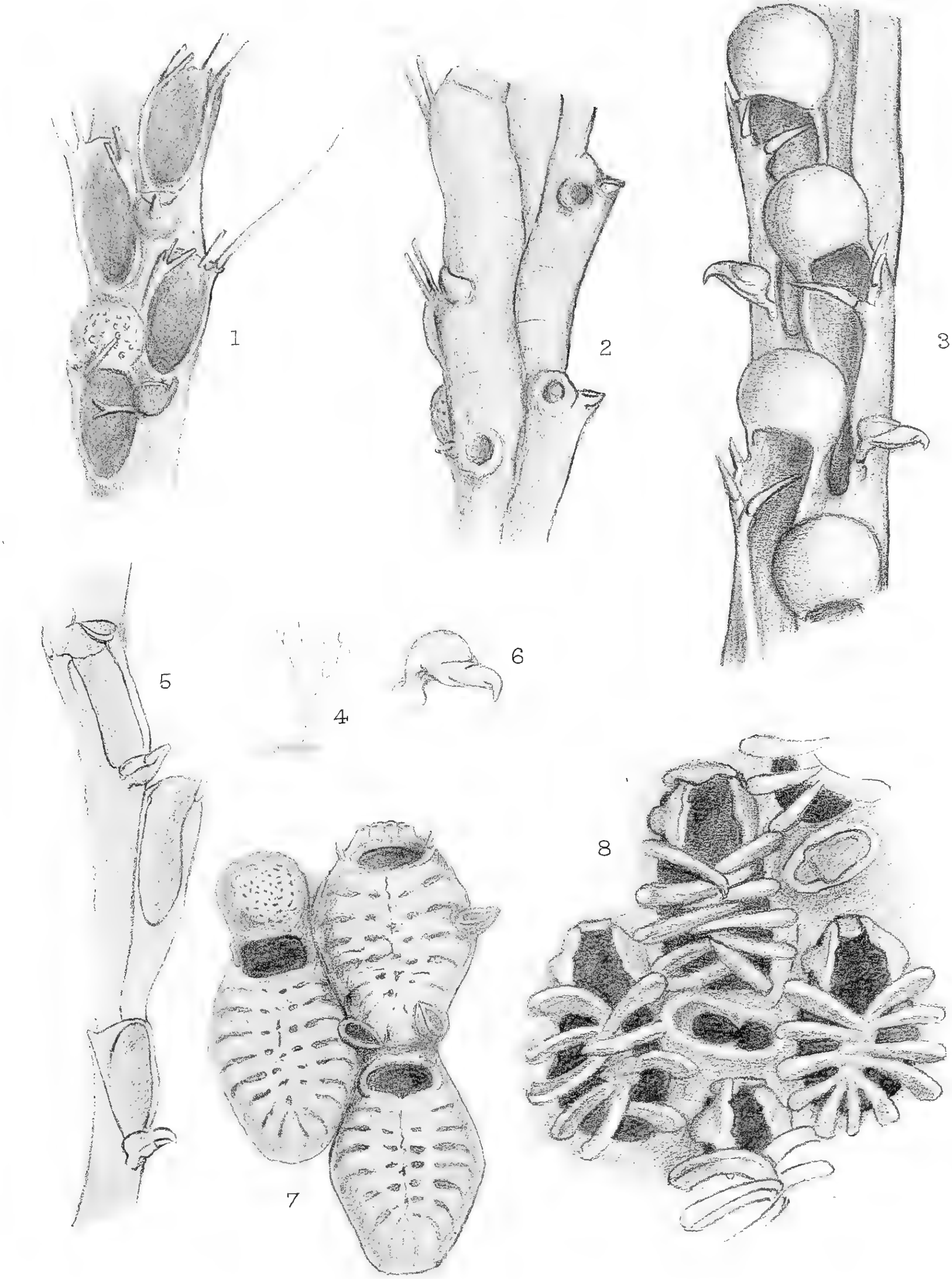

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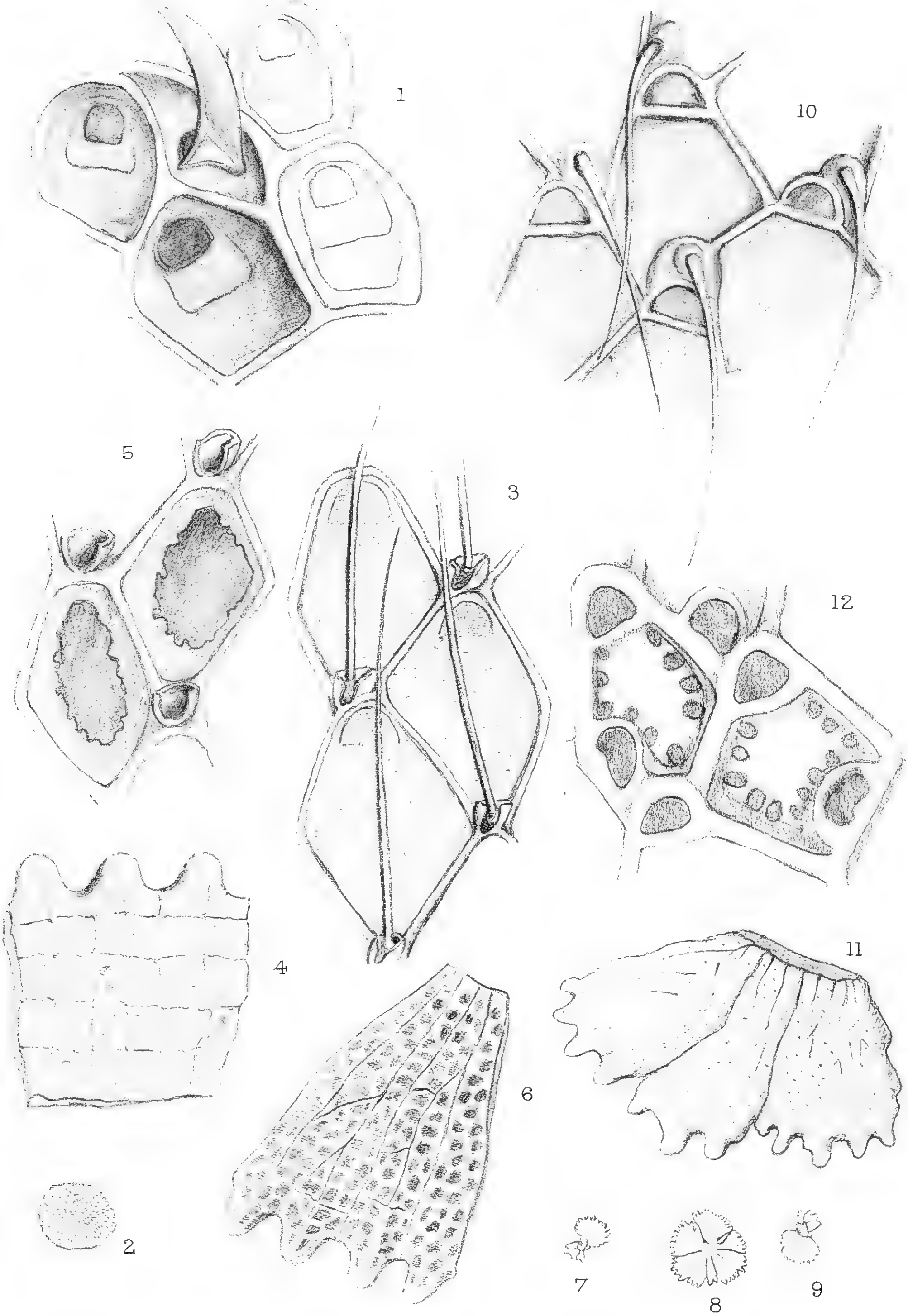

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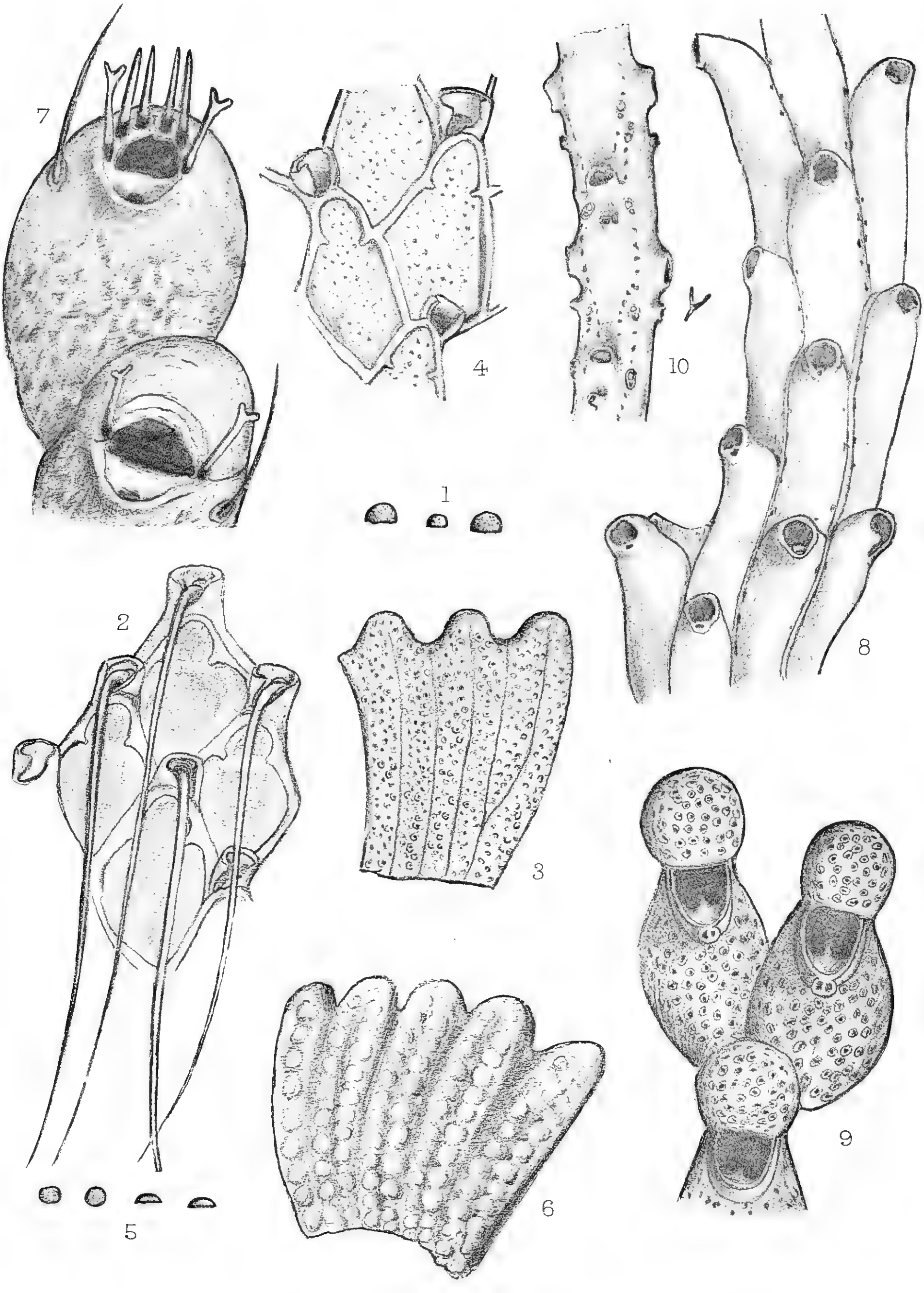

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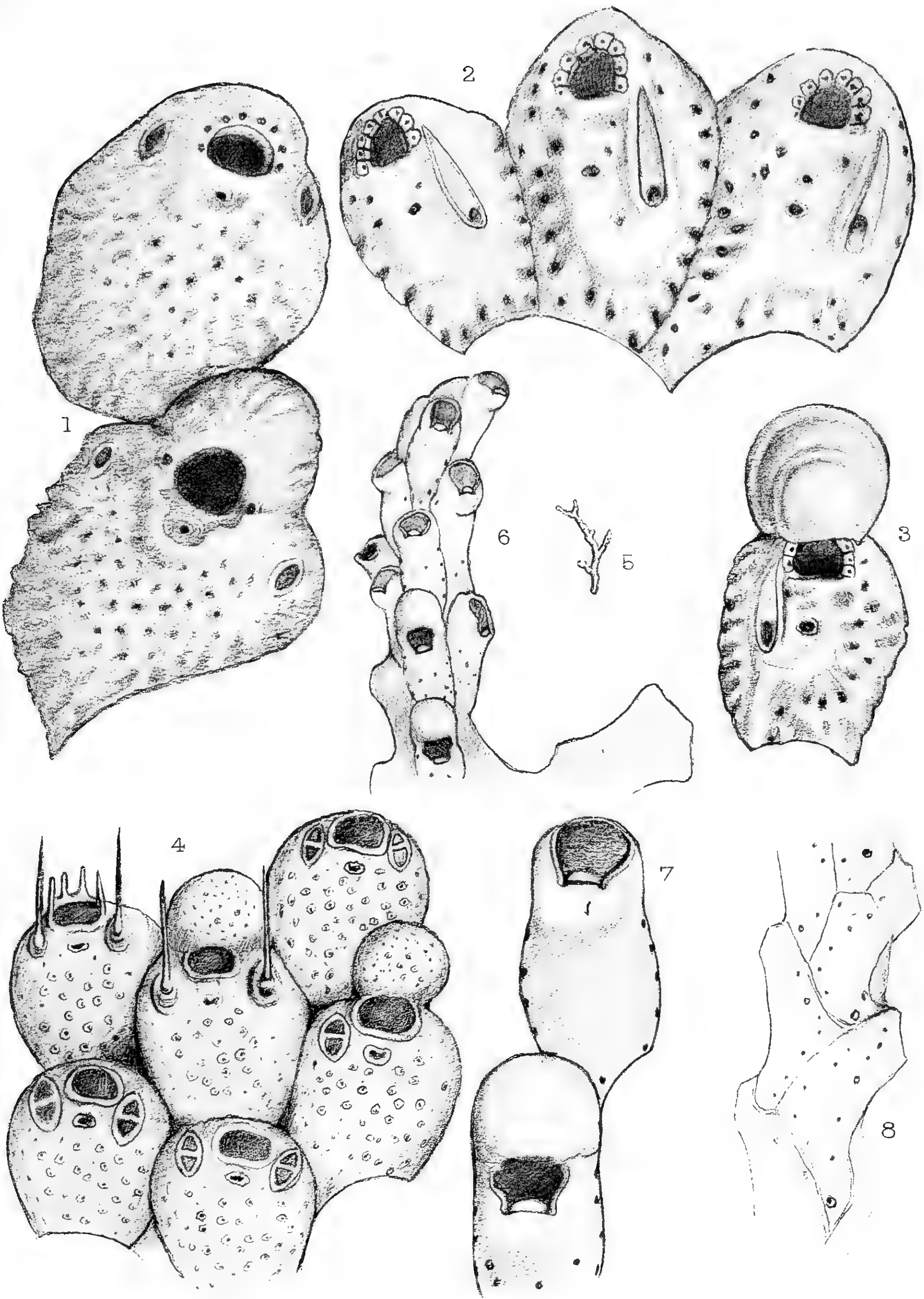

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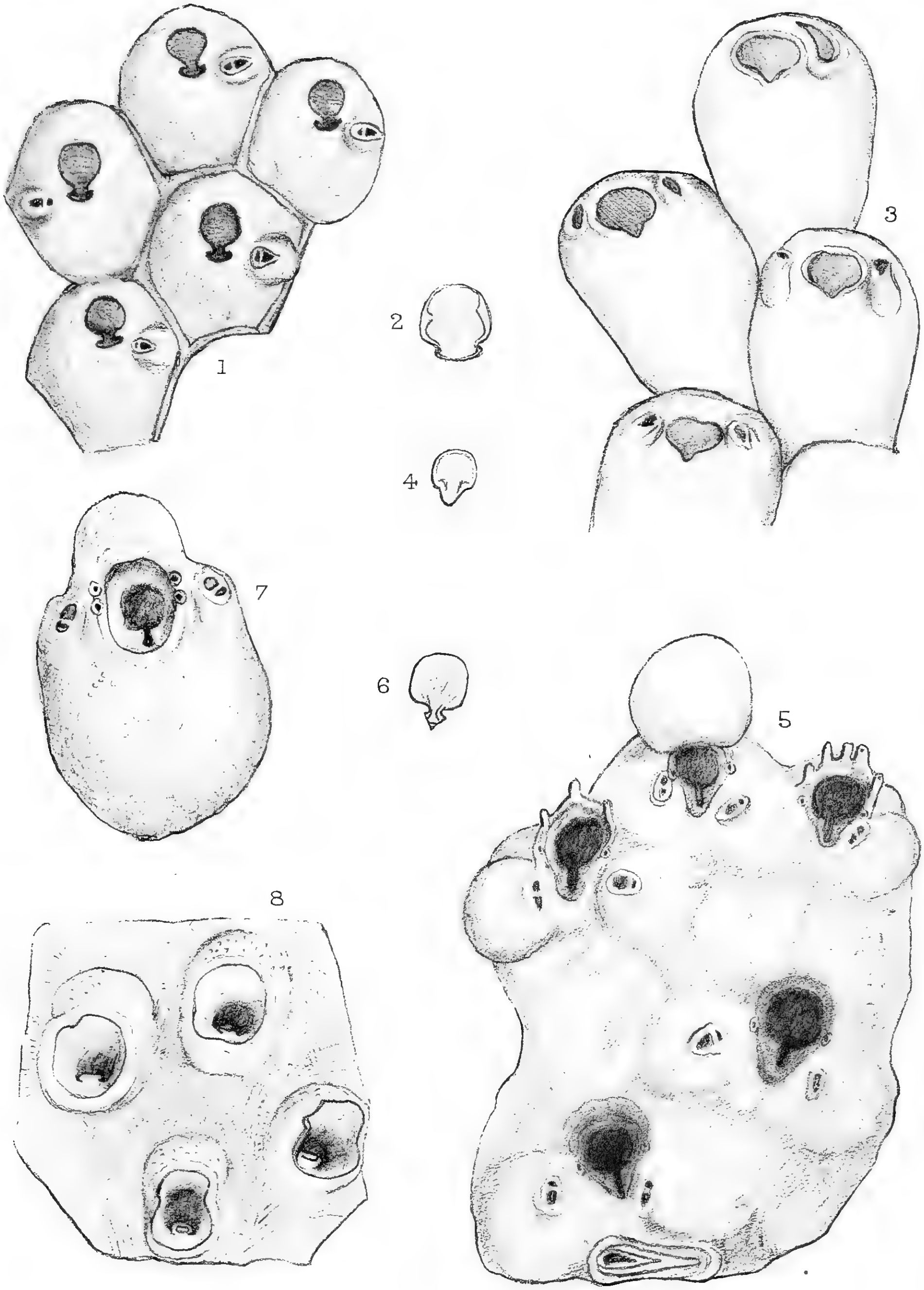

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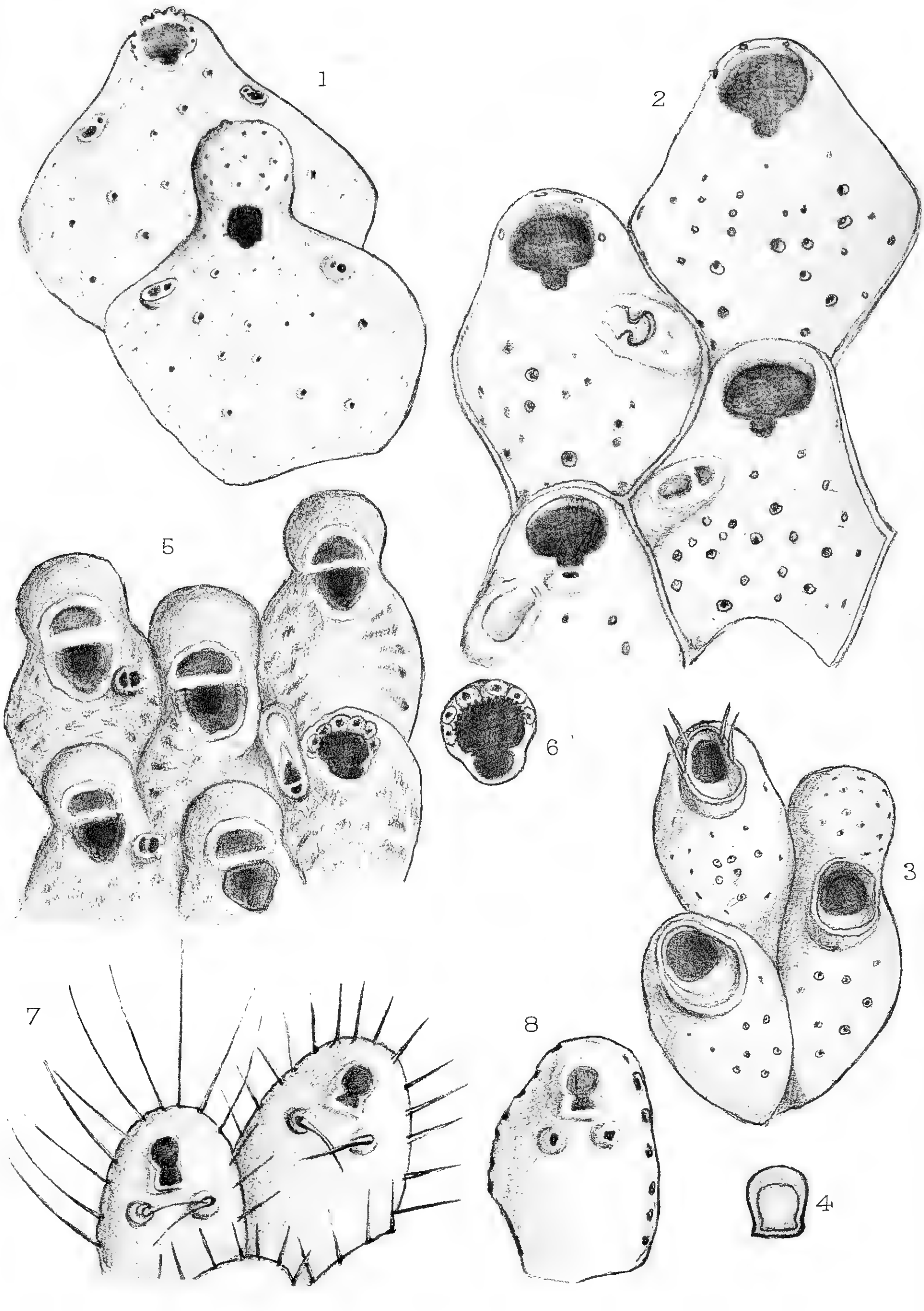

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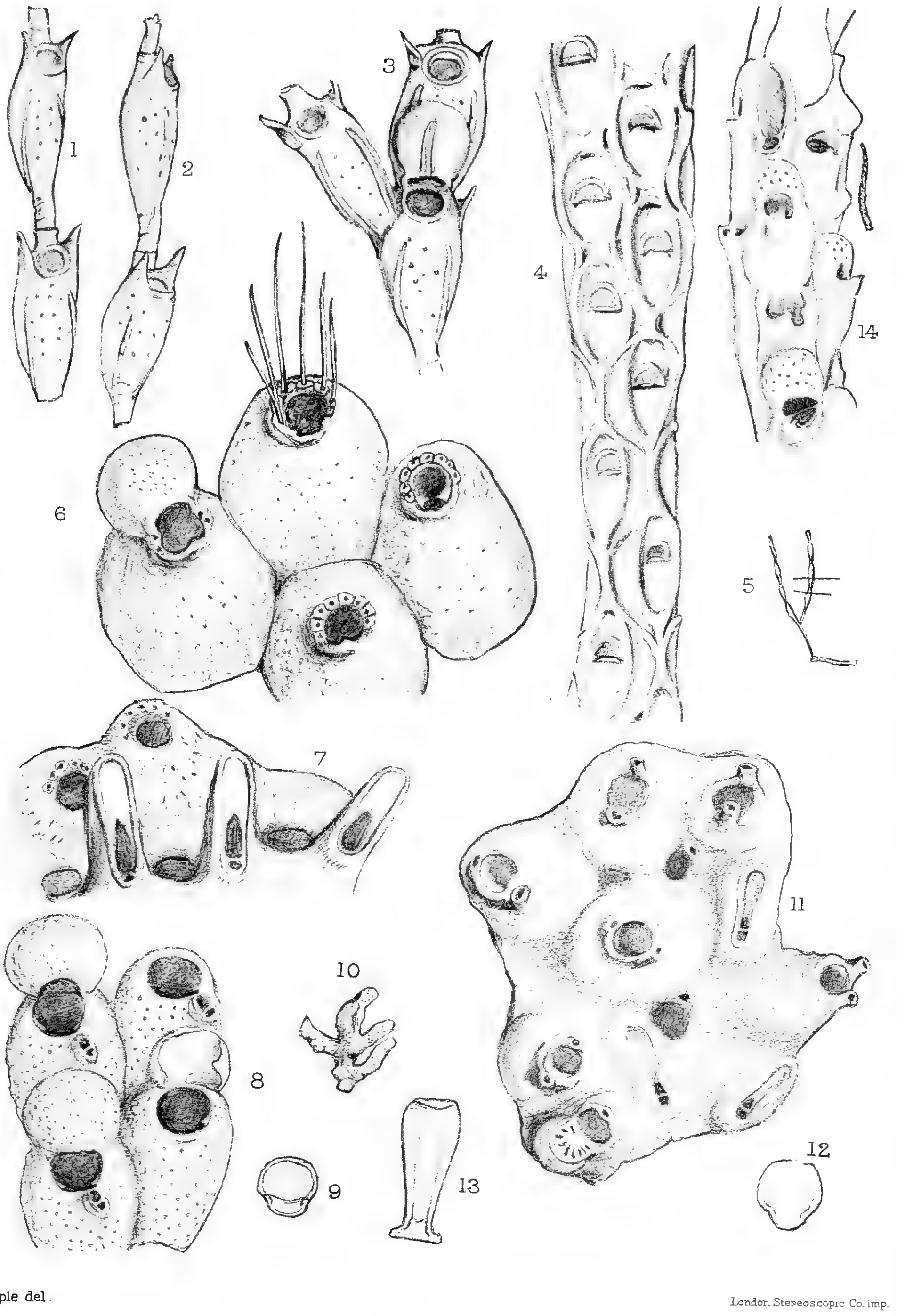

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Vol. **31**. Nos. 203–205.

This volume is reserved for reports on collections from the Sudanese Red Sea.

B. DAYDON JACKSON,
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On some Zoantheæ from Queensland and the New Hebrides.

By LEONORA J. WILSMORE, M.Sc., Zoological Laboratory, University College, London. (Communicated by Prof. J. P. HILL, D.Sc., F.L.S.)

(PLATES 43–45.)

[Read 6th May, 1909.]

THE Actinaria treated of in this paper form part of a small collection of these animals brought from Australia by Professor J. P. Hill, who kindly suggested the investigation to me, and to whom for his advice and assistance throughout the work my grateful thanks are due.

In the present communication the following four species are described as new :—

ZOANTHEÆ.
  BRACHYCNEMINÆ.
    Zoanthus sandvicensis, sp. n.
    Zoanthus similis, sp. n.
    Zoanthus pigmentatus, sp. n.
    Gemmaria arenacea, sp. n.

ZOANTHUS SANDVICENSIS, sp. n. (Pls. 43, 44. figs. 1–6.)

Form (Pl. 43. fig. 1).—The polyps form a colony covering an irregular shaped piece of coral and have apparently been broken off from a larger mass. The cœnenchyme is freely developed, and forms an incrustation over the coral, the indentations of which it closely follows. The free ends of the cœnenchyme advance in broad bands and form an almost continuous incrustation. Irregular spaces occur in the older parts, so that the whole structure forms a network.

The polyps grow fairly thickly on the cœnenchyme and are regularly distributed over its surface. In form they are usually cylindrical, but several of the larger are clavate. The capitula of the adults are all at nearly the same level. Their form and height seem to be determined by their position in the colony, since it is the polyps growing on the depressed borders of the coral which become drawn out and clavate; those on an elevated part are mere buttons having greater width than height. The columns in spirit specimens are wrinkled transversely. Three young polyps present on the older parts of the cœnenchyme arise from it directly, and not from the bases of other polyps.

Colour.—In spirit they are a light sand-colour. An enclosed label states that in life they were pink or green when expanded, and brown when contracted.

Dimensions.—Height 3–12 mm.; average height 6 mm.; diameter 3–5 mm.

Locality.—Collected in Erikor Lagoon, Sandwich Island, New Hebrides, by Mr. W. T. Quaife, in April 1903. 24 specimens.

The specific name *sandvicensis* refers to the island in the New Hebrides in whose waters they were collected.

Column-wall (Pl. **44.** fig. 2).—A cuticle and subcuticle are present. Numerous foreign bodies, mainly diatoms, adhere to the cuticle. The ectoderm is discontinuous, and the connecting strands of mesoglœa pass at frequent and regular intervals from the mesoglœa to the subcuticle. Nucleated ectodermal cells are present more or less abundantly in some of the cavities thus formed; in others they are not to be distinguished. It is probable that shrinkage has taken place as large vacuoles are of frequent occurrence. Large oval nematocysts are present. The mesoglœa is thick, averaging 0·29 mm. The numerous canals and small sinuses present are not definitely enough arranged to give the appearance of a broken encircling canal. The lacunæ contain nucleated cells and nematocysts. Enclosed cells, both with and without fibrillate terminations, are very numerous, especially towards the base of the polyp. The endoderm, which is thick, contains occasional nematocysts and is crowded with zooxanthellæ in the region of the capitulum, though elsewhere they are rare. Comparatively few fibres run from the endoderm into the mesoglœa. A distinct endodermal muscle is to be seen in longitudinal sections.

Capitulum.—The capitulum is thrown into some 20–24 ridges. Its ectoderm is crowded with nematocysts, and its endoderm with zooxanthellæ.

Sphincter muscle (Pl. **44.** fig. 3).—The sphincter muscle is double and embedded in the mesoglœa. In contraction, the line of demarcation between the two halves is very deep. The distal muscle is short but well developed. Its cavities are two rows deep distally, and the muscle ends abruptly at this point. The proximal muscle is very strong. At its widest part it occupies almost the whole of the mesoglœa, but lies throughout its course nearer the ectoderm than the endoderm. In parts indeed it is only separated from the ectoderm by the thinnest strands of mesoglœa. The cavities are very long at its widest point, and so closely packed together that the mesoglœa between them amounts merely to separating walls (Pl. **44.** fig. 3). The cavities are lined with muscle-cells, and the smaller cavities have in addition a few free cells enclosed. The ectoderm in this region is crowded with nematocysts.

Tentacles (Pl. **44.** fig. 4).—In three specimens cut transversely the tentacles number respectively 36, 39, and 40. The ectoderm is thick and contains two varieties of nematocysts: (*a*) Large oval, deeply staining nematocysts with distinct threads are crowded together in patches on the outer side of the tentacles (Pl. **44.** fig. 4, *nem. a*); (*b*) Smaller narrow, unstained nematocysts, often slightly curved, are numerous in the apical region of the tentacles, where they occur singly near the surface of the ectoderm (Pl. **44**. fig. 4, *nem. b*). A well developed ectodermal muscle on small mesoglœal plaitings is present. Between the ectodermal nuclei and this muscle is a clear nervous zone containing numerous nerve-cells scattered irregularly, and a great number of small oval highly refractive bodies which do not stain. These bodies are most abundant in the tentacles especially towards the tips (Pl. **44**. fig. 4, *r.b.*), but are also present in the disc. Von Heider (**7**) describes similar structures in the disc of *Z. chierchiæ*. The mesoglœa is thin, and contains lacunæ and occasional enclosed cells (Pl. **44**. fig. 4, *m.*). The endodermal muscle is small and flat (Pl. **44**. fig. 4, *end.m.*). The endoderm is much thicker than the ectoderm, and so crowded with zooxanthellæ that the endodermal nuclei are generally only visible at the edge of the lumen, which itself is very small.

Disc (Pl. **44**. fig. 5).—The ectoderm of the disc is broad and its structure unusual. Internal to the nuclei of the columnar cells there is a granular nucleated zone of considerable breadth. In the centre of the disc this zone is divided by a clear space crossed by fibres, which does not exist in the peripheral part of the disc. This granular ectoderm frequently invades the mesoglœa and reaches the endoderm. The layer of mesoglœa therefore is apparently not continuous through the disc, and where present is broken into pieces of various shape (Pl. **44**. fig. 5, *m.*). An endodermal muscle is seen only where mesoglœa is also present. This granulated ectoderm is present through the whole disc, and is at its thickest at the commencement of the lip. It disappears as the lip turns over into the œsophagus. Von Heider describes "eine eigenthümliche Gewebeschicht" in the disc of *Z. chierchiæ* (**7**), which is very similar to this structure, but which does not invade the mesoglœa, and is also apparently quite distinct from the overlying ectoderm. In the endoderm, which is half the width of the ectoderm, the zooxanthellæ present are not sufficiently numerous to conceal the endoderm cells. The lip is raised.

Œsophagus.—The ectoderm of the œsophagus consists of three zones as described in *Z. flos marinus*, McMurrich & Duerden (**3** and **8**), and in *Z. chierchiæ*, von Heider (**7**). Nematocysts are very numerous, and gland-cells much more so than figured by von Heider (**7**). A sulcar groove is present, and the ectoderm which lines it is thinner and smoother than elsewhere. The folding of the ectoderm is very irregular.

Mesenteries (Pl. **44**. fig. 6).—The mesenteries in three specimens cut numbered 36, 38, and 40. Owing to great increase in numbers of zooxanthellæ in the endoderm near the œsophagus, the mesenteries are much thicker there than towards the column-wall. Nematocysts are also present. The mesoglœa is thick, reaching its maximum in the directive mesenteries. The longitudinal muscle is strongly developed on long plaitings of the mesoglœa (Pl. **44**. fig. 6, *l.m.*). The parieto-basilar muscle is well developed on both sides; on the entocœle side it is continuous with the longitudinal muscle; on the exocœle side it continues to about two-thirds the length of the basal canal. A large basal canal is present, oval or circular in transverse sections (Pl. **44**. fig. 6, *b. c.*). In the upper part of the polyp, the basal canal widens into a long slit which may be continuous through the width of the mesentery. Duerden (**8**) has described the opposite condition in *Z. pulchellus*, where the long slits occur at the base of the polyp. The endoderm of the mesenteries from the capitulum to the lower end of the œsophagus contains very numerous zooxanthellæ. Below that point there are none present. As zooxanthellæ disappear from the endoderm of the column-wall at about the same level, it follows that they are very abundant in the distal and rare in the proximal part of the polyp. The reflected ectoderm of the mesenteries closely resembles that of *Z. Macgillivrayi* as described by Haddon and Shackleton (**5**). The digestive endoderm is very thick and encloses many foreign granules as in *Z. flos marinus* (**3** and **8**); but here nematocysts also occur, while the green granules of *Z. flos marinus* are rare.

Gonads.—The species is hermaphrodite. Spermaria are present in abundance in all five polyps examined. Three ova also occur in one polyp and a single ovum in another. All four ova are ripe, of large size, and borne on mesenteries which carry spermaria also. Nematocysts are frequently present in the endoderm surrounding the spermaria.

Parasites.—Two kinds of parasitic Protozoa are present in large numbers in the swollen endoderm of the mesenteries.

The unusually powerful sphincter muscle of *Z. sandvicensis* is its distinguishing characteristic.

This is the more remarkable, since, as pointed out by Duerden (**8**), the sphincter muscle in Pacific species is, on the whole, much less developed than in West Indian species.

In other anatomical points *Z. sandvicensis* comes nearest to *Z. flos marinus* described by Duerden from the West Indies, and to *Z. chierchiæ*, von Heider (**7**). The locality of the latter is unknown.

It is, however, easily distinguished from these two species by, among other points, the sphincter muscle, number and character of mesenteries, structure of column-wall and ectoderm, and form of cœnenchyme.

Zoanthus similis, sp. n. (Pls. **43**, **44**. figs. 7–10.)

Form (Pl. **43**. fig. 7).—This colony closely resembles that of *Z. sandvicensis* in external appearance, but the polyps are distinctly smaller and more slender. The growth of the cœnenchyme takes place as in *Z. sandvicensis* by broad bands. Several are present measuring 12–15 mm. in length, and 5–7 mm. in width. There is a large growth of cœnenchyme at one side (Pl. **43**. fig. 7), on which some young polyps are developing at long intervals.

Colour.—Sand-colour in spirit. No account of colour when living enclosed.

Dimensions.—Height 2–8 mm., average 2–5 mm.; diameter of capitulum 2–3·5 mm.

Locality.—Collected in Erikor Lagoon, Sandwich Island, New Hebrides, by Mr. Douglas Mawson, B.E., B.Sc., in 1903. Part of a colony. Numerous specimens.

The specific name refers to its undoubted relationship to *Z. sandvicensis.*

Column-wall.—Distinctly thinner than in *Z. sandvicensis*, averaging ·19 mm. in place of ·29 mm. (Pl. **44.** fig. 8). The ectoderm is discontinuous; a cuticle and subcuticle are present. The cavities in the mesoglœa in which the ectoderm lies are more irregular than those of *Z. sandvicensis* and contain a larger amount of cellular tissue, indeed the latter may occasionally fill the mesoglœal spaces. In this smaller species endodermal fibres extending through the mesoglœa are more numerous than in *Z. sandvicensis*, but the general structure of the column-wall is very similar in the two species.

Sphincter muscle (Pl. **44.** fig. 9).—This is double and strong, consisting of small rounded and irregular cavities which extend through the greater width of the mesoglœa. The muscle-lining is thin and free muscle-cells are present in all the cavities. Large quantities of diatoms are caught in the ridges of the capitulum in this region.

Tentacles.—Number 50, 54, and 56 in three specimens examined. The ectoderm and mesoglœa resemble those of *Z. sandvicensis*; large oval, and small narrow, nematocysts are present, but the oval refractive bodies of *Z. sandvicensis* are absent. The endoderm contains fewer zooxanthellæ and the lumen is larger.

Disc.—The structure of the ectoderm and mesoglœa resembles that of the tentacles, but the endoderm is much narrower and contains fewer zooxanthellæ. Only the large oval nematocysts are present in the ectoderm, which is not granulated as in the last species.

Œsophagus (Pl. **44.** fig. 10).—The structure of the œsophagus resembles that of *Z. sandvicensis*, *Z. flos marinus*, and *Z. chierchiæ* (**3**, **6**, and **8**). The folding of the œsophagus is always unsymmetrical. Nematocysts are very numerous in the ectoderm.

Mesenteries (Pl. **44.** fig. 10).—The mesenteries number 50–56. In this species all the perfect mesenteries including the sulcar directives are of equal thickness and the basal canal is oval. The musculature is well developed, the longitudinal retractor muscles on plaitings of the mesoglœa. Nematocysts are present in the endoderm and zooxanthellæ are very abundant, but, as in *Z. sandvicensis*, these latter are absent below the level of the œsophagus.

Gonads.—All the six polyps cut were fertile, and the gonads well developed, ripe and numerous. Three were male individuals, and three female. This is the first instance recorded of both male and female individuals being present in one colony of *Zoanthus*. Haddon and Shackleton mention that they did not meet with an instance in any Zoantheæ (**5**). Our knowledge of the reproductive systems of the genus *Zoanthus* is, however, still incomplete, since several species have been described which contained no gonads.

Z. sandvicensis and *Z. similis* are undoubtedly closely allied. The two species resemble each other externally in general appearance and in the character of the cœnenchyme ; and internally, in the general structure of the column-wall, mesenteries and tentacles. They differ in shape and size and in several anatomical points, such as structure of the disc, thickness of the column-wall, character of the sphincter muscle, and number of mesenteries and tentacles. These latter number from 50–56 in the smaller form, *Z. similis*, and from 34–40 in *Z. sandvicensis*.

The sphincter muscle of *Z. similis* is intermediate in structure between that of *Z. sandvicensis* and of *Z. chierchiæ*, von Heider (**6**). It differs from the former in arrangement, shape and number of cavities and their contents (Pl. **44**. figs. 3, 9), and from the latter in that it does not lie nearer the endoderm, but occupies the whole width of the mesoglœa and the cavities, which are much more numerous and more closely packed than in *Z. chierchiæ* ; all contain free muscle-cells.

I have had some difficulty in deciding whether the two forms *Z. sandvicensis* and *Z. similis* should be regarded as one or two species, and have decided on the latter alternative chiefly from a consideration of the value placed on the sphincter muscle for specific purposes within the genus. The other anatomical differences give weight to this decision.

ZOANTHUS PIGMENTATUS, sp. n. (Pls. **43**, **45**. figs. 11–15.)

Form (Pl. **43**. fig. 11).—The polyps, which are distinctly club-shaped, present a very irregular appearance both in size and grouping. Column and capitulum alike are much wrinkled transversely, only a few fine ridges are present at the opening in the swollen capitulum. The cœnenchyme forms a flattened expansion, from which little groups of polyps arise. This may have formed a network, but the pieces collected are not sufficient to decide the point. Stolons are also present, and occasionally a stolon is found passing from one polyp to another above the level of the cœnenchyme proper. New polyps arise either directly from the new unpigmented cœnenchyme, or by budding from the column of an older individual. In this latter case, the budding takes place near, but not at, the base of the column, and the piece of the column below the budding forms a common stalk for both polyps (Pl. **43**. fig. 11). In this way are formed the stems with two branches which arise here and there from the cœnenchyme.

Colour.—Greyish brown in spirit : a few of the polyps and patches of the cœnenchyme are a light sand-colour. Reddish-brown spots surround the orifice of the capitulum in many individuals.

Dimensions.—Height 5–24 mm., average 8–10 mm.; diameter, capitulum 3–4 mm., column 1·5–2 mm.

Locality.—Collected at Masthead Island, Queensland, by Mr. C. Hedley's expedition in 1904.

The specific name *pigmentatus* refers to the circular zone of pigment-granules in the mesoglœa of the column-wall.

Column-wall.—Beneath the cuticle of many of the shorter polyps one or two little grains of coral are to be seen. In many of the longer ones this process has gone much further, and the basal half of the polyp is covered with little projections each containing a number of coral fragments. Sections show that a very irregular form of incrustation has taken place. The coral fragments are not distributed regularly round the column-wall, they remain closely packed together and occupy the whole width of the mesoglœa immediately interior to their point of entry. In many cases single pieces break through the endoderm and enter the cœlenteron. These coral fragments are sometimes sufficiently numerous to make the polyp quite rigid, and occurring as they do in the slender basal part of the elongated polyps must afford a great support. Seven polyps of different heights were sectionized, and in each case small fragments of coral were found lying free in the cœlenteron.

The column-wall is comparatively thin, averaging ·15 mm. The proximal part is thicker than the distal. A yellow cuticle and a very thick subcuticle are present. In longitudinal sections the column-wall frequently presents a correspondingly convoluted appearance to that of *Z. Shackletoni* (Haddon & Duerden, 7). But in this species the ectoderm and mesoglœa proper take part in the folding. Fig. 12 is a drawing of a much less wrinkled specimen. The ectoderm is discontinuous, but the connecting strands of mesoglœa are neither so numerous nor so regular as in *Z. sandvicensis* (fig. 12). A large number of nucleated ectodermal cells are present in irregular groups, and the ectodermal spaces contain also many large oval nematocysts. The mesoglœa is thinner in the distal part of the column and capitulum than in the proximal part.

An irregular row of globular lacunæ lies in the mesoglœa immediately below the ectoderm (Pl. **45.** figs. 12, 13), extending throughout the length of the column and into the proximal portion of the capitulum. Generally these globular lacunæ appear quite empty, but they may contain a little pigment and more rarely a single nucleated cell. Duerden has described the same structures, but without contents, as occurring in *Z. Solanderi* (**8**).

In close proximity to these spherical cavities and scattered partly among them is a very distinct circular zone of pigment-granules. Its presence gives a characteristic appearance to transverse sections of this species (Pl. **45.** figs. 12, 15). This zone is present throughout the length of the column, and the pigment-granules increase in the region of the capitulum. Proximally they become scattered through the mesoglœa.

Abundant lacunæ containing nematocysts and cellular tissue form a broken encircling canal situated about the middle of the mesoglœa. Ectodermal canals entering the mesoglœa are frequent (Pl. **45.** fig. 15, *ect.c.*). A weak endodermal muscle is present. The zooxanthellæ are many rows deep in the endoderm distally, proximally they are rarer.

In the basal contracted part or pedicel of the polyp the cœlenteron is represented by a series of small cœlenteric canals branching in a mesoglœal mass, which is continuous with the column-wall and which contains many lacunæ. The structure of the pedicel is, therefore, precisely that of a stolon. In elongated polyps this portion is very long, at least a quarter of the total length of the polyp.

Capitulum.—The capitulum is thrown into a few fine ridges. A cuticle and subcuticle are present. The subcuticle is thinner, and nematocysts are more numerous than in the column-wall.

Sphincter muscle (Pl. **45.** fig. 13).—The sphincter muscle is double and mesoglœal. The line of demarcation between the two portions is very deep. The proximal portion consists of a large number of small irregular cavities which are scattered throughout the width of the mesoglœa, internal to the globular lacunæ. All the cavities contain free muscle-cells of large size which frequently entirely fill the spaces. The distal muscle is small. Its cavities may be arranged in the characteristic horseshoe-shape, or more irregularly as in fig. 13.

Tentacles.—The tentacles in three cases number respectively 50, 50, and 52. Cuticle and subcuticle are absent. Small narrow unstained nematocysts are present in numbers in the outer border of the ectoderm, and fewer large oval ones are scattered through it. Yellow pigment-granules are more or less abundant in the ectoderm of many of the tentacles, while in others there are only a few granules. The mesoglœa is thin and contains cells. The ectodermal muscle is stronger than the endodermal, and is slightly plaited. The endoderm is so crowded with zooxanthellæ that no lumen is present.

Disc.—The structure of the disc resembles that of the tentacles, but the endoderm is thinner than the ectoderm. The latter contains patches of yellowish pigment.

Œsophagus (Pl. **45.** fig. 15).—The ectoderm is not thrown into definite ridges, and is generally quite smooth.

Both nematocysts and yellow pigment are present in the non-staining nervous zone. The mesoglœa and endoderm are both thin. The latter contains zooxanthellæ.

Mesenteries (Pl. **45.** figs. 14 and 15).—The mesenteries in three specimens cut number 50, 50, and 52. They are of the brachycnemic type and very thin towards the œsophagus. The basal canal is small oval in transverse section, frequently contains nematocysts, and is double above the level of the mouth. The endoderm is narrow and contains numerous zooxanthellæ and nematocysts. Both parieto-basilar and longitudinal retractor muscles are well developed, the latter on plaitings of the mesoglœa (Pl. **45**. fig. 14, *p.b.m.* & *l.m.*). The digestive endoderm present on the mesenteries in the proximal region is not so thick as in *Z. sandvicensis*. It contains many nematocysts, and is loaded with pigmented granules to such an extent that the whole endoderm is often of a bright yellow-brown colour left unstained by the carmine.

Gonads.—All the polyps cut are fertile and contain ova only.

Parasites.—A dark brown encysted parasite, probably protozoan, is present in numbers in some of the basal canals.

The abundance of yellow-brown pigment present in *Z. pigmentatus* is very striking. At the same time zooxanthellæ are as abundant as in *Z. sandvicensis* and *Z. similis*, in which species there is very little pigment. It seems, therefore, that the relationship between zooxanthellæ and pigment-granules, in virtue of which they replace one another in the genus *Parazoanthus* and in several families of Actinaria (Duerden, **9**), does not exist in these species.

Z. pigmentatus resembles *Z. sociatus* (McMurrich, **4**) in size, shape and colour, in its irregular mode of growth and in its stolon. Professor McMurrich, however, to whom I have submitted specimens, has no hesitation in describing it as distinct from his species. He also, with great kindness, sent specimens of *Z. sociatus* for comparison.

The globular cavities in the mesoglœa are present also in *Z. Solanderi* (**8**), but confusion between *Z. Solanderi* and *Z. pigmentatus* is impossible. *Z. pigmentatus* can be readily distinguished from all species hitherto described, by the pigment zone, the sphincter muscle, the structure of the column-wall, and by the irregular incrustation in the proximal half of many of the polyps, all other species of this genus having the mesoglœa proper of the column-wall unincrusted.

GEMMARIA ARENACEA, sp. n. (Pls. **43**, **45**. figs. 16–20.)

Form (Pl. **43**. fig. 16).—The polyps, erect, cylindrical, rigid and very gritty, arise from a freely developed, tough, and very thick cœnenchyme. They are of equal diameter throughout. The capitulum, marked by some 28 to 29 ridges, is not swollen in retraction. The young polyps present arise from the cœnenchyme, not from the bases of other polyps. The surface is thickly covered with adhering sand grains, which form a crust largely concealing the deep transverse wrinkles of spirit-specimens. Both column and cœnenchyme are overgrown with patches of *Rivularia* and *Lyngbya*, two genera of the Cyanophyceæ, from which the ridges of the capitulum are more or less free.

Colour.—Sand-coloured in spirit-specimens.

Dimensions.—Vary considerably in the different polyps, and are independent of position of polyp in the colony. Height 5–14 mm., average 8–10 mm.; diameter 4–7 mm., average 5–6 mm.

Locality.—Collected at Masthead Island, Queensland, by Mr. C. Hedley's expedition in 1904. Numerous specimens.

The specific name *arenacea* has reference to its markedly incrusted character. No species of this genus hitherto described is so thickly incrusted with calcareous sand-grains.

Column-wall (Pl. **45**. figs. 17–18).—The incrustations of the column-wall are chiefly calcareous sand-grains with a sprinkling of siliceous spicules. A certain amount of selection is shown, the sand-grains in the distal part of the capitulum being more regular in size and much smaller than those in the column. Still smaller grains are found in the disc and tentacles. The occasional siliceous spicules are distributed irregularly throughout, and not confined to the lower column-wall as described by von Heider in *G. variabilis* (**11**). The incrustations extend through the whole of the ectoderm and occupy from one-half to four-fifths of the mesoglœa also. They penetrate to a varying and irregular depth in different parts of the same column-wall. Peripherally the sand-grains are so closely packed that only small portions of the original tissue are seen between them. More centrally they may be very scattered. Occasionally a grain comes into contact with the endoderm, and pushing it inwards forms a projection into the cœlenteron. In the capitulum the incrustations do not pass through the sphincter muscle.

The ectoderm is of the continuous type, and no cuticle is present. It is mnch broken up and its structure difficult to determine owing to numerous grains of sand imperfectly enveloped which project through the surface. Zooxanthellæ are everywhere very numerous. In the capitulum the ectoderm is much less broken, and the zooxanthellæ, massed together, occupy all the tissue free from sand-grains. In this region the ectoderm presents very rregular internal limitations as in *G. variabilis*, Duerden (**8**). It is here much thicker than in the column, reaching an average width of 2 mm. and in the ridges 3·5 mm. The mesoglœa measures about 2 mm. in the capitulum, and attains its greatest breadth (8 mm.) in the proximal part of the column. The innermost portion of the mesoglœa, which is free from incrustations, contains no sinuses, but many cell islets and lacunæ are scattered irregularly through its substance. They are filled with zooxanthellæ, and are much more numerous proximally. Single cells and long radial fibres stretching from the endoderm through the mesoglœa are very common, and the endodermal surface of the mesoglœa is much plaited. A considerable amount of pigment is present, chiefly confined to the cell islets and lacunæ. The endoderm is thin and contains zooxanthellæ, but they are not so numerous as in the ectoderm, and this rule obtains throughout the polyp.

Sphincter muscle (Pl. **45**. fig. 19).—The sphincter muscle is single, mesoglœal and relatively weak, and lies throughout its length close to the endoderm. In position it resembles the sphincter of *G. multa sulcata* (Carlgren, **13**), but is distinctly weaker. It consists of an irregular single row of small mesoglœal cavities which are completely filled with muscle-cells. These cavities are extremely small proximally; distally they increase in size.

Tentacles.—In two polyps the tentacles numbered 56. The ectoderm is several times thicker than either meso- or endoderm. Long, narrow nematocysts occur in small numbers in the outer zone of the ectoderm, while the inner zone is crowded with zooxanthellæ. Little groups of sand-grains lie in the ectoderm on the outer side only of the tentacles and towards their tips. A weak ectodermal muscle is present. The mesoglœa and endoderm are both thin. The former contains numerous isolated cells. Zooxanthellæ occur in the endoderm, but not in sufficient numbers to fill the lumen.

Disc.—The centre of the disc is smooth and flat. The mouth is oblong and placed on a slight prominence. Peripherally there are a number of ridges, produced by thickenings of the mesoglœa, one corresponding to each of the tentacles. In the centre of the disc both ectoderm and mesoglœa contain a thin sprinkling of minute sand-grains (Pl. **45**. fig. 20, *lac.d.*). The ectoderm, which is very thick throughout and particularly so peripherally (Pl. **45**. fig. 20), contains many zooxanthellæ. The mesoglœa is thickest at the central part of the disc. Numerous large isolated cells are enclosed in this layer, and enter the bases of the tentacles at their point of junction with the disc (Pl. **45**. fig. 20, *ect.m.*). These appear to be identical with the ectodermal muscle-cells described by Hill and Whitelegge (**12**) as present in the disc of *G. Willeyi*. The endoderm is thin and contains few zooxanthellæ.

Œsophagus (Pl. **45**. fig. 18).—The œsophagus has the usual well-marked truncated groove characteristic of the genus. Its ectoderm is deeply folded into 10 ridges, the mesoglœa passing partly into these. A good deal of pigment is present in the clear nervous zone. In the sulcar groove the ectoderm is smooth and thinner than elsewhere, while the mesoglœa is thicker. Its many cell enclosures are scattered irregularly and not placed at the insertion of the mesenteries as in *G. isolata*, *G. Rusei*, and *G. canariensis* (**3**, **4**, & **6**). The endoderm is low with occasional zooxanthellæ.

Mesenteries.—The arrangement of mesenteries is brachycnemic. In one polyp cut transversely, there are thirteen perfect mesenteries on one side and fifteen on the other (Pl. **45**. fig. 18). In another there are fourteen perfect mesenteries on each side. The sulcar directives are always much thicker than the other mesenteries, but the degree of difference varies. The mesoglœa is thick and the endoderm thin, containing from one to two rows of zooxanthellæ. The parieto-basilar and longitudinal muscles are very feebly developed, and the plaiting present is not well marked. In this it agrees with the other Australian forms, *G. Macmurrichi* and *G. mutuki*, Haddon & Shackleton (5). The basal canal through the greater part of its length is large and oval; distally it breaks up into 6–8 smaller canals. Proximally the basal canals elongate and widen considerably, the mesoglœa thickens and the mesenteries become joined together in the centre, forming a large mass pierced by the numerous basal canals and attached to the column-wall by the narrow ends of the thickened mesenteries. In this way the body-cavity is filled up a little distance above the base of the polyp. This mesenteric mass is in direct continuity with the mesoglœa of the cœnenchyme, and its basal canals are in communication with lacunæ in that structure. Duerden (8) describes a somewhat similar arrangement in *Isaurus Duchassaingi*. I have not been able to trace any connection between the basal canals and the spaces in the column-wall.

Gonads.—There were no gonads present in any specimen examined.

The distinguishing characters of *G. arenacea* are :—

(1) Its markedly incrusted character.

(2) Its weak sphincter muscle, the cavities of which are completely filled with muscle-cells.

[*G. isolata*, McMurrich (4), has a few of the upper cavities of the sphincter filled in the same manner.]

(3) Its shape. It is shorter and at the same time thicker than any other of the smaller species of *Gemmaria*. It agrees with *G. fusca*, Duerden (8), and disagrees with all others in having a column of equal diameter throughout, including the capitulum.

It is, perhaps, most closely allied to *G. canariensis* (Haddon & Duerden, 7), but in addition to the above general points of difference it has no cuticle, a different number of mesenteries, and distinctly weaker mesenteric musculature, in which latter point it agrees better with the Australian species *G. Macmurrichi* and *G. mutuki* (Haddon & Skackleton, 5).

University College, London.
January 1909.

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EXPLANATION OF THE PLATES.

Plate 43.

Fig. 1. *Zoanthus sandvicensis.* Portion of a colony. × 3.
7. *Zoanthus similis.* Portion of a colony. × 3.
11. *Zoanthus pigmentatus.* Portion of a colony. × 3.
16. *Gemmaria arenacea.* Portion of a colony. × 3.

Plate 44.

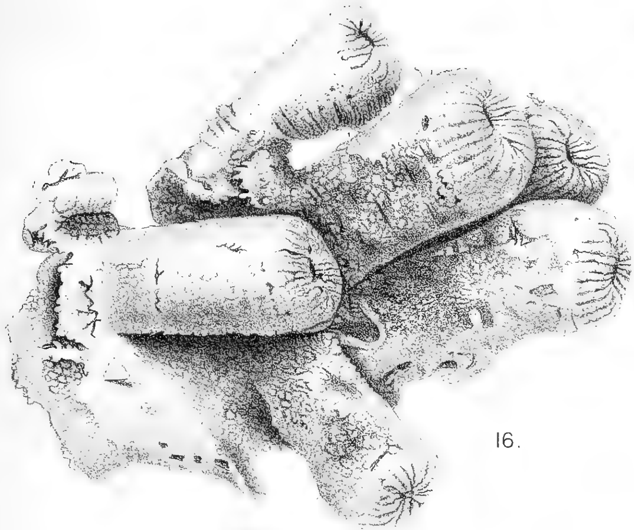
Fig. 2. *Zoanthus sandvicensis.* Transverse section through column-wall. × 282.
3. *Zoanthus sandvicensis.* Longitudinal section through the sphincter muscle. × 70.
4. *Zoanthus sandvicensis.* Longitudinal section through tentacle near tip. × 220. A small group of the refractive bodies at one end only drawn.
5. *Zoanthus sandvicensis.* Longitudinal section through disc. × 440.
6. *Zoanthus sandvicensis.* Transverse section through a perfect mesentery. × 188.
8. *Zoanthus similis.* Transverse section through column-wall. × 282.
9. *Zoanthus similis.* Longitudinal section through sphincter muscle. × 70.
10. *Zoanthus similis.* Transverse section through œsophageal region. × 34.

Plate 45.

Fig. 12. *Zoanthus pigmentatus.* Longitudinal section through column-wall. × 282.
13. *Zoanthus pigmentatus.* Longitudinal section through sphincter muscle. × 52.
14. *Zoanthus pigmentatus.* Transverse section through œsophageal region. × 70.
15. *Zoanthus pigmentatus.* Transverse section through a perfect mesentery. × 188.
17. *Gemmaria arenacea.* Hand-cut section showing incrustations.
18. *Gemmaria arenacea.* Transverse section through œsophageal region, showing lacunæ left by decalcification. × 34.
19. *Gemmaria arenacea.* Longitudinal section through sphincter muscle. × 52.
20. *Gemmaria arenacea.* Longitudinal section through disc near centre. × 440.

Lettering adopted in the Figures.

bc., basal canal.
cu., cuticle.
d., diatoms.
dist.sph.m., distal sphincter muscle.
di., disc.
d.m., directive mesenteries.
sph.m., sphincter muscle.
ect., ectoderm.
ect.b., ectodermal bay.
ect.c., ectodermal canal.
ect.m., ectodermal muscle.
end., endoderm.
end.m., endodermal muscle.
g.lac., globular lacunæ.
inc., incrustation.
lac.d., lacunæ caused by decalcification.
l.m., longitudinal muscle.
m., mesoglœa.
n.c., nerve-cell.
nem., nematocyst.
oes., œsophagus.
p., parasites.
pb.m., parieto-basilar muscle.
pig., pigment.
prox.sph.m., proximal sphincter muscle.
r.b., refractive bodies.
s.d., sulcar directive.
s.l.d., sulcular directives.
spi., spicule.
sp., spermaria.
subc., subcuticle.
sul.g., sulcar groove.
t., tentacle.
z., zooxanthellæ.



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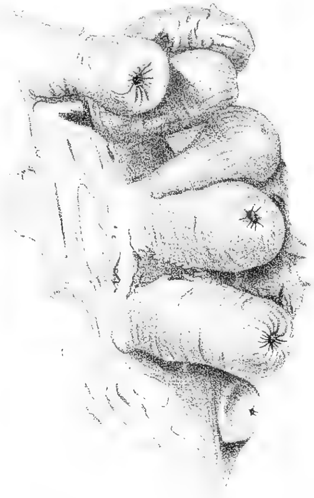

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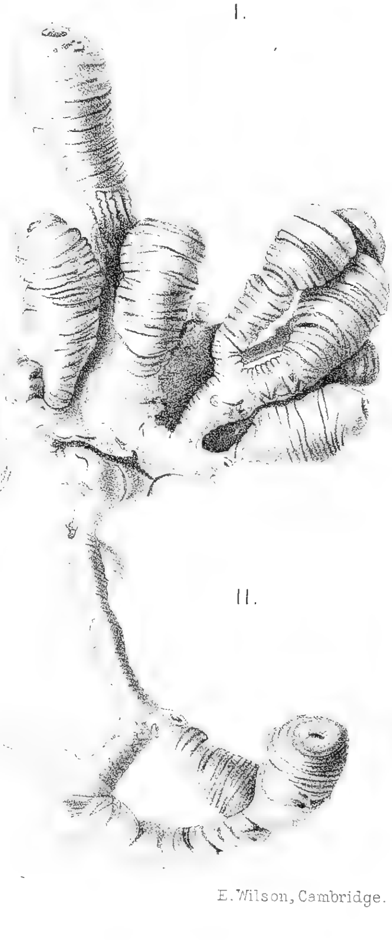

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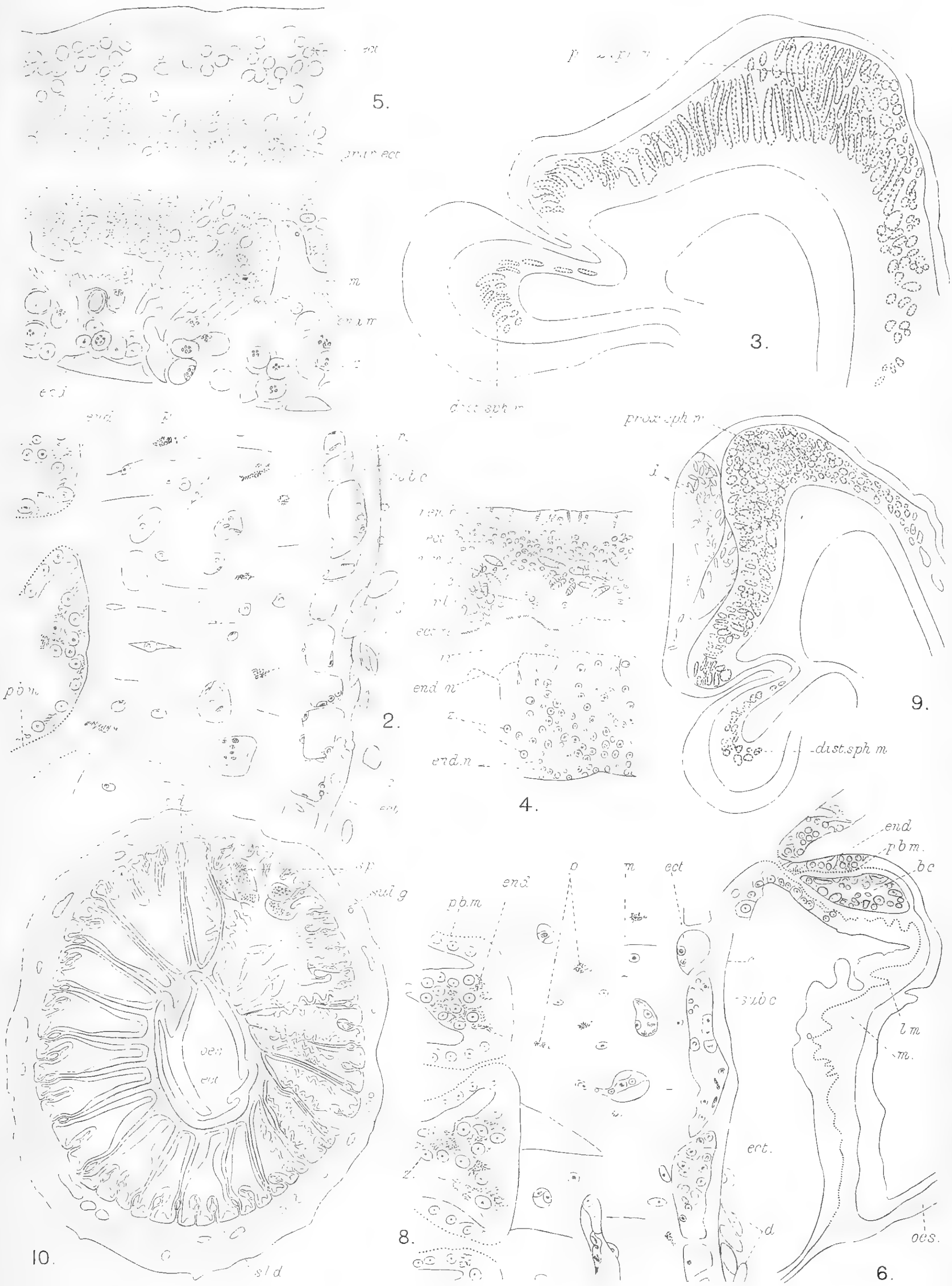

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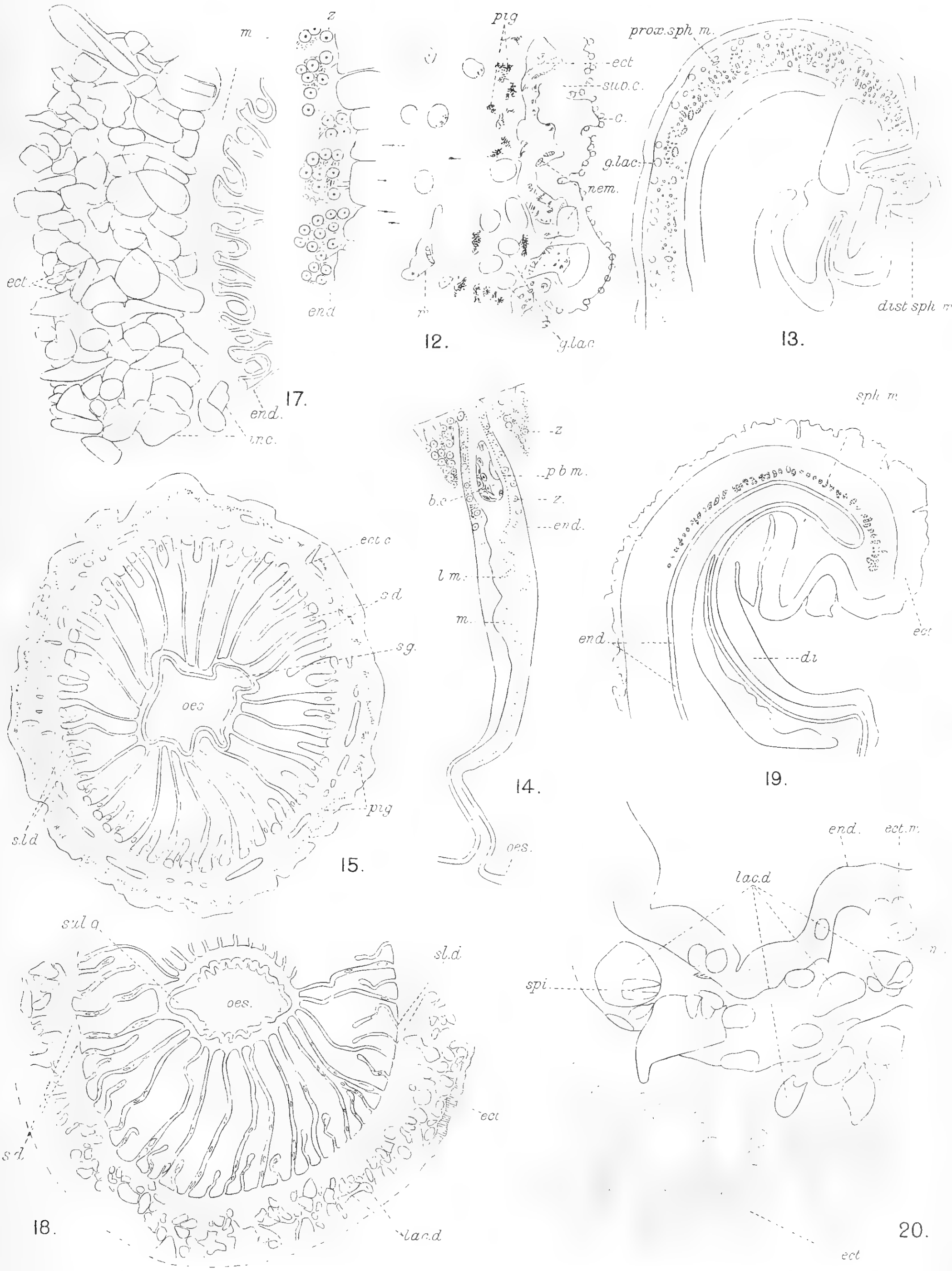

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ZOANTHEÆ FROM QUEENSLAND, ETC.

On two New Genera of THYSANOPTERA from Venezuela: *Anactinothrips* and *Actinothrips*. By RICHARD S. BAGNALL. (Communicated by the Rt. Hon. Lord AVEBURY, P.C., F.R.S., F.L.S.)

(PLATE 46.)

[Read 6th May, 1909.]

WHEN travelling in Venezuela in the year 1891 Dr. Meinert, of Copenhagen, made a small collection of Thysanopterous insects which he has kindly submitted to me for examination. Though poor in individuals the collection is unusually rich in species, and, owing to the difficulty I have experienced in satisfactorily tabulating certain genera, I have not yet been able to work out the whole material, but amongst those examined are two large and interesting species, each forming the type of a new genus, the subjects of this short paper. Both species were collected by Dr. Meinert at the same time and in the same place, and though each bears a strong superficial resemblance to the other, it will be seen that the genera are in reality widely separated, *Anactinothrips* naturally falling into the Phlœothripid group, and *Actinothrips* into the Idolothripid group of the Tubulifera.

In working out these species I have attempted, though imperfectly, to figure an organ, or series of organs, of doubtful function (Pl. 46. fig. 7 *x*). This organ apparently exists in all species of Thysanoptera, and is found at the base of the femur near the line of union with the trochanter, taking the form of a thinly chitinized area, or areas, of varying shapes. It was first discovered in the Thysanoptera by Dr. Trybom *, and suggested to him the auditory organs found in the tibiæ of certain *Locustidæ*.

It should be mentioned that the figure of the fore-tarsus of *Anactinothrips* (fig. 6) is taken from a mounted specimen in which the less strongly chitinized part of the foot (*i. e.*, the fore-part) has lost its original form.

In expressing my gratitude to Dr. Meinert I have pleasure in naming one of the species in his honour.

Order THYSANOPTERA.

Suborder TUBULIFERA.

Genus ANACTINOTHRIPS, nov.

Head twice as long as the prothorax and three times as long as the breadth immediately behind eyes; vertex slightly produced beyond eyes. Cheeks strongly widened at posterior third and set with a few short, stout spines. Mouth-cone broadly rounded, reaching more than halfway across prosternum.

* Entomologisk Tidskrift, xvii. 1896, pp. 102-4.

Eyes small; ocelli equidistant; postocular bristles very long, and a similar pair of bristles placed dorsally a little above the posterior third; anteocular pair short and very stout. Antennæ slender, more than half as long again as the head.

Prothorax transverse. Fore-legs in the male strongly developed, and the tarsus armed with a very long, sharp tooth; in the female slender, and tarsus armed with a minute, forwardly-directed tooth. Sides of metathorax broadly rounded and armed with a sublateral bristle, and the metascutum furnished with a pair of long bristles, one near each anterior angle. Hind and intermediate legs long and slender. Wings moderately long, broad; median vein obsolete.

Abdomen broader than metathorax; more slender in the male than in the female. Tube long. Only a single pair of wing-retaining bristles on each of the segments so furnished; a pair of short postero-lateral spines on each of the segments one to eight; abdominal bristles strong.

Species large.

Type, *Anactinothrips Meinerti*, mihi.

Anactinothrips Meinerti, sp. nov. (Pl. **46**. figs. 1–7.)

♀. Length 7·5 mm., breadth of mesothorax 0·875 mm., and breadth of metathorax through middle 1·0 mm.

Colour dark chestnut-brown, sides of intermediate abdominal segments with a reddish tinge; legs lighter and all tibiæ and tarsi reddish yellow; antennæ with second joint yellowish brown, third and fourth yellow and lightly shaded with brown near apices, basal half of fifth and base of sixth also yellow.

Head apparently elliptical in section, twice as long as the prothorax and three times as long as the width immediately behind eyes; vertex slightly produced beyond eyes. Cheeks rounded at basal third, where the head is once and one-third as wide as the width immediately behind eyes; set with a few short spines, a stout and prominent spine at basal third and two other slightly shorter ones immediately behind each eye. Eyes small, occupying laterally three-twentieths the length of head, and together four-sevenths the breadth; finely faceted; postocular bristles very long, and a pair of still longer ones set dorsally at about the basal third of head. Ocelli not large, equidistant; the posterior pair set on a line through anterior third of eyes and near their inner margins; anteocular spines moderately long and very stout. Mouth-cone not quite so long as broad, rounded at tip; maxillary palpi short, with the apical joint only about twice the length of basal, and labial palpi also short and broad. Antennæ subapproximate, inserted at the extreme vertex of head, which is slightly swollen for their reception; long and slender, one and three-quarter times as long as the head; basal joint cylindrical, longer than broad, equal in length to the second but broader; second slightly constricted towards base ; third to fifth mildly claviform, and sixth to eighth fusiform. Third joint six times the length of second ; fourth two-thirds of third ; fifth one-half of fourth ; sixth three-quarters of fifth ; seventh two-thirds of sixth ; the apical three-quarters of penultimate, much narrower and apparently having the apical third styliform. Sense-cones short and almost indistinguishable.

Prothorax strongly transverse, one-half as long medianly as broad ; dorsal surface with a slight depression near each fore-angle and a similar depression (or irregular fovea) just below centre of disc ; anterior margin emarginate and posterior margin arcuate, sides strongly and evenly widened posteriorly to mid-line where the breadth is equal to the breadth of base ; posterior angles rounded. Spines at posterior angles and the posterior-marginal pair long and strong, the inner pair being especially long ; pair at anterior angles very short and stout, and other prothoracic spines obsolete. Fore-coxa with one short and conspicuous spine ; fore-femur not strongly dilated, three and one-half times as long as wide through middle ; outer basal angle somewhat acute, and slight constriction before apex ; encircled before apex with several stout spines, which are shortest within, and two longer spines before middle ; similar arrangement of spines on the posterior and intermediate femora, but each with only a single long spine before middle. Two long bristles on all tibiæ just below knees, and a similar but weaker bristle before tip on the hind and intermediate pairs. Fore-tarsus armed with what appears to be a slender, acute, and forwardly-directed tooth. Posterior and intermediate legs long and slender. Pterothorax slightly broader than long ; mesothorax decidedly wider than the width across fore-coxæ, nearly five times as wide as long, and only one-half the length of metathorax ; metathorax strongly rounded laterally, and armed in the mid-line with a moderately long and strong sublateral dorsal spine, and a shorter lateral one near base. Metascutum armed with two very long bristles, each having its base near the anterior angles. Wings reaching to the sixth abdominal segment, strong and broad with the tips broadly rounded ; cilia fine, not exceptionally long ; median vein obsolete.

Abdomen subdepressed, broadening from the base to the third segment where it is decidedly broader than the metathorax, and from thence gradually narrowing to base of tube. Segments one to nine transverse, eighth and ninth apparently cylindrical, the eighth almost quadrate and as long as the preceding, and the ninth one-half the length of the eighth and two-thirds as long as wide. Tube with sides almost parallel, slightly widened near base and gently constricted near apex ; seven times as long as breadth through middle, not quite five times the length of the preceding segment, and equal in length to the dorsal length of head. Terminal bristles short. Bristles on hind margin of ninth segment very long, about the length of tube. Other abdominal bristles more than usually stout, and placed as follows :—a short one at each angle of the first abdominal tergite; a very small one and a longer one at each posterior angle of the second segment; a short one and two long ones at the posterior angles of each of the segments three to seven, which gain in length posteriorly. A single pair of weak, wing-retaining spines placed posteriorly on each of the segments three to six. In addition to the spines at the posterior angles of the seventh segment there are marginal spines present, and the eighth segment has a moderately long spine at each posterior angle as well as slightly shorter marginal spines.

♂. The male is smaller and has the abdomen more slender. It differs from the female in having the fore-femora and tibiæ greatly enlarged, the femur being strongly inflated and having the surface very glossy; and also in the possession of a very long and acute fore-tarsal tooth. The tube is six times as long as the ninth abdominal segment, and the ninth sternite is furnished with a pair of long bristles.

Habitat. One male and one female, Caracas, Venezuela (*Meinert*).

Type. In the Copenhagen Museum.

Genus Actinothrips, nov.

♀. Head about twice as long as wide and only slightly swollen at basal third, a little more than twice the length of prothorax; vertex slightly produced beyond eyes. Cheeks armed with two pairs of stout spines. Mouth-cone reaching more than halfway across prosternum. Eyes medium-sized; anterior ocellus placed at extreme vertex and widely separated from posterior pair; postocular bristles short and anteocular pair obsolete. Antennæ very long and slender, at least three times the length of head; each basal joint armed with a strong dorsal spine near apex.

Prothorax transverse. Fore-legs slender, and fore-tarsus with a minute tooth. Pterothorax much wider than prothorax; metascutum armed with a pair of spine-set tubercles, one on each side of the mid-line and near the anterior margin. Wings long and slender; median vein strong, and reaching for almost the entire length of wing. Hind and intermediate legs long and slender.

Abdomen as wide as pterothorax, long and gradually narrowed from base to tube; each of the segments two to eight more or less produced laterally at apical third for seating of bristles; strongly sculptured dorsally. Tube very long, sparsely clothed with long, slender white hairs. Only a single pair of wing-retaining bristles on each of the segments so furnished, and a pair of rather long stout spines placed laterally below the abdominal bristles, which latter are moderately long but slender.

Type, *Actinothrips longicornis*, mihi.

Actinothrips somewhat closely resembles *Anactinothrips*, but may be easily separated by the relatively longer antennæ and tube; the form of head and abdomen; the spine on the first antennal joint; the ocelli which are not equidistant; the absence of the long, dorsal, cephalic bristles and of the anteocular spines, and by the possession of metascutular tubercles. In *Actinothrips* the wings are more slender, and each has a strong median vein reaching almost to tip, whilst in *Anactinothrips* the wing is much broader and the median vein is obsolete. This vein, and the absence of it, suggest the generic names *Actinothrips* and *Anactinothrips* respectively.

Actinothrips longicornis, sp. nov. (Pl. **46**. figs. 8–12.)

♀. Length 7·5 mm., breadth of mesothorax 0·8 mm.

General colour dark chestnut-brown, tibiæ and tarsi lighter; wings testaceous with median veins dark brown and cilia shaded with brown; antennæ with second joint reddish brown, joints three to five yellow tipped with brown, and sixth joint yellowish at base.

Head about twice as long as wide through eyes, and very slightly more than twice the length of the prothorax; vertex slightly produced beyond eyes. Head gently narrowed behind eyes, as gently widened to basal third and constricted at base; cheeks with a few hairs; a very strong pair of lateral spines immediately behind eyes and a similar pair at basal third. Eyes moderately large, bulging and finely faceted, occupying laterally about one-quarter the length of the head; postocular spines short and only moderately stout, placed shortly behind eyes; anteocular spines obsolete. Ocelli large, not equidistant; posterior pair close to the inner margins of eyes and above a line drawn through their anterior third, anterior one unprotected, placed at the extreme vertex. Mouth-cone reaching more than halfway across prosternum, maxillary palpus stout, having the apical joint about three times the length of the basal; touch-bristles short and stout. Antennæ very long and slender, at least three times the length of the head; sub-approximate; basal joint stout, longer than broad, cylindrical, and dorsally armed with a rather long and stout spine near apex; second joint narrower than first; third to sixth very mildly claviform; seventh fusiform, and eighth most probably fusiform, but unfortunately broken in the solitary specimen. Third joint seven times the length of second; fourth about five-eighths of third; fifth five-sixths of fourth; sixth three-fifths of fifth, and seventh one-half as long as the preceding. Sense-cones very long, slender and acute; three on third joint, five or more on fourth, three or more on the fifth, and two on the sixth.

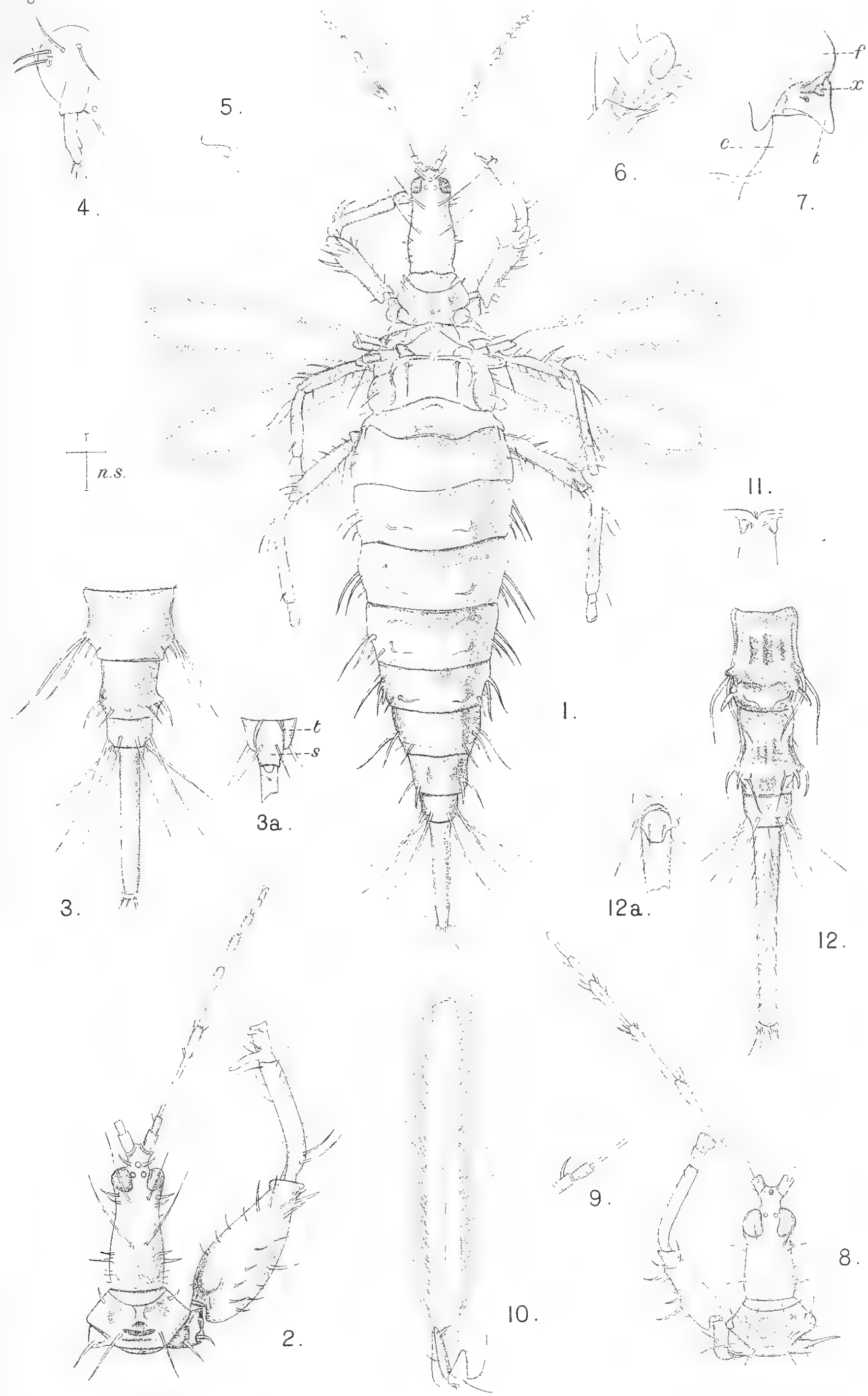
Prothorax transverse, only a little more than one-half as long as broad, a long spine at each posterior angle set in a tubercle, and a similar pair of spine-set tubercles above the mid-lateral angles ; spines at anterior angles and the posterior-marginal and anterior-marginal pairs short and inconspicuous. Each of the prothoracic tubercles, in addition to the chief bristles, is armed with a short seta at the base behind. Fore-coxa with one moderately long and comparatively slender spine. Fore-femur encircled with a series of long and stout spines before apex, a similar series of spines near middle and a very long one on the outer edge behind middle. Fore-tarsus with a minute tooth. Hind femora considerably longer than the intermediate pair; both pairs encircled with a series of spines before apex, and armed with one or more strong spines at apical third. All tibiæ furnished with rows of short, slender hairs, but without the long ones below each knee, and each hind tibia armed with a short and stout spine at tip within. Pterothorax much wider than the width across fore-coxa ; metathorax strongly rounded laterally, furnished sparsely with short setæ, and armed with one long and stout sub-lateral spine. Metascutum with a pair of erect tubercles, one on each side of mid-line near anterior margin, each armed with a long bristle. Meso- and metascutum rather closely set with numerous short hairs. Wings long and comparatively broad, reaching to the sixth abdominal segment ; cilia rather heavy, and each wing with a very pronounced median vein running for about the entire length.

Abdomen gradually narrowing from base to tube, and each segment, excepting the ninth, armed with a pair of strong postero-lateral spines ; a single pair of weak wing-retaining spines near the hind margins of the second to seventh segments ; seventh segment longer than broad, with a deep elongated fovea on each side of the mid-line ; eighth about one-half as long again as broad, with a pair of long and narrow fovea ; ninth segment cylindrical, and only four-fifths as long as broad. Tube very long, nearly ten times as long as its breadth near base, eight times as long as the preceding segment, and twice as long as the head ; slightly constricted before apex ; surface sparsely covered with rather weak hairs. Terminal bristles short and weak, only about one-quarter the length of tube. Bristles on the ninth segment slender, only about one-third the length of tube; eighth with a moderately long bristle above the short spine at hind angles and a more slender one on the hind margin within, the other segments with two long bristles above each spine, the sixth and seventh segments having the inner pair of these longer than the outer.

Habitat. One female, Caracas, Venezuela (*Meinert*).

Type. In the Copenhagen Museum.

Winlaton-on-Tyne, April 26th, 1909.



R.S.Bagnall del.

E.Wilson, Cambridge.

NEW THYSANOPTERA.

EXPLANATION OF PLATE 46.

ANACTINOTHRIPS MEINERTI, gen. et sp. nov.

Fig. 1. ♀, × 13·5. *n.s.* Natural size.
2. ♂, head, prothorax, right fore-leg and antenna, × 19.
3. ♂, end of abdomen, × 19. *a*, Ventral view of ninth segment; *t*, tergite; *s*, sternite.
4. Right maxillary palpus, × 60.
5. Right labial palpus, × 60.
6. Left fore-tarsus, × 45.
7. Part of left fore-leg showing organ of doubtful functions; *x*, organ; *c*, coxa; *f*, femur; *t*, trochanter. × 60.

ACTINOTHRIPS LONGICORNIS, gen. et sp. nov., ♀.

Fig. 8. Head, prothorax, left fore-leg, and antenna, × 19.
9. First two antennal joints viewed laterally, × 19.
10. Right fore-wing, × 13·5.
11. Metascutular tubercles, × 19.
12. End of abdomen, × 19. *a*. Ventral view of ninth segment.

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12. End of abdomen, × 19. 12 *a*. Ventral view of ninth segment.

On a Collection of BLATTIDÆ preserved in Amber, from Prussia.

By R. SHELFORD, M.A., F.L.S.

(PLATES 47 & 48.)

[Read 16th December, 1909.]

IN 1907 Dr. R. Klebs, of Königsberg-i.-Pr., sent to me for study the major part of his fine collection of Blattidæ enclosed in amber, and this spring I received from him the remainder. As practically nothing has been written on the Blattidæ of the amber-deposits since the appearance of the great memoir "Die im Bernstein befindlichen Hemipteren und Orthopteren der Vorwelt" * by Germar and Berendt in 1856, and as only 5 species of Blattidæ were described in that work, it is not surprising that a study of Dr. Klebs's large collection of these insects enables me to add considerably to our knowledge of the fauna that flourished in the Oligocene forests of East Prussia. I am greatly indebted to my kind correspondent for the opportunity he has afforded me of examining a collection unequalled in interest and wealth of material.

All the specimens come from the well-known amber-deposits in the Baltic provinces of East Prussia; the deposits are of Lower Oligocene age and correspond to the Headon beds in the Isle of Wight. As has long been recognised, the insect-fauna of the amber-deposits differs in no very striking features from a characteristic tropical or subtropical fauna of the present day, and the Blattidæ which I have examined, belonging to 9 genera and 24 species, present no details of structure or form which we can regard as peculiarly primitive and archaic. I have not found it necessary to erect a single new genus for the reception of any amber-enclosed species, for all are plainly referable to genera which flourish to-day in the tropical belt. The chief interest of the collection lies in the comparison which it is possible to make between the occurrence of certain genera in the amber-deposits and their geographical distribution at the present time. The following are the genera of Blattidæ occurring in the amber-deposits :—

Ectobius.	? *Nyctibora* (larval form only).
Ischnoptera.	*Periplaneta.*
Phyllodromia.	? *Polyphaga* (larval form only).
Ceratinoptera.	*Holocompsa.*
Temnopteryx.	

* This is Bd. ii. Abt. 1 of the memoir 'Organische Reste im Bernstein,' the first volume having appeared in 1845.

Of these genera, *Ectobius* at the present day is confined to Europe and tropical Africa * ; *Ischnoptera, Phyllodromia, Ceratinoptera,* and *Temnopteryx* occur in all the tropical regions, in Australia, and in the southern half of the Nearctic region ; *Nyctibora* is a characteristic Neotropical genus ; *Periplaneta,* if we exclude the cosmopolitan species distributed by the agency of man, is a tropical and subtropical genus ; *Polyphaga* is found in the southern and extreme eastern parts of the Palæarctic region, in Africa, and sporadically in the Oriental region ; *Holocompsa* is Neotropical, Ethiopian, and Oriental in its distribution. It must be remembered that the species of cockroaches preserved in amber are, with one exception, of small or moderate dimensions ; there are none rivalling in size the species of *Blabera* from S. America, or of *Nauphoëta* from tropical Africa. Large robust species if entrapped in the sticky resin exuding from the trees of the Oligocene forest would be able to break away and escape the doom that awaited more fragile species. That species of considerable size did exist side by side with smaller forms is indicated by the presence in Dr. Klebs's collection of a large larval moult which I refer with some little doubt to the genus *Nyctibora* ; judging from the general appearance of this specimen, I do not consider it to be a final moult, and there is every reason to suppose that the adult was not inferior in size to modern representatives of the genus. There can be little doubt that if the larger species of the amber fauna had been preserved they would have supplied additional evidence of its affinities with a modern tropical fauna.

A comparison of the amber-enclosed Blattidæ with the paucity of species occurring in Northern Europe at the present day is sufficiently indicative of the profound change of climate that has ensued within geologically-recent times. Of the 9 genera found in the amber fauna, only one † has persisted in N. Europe to the present day ; and that one is *Ectobius,* represented in the amber fauna by two species, in modern times by three N. European forms. At one time I was inclined to regard the two Oligocene species as a purely Palæarctic element in a tropical fauna and was puzzled to find a reasonable explanation of their presence. But since then I have examined a good many collections of Blattidæ from tropical Africa and there is no doubt that the genus *Ectobius* is well represented on that continent, though all but one of the species are undescribed. It is clear, then, that *Ectobius* is not purely a genus of temperate or subarctic regions and its presence in the amber fauna is not a matter for very great surprise. At the same time the two species of the amber fauna appear to be more closely related to the well-known

* I have recently had the opportunity of examining the types or co-types of species from Australia and New Zealand which have been referred to *Ectobius* ; not one of these belongs even to the subfamily *Ectobiinæ.*

† *Phyllodromia germanica* is not included ; it is a cosmopolitan species whose centre of dispersal is not known.

Ectobius lapponicus than to any other recent member of the genus, and it is tempting to suppose that the modern species is a direct descendant of one of the amber-enclosed forms. If this is so, we may perhaps continue our speculations and assume that whilst the onset of more rigorous conditions of climate eventually drove southwards the great bulk of the cockroaches of the amber fauna, two species of *Ectobius* held their ground and one of these has persisted with subsequent small modifications of structure until the present day. That the climate of N. Europe during the Glacial Epoch was of such severity that animal life was rendered impossible is, in the light of modern researches, extremely unlikely *, and there is nothing inherently improbable in the view that an insect could persist in one area from Oligocene to recent times with only slight changes in structure.

The unique specimen which I refer to the genus *Holocompsa* is most nearly allied to *H. minutissima*, de Geer, originally described from Surinam; but this and the two *Ectobii* are the only species which I can compare with any confidence with modern species, and in view of the almost world-wide distribution of the genera represented in the amber-deposits by adult forms it would be most hazardous to attempt to compare this fauna with any particular tropical fauna of to-day. Yet if I am right in determining a single damaged moult as belonging to a species of *Nyctibora*, we have, in conjunction with the undoubted affinities of the single species of *Holocompsa*, slight indications of a remote connection between the modern Neotropical fauna and the amber fauna, for the entire subfamily *Nyctiborinæ* is now confined to the Neotropical region of the world.

A few remarks may be made on the condition of the specimens which I have handled. The great majority are in a most admirable state of preservation and with a high-power simple lens it is generally possible to make out nearly all the details of their structure without great difficulty. When I reflect on the enormous antiquity of these absolutely perfect specimens I cannot refrain from expressing a hope that some method will shortly be devised for enshrining in a similar way in balsam or other resin the type-specimens of recent species of insects. As the science of entomology advances the importance of the type-specimen ever increases; unfortunately the ravages of mites, *Anthreni*, dust, mould, and careless students are often disastrous, and we bemoan to-day the irreparable loss of specimens that would afford valuable clues to hopeless tangles of synonymy. It is sad, but none the less true, that it is possible to make out more of the external anatomy of the Oligocene *Ectobius balticus* from an examination of specimens many thousands of years old, than of the recent *Ectobius lapponicus* from an examination of Linnæus's type, the shattered wreck of which is preserved in the cabinets of this Society.

* *Cf.* Scharff: 'The History of the European Fauna,' 1899.

Some of the amber-enclosed specimens are coated with an opaque whitish deposit, due probably to a mixture of body-juices or of water with the resin in contact with the enclosed insect's body. A few of the insects struggled violently when first entrapped, as shown by the wavy and disturbed appearance of the amber, and this obscures the structural details which it is important for classification's sake to make out.

I have not figured many of the species *in toto*, as I do not consider such illustrations of very great value. The species of *Phyllodromia* and *Ischnoptera*, both fossil and recent, present such a uniform appearance that a careful examination of details of wing and tegminal venation, of leg-armature, and of the form of the terminal abdominal segments is necessary to discriminate between the numerous forms; it is these details that I have figured wherever necessary.

I have succeeded in identifying all the species described by Germar and Berendt, but not those few described by authors who wrote before 1856, and I do not know where the types of these species are preserved.

Handlirsch in 'Die Fossilen Insekten,' 1906–1908, pp. 694–695, gives a complete list of all the species described from amber-*inclusa*, with references to the literature.

The numbers quoted under each species are those which Dr. Klebs's specimens bear; a glance at them indicates the relative abundance of the species. Numbers in italics signify type-specimens.

Subfam. Ectobiinæ.

Ectobius balticus, *Germ. & Ber.* (Pl. **47**. fig. 1.)

Blatta baltica, Germar & Berendt, Organ. Reste im Bernstein, Bd. ii. Abt. 1, p. 34, pl. 4. fig. 5 (1856).

♂♂. Nos. 5428, 5429, 5436, 5439, 5465, 5468, 5470, 5474, 5480, 5487, 5493, 5496, 5503, 5513, 5521, 5527, 5542, 5554, 5556, 6705, 6723, 6726, 6734, 7478, *α* 1.

♀♀. Nos. 5440, 5457, 5475, 5557, 5560, 6719.

The species resembles *E. lapponicus*, Linn., in its coloration, the venation of the tegmina, and the form of the apex of the abdomen. It is distinguished by its smaller size, by the long tegmina and wings of the female, and by the short acuminate genital style of the male. The single genital style in *E. lapponicus* is broad and rounded, and a microscopical examination shows that its apex is furnished on the dorsal side with a tuft of hairs; in *E. balticus* the style is like a small pin-point. Three undoubted female examples show that *E. balticus* differs from all the modern European species in the greater length of the tegmina and wings, these slightly surpassing the apex of the abdomen. The subgenital lamina of the female is semiorbicular, ample, and with the posterior margin slightly sinuate.

A slight variation in the coloration of the pronotum is exhibited by some specimens (Nos. 5428, 5436, 5474, 5503) ; in these the disc of the pronotum is divided by a pale central line, which at the base divides into two, and two short lines may or may not be given off from the limbs of the bifurcation. In No. 5436 the "titillator penis" is extended, its shape is as in *E. lapponicus*. The species average 9 mm. in length ; the females are slightly shorter and broader than the males.

ECTOBIUS INCLUSUS, sp. n. (Pl. **47**. fig. 2.)

♂ ♂. Nos. *5469*, 5531 (adults), 5530 (larva).
♀ ♀. Nos. *5437*, 5543.

Allied to *E. balticus*, Germ. & Ber., but the disc of the pronotum testaceous, with numerous castaneous dots (? punctures) and lines more or less symmetrically arranged. Sub-genital lamina (♂) rather more elongate and furnished with one long and sharply pointed style. ♀. Shorter and broader, with tegmina and wings exceeding apex of abdomen ; sub-genital lamina semi-orbicular, ample, posterior margin sinuate. Femora very sparsely armed.

Total length (♂) 9 mm. ; (♀) 8·8 mm.

In No. 5437 the tegmina are slightly parted, revealing the apex of the wing, the venation of which, so far as it can be seen, conforms to the arrangement characteristic of the genus. In the larva (No. 5530) the posterior angles of the meso- and metanotum are backwardly produced, as in all Blattid larvæ of winged species. The genital style of the male is highly characteristic of the species.

Subfam. PHYLLODROMIINÆ.

ISCHNOPTERA GEDANENSIS, *Germ. & Ber.* (Pl. **47**. fig. 3.)

Ischnoptera gedanensis, Germar & Berendt, t. c. p. 33, pl. 4. fig. 4 (1856).

♂ ♂. Nos. 5455, 5462, 5484, 5562, 6702, 6706, 6709, 6715, 6717, 6722, *a* 4.
♀. No. 6712.

Since the wings are completely concealed in all the examples which have been examined, it is impossible to be absolutely certain if this species really belongs to the genus *Ischnoptera*; but as the insect in its general facies bears a very close resemblance to certain modern species of *Ischnoptera*, I refer the fossil form to that genus without much hesitation. The published description of the species is fairly complete and the following details only need to be added to it :—Tegmina with mediastinal vein simple or with one short branch, radial vein bifurcate and ramose at apex, 15–17 costals, 9–10 longitudinal discoidal sectors connected with each other by numerous transverse venulæ. Anal field rather elongate and narrow, anal vein near its apex curved sharply inwards to the sutural margin. Front femora on anterior margin beneath with 4–5 stout spines, succeeded distally by numerous closer set and smaller spines; two spines on the posterior margin near the apex. Mid- and hind-femora with 4–5 long spines on both margins beneath. Genicular spines long. Formula of apical spines $\frac{1}{1}, \frac{1}{1}, \frac{1}{1}$. Sub-genital lamina almost symmetrical, posterior margin bisinuate; the styles short, situated in the sinuations. Cerci moderate, with 9 visible joints.

♀. Similar to ♂, but shorter and rather more robust; sub-genital lamina semi-orbicular, ample. Total length (♂ & ♀) 18 mm.

One example (6722) is a mere fragment, only the pronotum, tegmina, wings, and one leg remaining, the rest having probably been devoured by some predaceous insect.

Ischnoptera klebsi, sp. n. (Pl. **47**. fig. 4.)

♂ ♂. Nos. *5450*, 5481, 6701.

♂. Allied to *I. gedanensis*, Germ. & Ber. Antennæ considerably longer than the body and tegmina. Eyes rather wide apart. Pronotum trapezoidal, anteriorly subtruncate, freely exposing the vertex of the head, posteriorly most obtusely angled, sides deflexed, disc with two oblique and shallow impressions. Tegmina and wings exceeding the apex of the abdomen. Venation of tegmina and armature of femora as in *I. gedanensis*. Sub-genital lamina hirsute, almost symmetrical, and with a pair of stout, short hirsute styles, placed close together near the middle, the right style a little stouter than the left and with some strong short setæ near its apex. Cerci 10-jointed, sub-fusiform, not surpassing the apex of the tegmina.

Total length 18 mm.

This species is undoubtedly very close to *I. gedanensis*, but the different form of the sub-genital lamina and styles serves to distinguish it.

Ischnoptera perplexa, sp. n. (Pl. **47**. fig. 5.)

♂ ♂. Nos. *5473*, 5491. ♀. No. *5477*.

♂. Closely allied to the two preceding species, but smaller than either. Sub-genital lamina as in *I. klebsi*, but more hirsute, and the styles shorter, their dorsal surface furnished with very stout setæ.

♀. Similar to ♂; sub-genital lamina ample, semi-orbicular; cerci stouter; tegmina shorter.

Total length (♂) 14·5–15·8 mm.; (♀) 13–15·8 mm.

It is very difficult to separate these three closely allied species from one another from an examination of the tegminal venation and ventral surface alone; it is more than likely that important differences are presented by the secondary sexual characters, such as gland-openings, occurring on the dorsal surface, and by the form of the supra-anal lamina; but since these are not visible in the specimens before me I have relied on the slight differences in the form of the sub-genital laminæ and styles and in the size.

PHYLLODROMIA LORENZ-MEYERI, sp. n.* (Pl. **47**. figs. 6, 17.)

♂♂. Nos. 5432, 5445, 5447, 5456, 5458, 5460, 5476, 5495, *5497*, 5501, 5502, 5505, 5508, 5537, 5538, 5549, 5561, 6714.

♀♀. Nos. *5504*, 5555, 6724, 6732, 6704, larvæ Nos. 5486, 6711.

♂. Dark castaneous. Vertex of head not covered by pronotum. Eyes wide apart. Antennæ not exceeding the apex of tegmina. Pronotum trapezoidal, posteriorly truncate, exposing the scutellum, lateral margins hyaline, but the hyaline not extending to postero-lateral angles which are concolorous with disc. Tegmina exceeding the apex of the abdomen, lateral margins narrowly hyaline; mediastinal and radial veins simple, 10–12 costals, discoidal field strongly reticulated, anal vein well-marked. Sub-genital lamina sub-trapezoidal, symmetrical, posterior margin slightly notched in the middle, styles minute, situated in small notches. Cerci pointed, 13-jointed, not exceeding apex of tegmina. Titillator strongly hooked, apex rounded. Front femora on anterior margin beneath with 4 spines, succeeded distally by piliform spines, 3–4 spines on posterior margin; remaining femora with 4–5 spines on anterior margin beneath, 3–4 spines on posterior margin. Metatarsus much longer than remaining joints.

♀. Shorter and broader, tegmina barely exceeding apex of abdomen; hyaline margins of pronotum broader; sub-genital lamina ample, produced, apex notched. Cerci stouter.

Length (♂) 10·5–14·5 mm.; (♀) 12 mm.

None of the specimens are in a very good state of preservation and it is not easy to make out the details of structure in them, the difficulty being increased by the dark colour of the species. The incomplete hyaline lateral margins of the pronotum afford the most obvious character whereby to recognize the species. There is considerable variation in size, and it is a little difficult at first to believe that the smallest example is specifically identical with the largest; but even after the most careful examination I am unable to find any character on which to separate the small specimens from the large. It is possible that the wing-venation or the structure of the supra-anal lamina might present discriminating characters, but as they are not visible in any of the specimens before me I have no option but to regard the

* Named in honour of my friend Herr Ed. L. Lorenz-Meyer, who has done so much to enrich the collections of the Hope Department, Oxford University Museum.

whole series of examples as representatives of one species. No. 5432 is not in a good state of preservation and is referred, with considerable doubt, to this species.

PHYLLODROMIA GERMARI, sp. n. (Pl. **47.** figs. 7, 8, 18.)

♂ ♂. Nos. 5433, 5441, *5444*, 5483, 5494, 5498, 5509, 5515, 5545, 5547, 5551, 5558, 6713, 6721.

♀ ♀. Nos. 5482, 5500, 5520, *5544*.

Larvæ. Nos. 5446, 5463, 5482, 5525, 5528, 5533, 5534.

♂ ♀. Testaceous, with a symmetrical piceous or castaneous pattern on the disc of the pronotum. Head piceous, vertex pale, a transverse pale band at base of the clypeus, mouth-parts pale. Antennæ longer than body and tegmina. Eyes wide apart. Pronotum trapezoidal, anteriorly not covering the vertex of the head, sides not deflexed, lateral margins hyaline. Scutellum exposed. Tegmina and wings exceeding the apex of the abdomen, of equal length in both sexes. Veins of tegmina paler than the ground-colour, which in well-preserved examples appears to be pale castaneous ; mediastinal and radial veins simple, marginal area broad, 11 costals, anterior ulnar 6-ramose, posterior ulnar simple, 5–6 axillaries. Sub-genital lamina (♂) produced, slightly asymmetrical, the apex forming an obtuse lobe, a stout style situated in a notch on the left of this lobe, a small slender style on the right ; (♀) large, strongly produced, apex emarginate. Cerci slender, pointed, not exceeding the apex of the tegmina, of 13 joints, the two apical joints minute. Front femora armed on anterior margin beneath with 4–5 spines, succeeded distally by piliform spines, on posterior margin 2–3 spines ; mid-femora with 3–4 spines on anterior margin beneath, 5 spines on posterior margin ; hind-femora with 2–3 spines on anterior margin, 4 on posterior margin. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$.

Total length (♂) 12·5–14 mm. ; (♀) 11–12·5 mm.

Some larval forms that I refer without much doubt to this species have the mesonotum, metanotum, and abdominal tergites heavily blotched with castaneous ; the supra-anal lamina is trigonal. In one specimen (5534) the dorsal integument has been ruptured, and from the rent protrudes a portion of the alimentary canal.

PHYLLODROMIA YOLANDA, sp. n. (Pl. **47.** fig. 9.)

♂. No. *5523*.

Piceous. (Antennæ mutilated.) Vertex of head not covered by the pronotum. Pronotum trapezoidal, posteriorly truncate, exposing the scutellum, margined all round with testaceous, broadly on the lateral margins, narrowly on the anterior and posterior margins. Tegmina short, barely exceeding the apex of the abdomen, their apices obtusely rounded, laterally margined with testaceous ; 14 costals ; discoidal sectors numerous, almost longitudinal, discoidal field reticulated, anal field elongate, more than one-third of total length of tegmina. Sub-genital lamina produced, asymmetrical, both styles, which are strongly chitinized, situated on the left side, the right style stout and bifurcate, the left style more slender, acuminate, and with a minute tooth near its base. Titillator nearly straight, acuminate. Cerci slender, exceeding the apex of tegmina, with 11 visible joints. Legs testaceous. Front femora armed with a complete row of spines on the anterior margin beneath, posterior margin sparsely armed.

Total length 12·5 mm.

Distinguished by the long anal field of the tegmina, the pronotum margined all round with testaceous, and the bifurcate style.

Phyllodromia antiqua, sp. n. (Pl. **47**. figs. 10, 16.)

♂. Nos. *5548* (adult), 5522 (larva).

Dark castaneous. Head piceous, antennæ longer than total length ; vertex not covered by the pronotum. Pronotum trapezoidal, posteriorly sub-truncate, lateral margins hyaline and extending inwards at the postero-lateral angles. Tegmina rather broad, not exceeding the apex of the abdomen by much ; marginal field broad, venation conforming to usual Phyllodromiine type, about 11 costals. Sub-genital lamina sub-trapezoidal, asymmetrical, the right style situated in the middle line and shorter than the left style. Cerci moderate, not exceeding the apex of the tegmina, with 11 visible joints. Front femora with a complete row of stout spines on anterior margin beneath, 3 spines on posterior margin ; mid- and hind-femora with 4–5 spines on anterior margin, 5 spines on posterior margin beneath, the latter longer than the former. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$. No genicular spine on front femora.

Total length 15·9 mm.

In a small larva which I refer to this form the mesonotum is laterally bordered with testaceous, and the metanotum is entirely testaceous, except for a narrow piceous line along the anterior border.

Phyllodromia latissima, sp. n. (Pl. **47**. fig. 11.)

♂. No. *5507*.

♀. Nos. *6703* (adult), 5540 (larval moult).

Broad, depressed, castaneous. Antennæ equal to total length. Vertex of head not covered by pronotum. Pronotum trapezoidal, lateral margins hyaline. Tegmina sub-ovate, not exceeding by much the apex of the abdomen ; marginal field broad, hyaline, 15–16 costals, discoidal sectors numerous, oblique. Wings broad, semi-coriaceous. Sub-genital lamina (♂) sub-trapezoidal, a pair of long styles situated in deep notches; (♀) semi-orbicular, ample. Cerci rather short, stout, fusiform, apex blunt, 9-jointed. Legs piceous, coxæ edged with testaceous. Front femora with a complete row of strong spines on the anterior margin beneath, 2–3 spines on posterior margin; mid- and hind-femora with 4–5 spines on both margins beneath. Genicular spines well developed. Formula of apical spines $\frac{1}{1}, \frac{1}{1}, \frac{1}{1}$.

Total length 16·5–18 mm.

The species shows some affinities to the genus *Liosilpha*, Stål, and belongs to a section of the genus *Phyllodromia*, which will perhaps be raised eventually to distinct generic rank.

PHYLLODROMIA TENACULA, sp. n. (Pl. **47**. fig. 12.)

♂ ♂. Nos. *5519*, 6708.

Piceous. Vertex of head not covered by pronotum. Antennæ setaceous, longer than the body. Pronotum trapezoidal, lateral margins hyaline. Tegmina considerably exceeding the apex of the abdomen, mediastinal field hyaline; 16 costal veins, anal vein impressed; anal field moderately long. Sub-genital lamina produced, asymmetrical; right style short, stout, and beset with minute acuminate tubercles, left style slender. Cerci slender, with 12 visible joints, not exceeding apex of tegmina. Front femora with a complete row of strong spines on anterior margin beneath, 3 spines on posterior margin; mid- and hind-femora with 4 to 5 spines on both margins beneath. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$; no genicular spines on anterior femora.

Total length 14·5 mm.; length of tegmina 11 mm.

PHYLLODROMIA KLEBSI, sp. n. (Pl. **47**. fig. 15.)

♂. No. *a 2*.

Dark castaneous. Vertex of head almost covered by the pronotum, with 3 testaceous stripes. Pronotum trapezoidal, sides broadly hyaline. Tegmina and wings rather ample, extending considerably beyond the apex of the abdomen; tegmina with mediastinal area ample; about 14 costals, the last 2 or 3 ramose. Supra-anal lamina asymmetrical, posterior margin widely notched in the middle, 2 short teeth on the left side of this notch. Sub-genital lamina asymmetrical, with 2 slender styles, the left style straight and situated at the posterior angle of the plate, the right style sinuate and situated in a notch a little to the right of the middle line of the plate. Cerci moderate, blunt, with 9 visible joints. Front femora with a complete row of spines on anterior margin beneath, 3 on the posterior margin; mid- and hind-femora with 4–5 long spines on both margins beneath.

Total length 18 mm.

The apex of the abdomen in the unique specimen is somewhat obscured by clouding of the amber and by enclosed foreign particles, but I trust that I have succeeded in making out the details of structure successfully. Asymmetry of the supra-anal lamina in the Blattidæ is unusual, but by no means unknown (cf. *Anisopygia jucunda*, Sauss.); where it occurs it serves to mark a species very distinctly.

Phyllodromia furcifera, sp. n. (Pl. **47**. fig. 13.)

♂. No. *5539*. ♀. No. *6740*.

Piceous. Antennæ longer than total length. Pronotum trapezoidal, without pale margins. Tegmina rather narrow, not exceeding the apex of abdomen by much, outer margins not pale. Sub-genital lamina (♂) produced, asymmetrical; both styles, which are strongly chitinized, situated on the left side, the left style is slender and sharply pointed, the right style is larger, stouter, and bifurcate; (♀) semiorbicular, ample. Cerci slender, with 12 visible joints, exceeding apex of tegmina. Front femora with a complete row of spines on anterior margin beneath, 4 spines on posterior margin; mid- and hind-femora with 4–5 spines on both margins beneath. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$; no genicular spine on front femora.

Total length (♂ & ♀) 16 mm.

The genital styles are remarkable, and I know of no recent species of the genus with styles at all like them; they recall, however, the genital styles of some W. African species of *Stylopyga* recently described by me.

Phyllodromia baltica, sp. n. (Pl. **47**. fig. 14.)

♂. No. *5479*.

Dark castaneous. Antennæ longer than total length. Vertex of head not covered by pronotum. Pronotum trapezoidal, posteriorly very obtusely produced, lateral margins not hyaline. Tegmina not exceeding the apex of abdomen by much, about 12 costals; discoidal sectors oblique, numerous; anal vein well marked. Sub-genital lamina produced and very asymmetrical; two slender styles, the left slightly stouter than the right. Cerci rather stout, exceeding the apex of the tegmina, with only 9 visible joints, the apical joint rather large. Front femora with a complete row of spines on the anterior margin beneath, 3–4 spines on the posterior margin; mid- and hind-femora with 6 spines on anterior margin, 5 on posterior margin, beneath. Formula of apical spines $\frac{1}{1}, \frac{1}{1}, \frac{1}{1}$; genicular spines on all the femora.

Total length 13 mm.

Distinguished by the great asymmetry of the sub-genital lamina and by the stout cerci.

PHYLLODROMIA PRISTINA, sp. n. (Pl. 47. fig. 19.)

No. *5451*.

Piceous. Vertex of head not covered by pronotum. Pronotum trapezoidal, posteriorly truncate, exposing the scutellum, laterally broadly hyaline; at the postero-lateral angles the hyaline area is very broad and extends inwards irregularly towards the middle of the disc. Tegmina lanceolate, exceeding the apex of the abdomen, about 12 costals; discoidal sectors numerous, oblique; anal field rather elongate. Cerci moderately stout, exceeding the apex of the tegmina, with 12 visible joints.

Total length 11 mm.

The unique specimen is in a bad state of preservation and the sex cannot be determined, for the ventral scutes of the abdomen and the abdominal contents, as well as the legs, have disappeared. These injuries must have been caused prior to the inclusion of the insect in the amber, probably by some predatory insect, which, having devoured the more succulent portions of its prey, left the carcase to be overwhelmed later in a flow of resin. The pronotal pattern is the only character which I can employ to distinguish this species from its congeners. It is allied to *P. antiqua*, but is much smaller and darker.

As the species of *Phyllodromia* above described are only to be made out with some difficulty, I append the following key, which may render their determination easier. *P. pristina*, described from a single imperfect specimen, is omitted:—

1. Front femora armed on the anterior margin beneath with a few spines, succeeded distally by piliform spines.
    2. Dark castaneous; disc of pronotum unicolorous .... *P. lorenz-meyeri.*
    2′. Testaceous; disc of pronotum with a fuscous pattern.... *P. germari.*

1′. Front femora armed on the anterior margin beneath with a complete row of strong spines.
    2. Pronotum with the lateral margins distinctly hyaline.
        3. Pronotum anteriorly and posteriorly with pale margins. *P. yolanda.*
        3′. Pronotum without pale anterior and posterior margins.
            4. Hyaline lateral margins extending inwards at the postero-lateral angles......................... *P. antiqua.*
            4′. Hyaline lateral margins not extending inwards at the postero-lateral angles.
                5. Broad, depressed species .... *P. latissima.*
                5′. Narrower species.
                    6. Cerci slender, 12-jointed .... *P. tenacula.*
                    6′. Cerci short and obtuse, 9-jointed .... *P. klebsi.*
    2′. Pronotum with the lateral margins not hyaline.
        3. Right genital style bifurcate at apex .... *P. furcifera.*
        3′. Right genital style not bifurcate at apex .... *P. baltica.*

One species of the group, No. 5563, I leave undescribed, for it is represented by a single specimen which is so damaged that the important details of its structure are not visible.

Ceratinoptera didyma, *Germ. & Ber.*

Blatta didyma, Germar & Berendt, t. c. p. 34, pl. 4. f. 6.
? *Blatta elliptica,* Giebel, Z. f. d. g. Nat. xx. (1862) p. 315.

♀ ♀. Nos. 5434, 5472.

Two females that correspond well with the description and figure of this species. The tegmina appear to be semi-corneous, and their venation on account of the clouding of the amber cannot be made out at all distinctly. The femora are sparsely armed; the front femora have 3 spines in the middle of the anterior margin beneath, succeeded distally by piliform spines, there are about 4 spines on the posterior margin; the mid- and hind-femora have 2–3 spines on the anterior margin beneath, 3–4 on the posterior margin. Sub-genital lamina ample and semi-orbicular. Cerci moderate, fusiform.

Total length 11 mm.

Ceratinoptera soror, sp. n.

♂. No. *7477*. ♀. No. *5901*.

Allied to *C. didyma*, Germ. & Ber., but larger and more stoutly built.

♂. Piceous, the pronotum bordered anteriorly and posteriorly with testaceous. Tegmina not exceeding the apex of the abdomen, venation more distinct than in *C. didyma,* mediastinal area broad, about 17 costals, anal vein impressed. Sub-genital lamina asymmetrical, similar to that of *Phyllodromia baltica* mihi, but with only one style, the left. Cerci stout, 9-jointed.

♀. Tegmina not extending beyond the 5th abdominal tergite, their apices sub-truncate. Apex of abdomen somewhat constricted; supra-anal lamina transverse, surpassed by the sub-genital lamina, which is semi-orbicular and ample. Front femora armed on the anterior margin beneath with a complete row of stout spines; mid- and hind-femora with 4–5 spines on the anterior margin, 5–6 on the posterior margin, beneath.

Length (♂) 10·5 mm., (♀) 11·1 mm.; length of tegmina (♂) 8 mm., (♀) 5·1 mm.

Ceratinoptera cruenta, sp. n. (Pl. **48**. fig. 20.)

♀. No. *5529*.

Light castaneous. Antennæ longer than total length. Pronotum trapezoidal, sides deflexed, posteriorly sub-truncate. Scutellum exposed. Tegmina not reaching to the apex of the abdomen, lanceolate, apparently semi-corneous, venation indistinct; anal vein deeply impressed, not angulate. Abdomen broadly ovate; sub-genital lamina semi-orbicular, ample. Front femora with piliform spines only on anterior margin beneath, posterior margin unarmed; mid-femora with 3 spines on anterior margin beneath in the middle, none on posterior margin; the left hind femur with one spine on anterior margin and none on posterior margin beneath, the right hind-femur entirely unarmed. Formula of apical spines $\frac{2}{0}, \frac{1}{1}, \frac{1}{1}$; no genicular spines on front femora.

Total length 8 mm.

I know of no modern representative of the genus with so sparse a femoral armature. The apex of the abdomen is obscured by some foreign body, so that it is not possible to examine the cerci or the supra-anal lamina.

CERATINOPTERA KLEBSI, sp. n.

♀. No. *6731*.

Testaceous, with a piceous pattern on the pronotum and the veins of the tegmina piceous. Pronotum trapezoidal, posteriorly truncate. Tegmina lanceolate, not extending beyond the 5th abdominal segment; mediastinal area large, marginal area broad, 4–5 costals, 3 longitudinal discoidal sectors, anal vein well marked, 3 axillaries. Supra-anal lamina produced, angles rounded, surpassed by the sub-genital lamina, which is large and subcucullate. Cerci moderate, with 7 visible joints. Front femora on anterior margin beneath with 4 strong spines, succeeded distally by minute piliform spines; remaining femora strongly armed. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$

Total length 8·1 mm.; length of tegmina 4 mm.; pronotum 2·3 mm. × 2·6 mm.

The unique specimen is in a bad state of preservation, but in size it is intermediate between the other species of the genus, and is readily distinguishable from them by its coloration and markings.

TEMNOPTERYX KLEBSI, sp. n.

♂. No. *5461*. ♀ ♀. Nos. 5449, *6710*.

Castaneous. Antennæ longer than the body. Vertex of head not covered by pronotum. Pronotum trapezoidal, posteriorly truncate, exposing the large scutellum in the ♂, lateral margins paler than the disc. Tegmina quadrate, not extending beyond the middle of the first abdominal tergite, their sutural margins touching, outer and inner posterior angles rounded, marginal field broader and paler than disc, venation obsolete, anal vein not visible. Abdomen in the ♂ not tapering, the last 4 segments somewhat constricted, supra-anal lamina trigonal, apex sub-truncate, sub-genital lamina produced and slightly asymmetrical with two (?) blunt styles. Abdomen of the ♀ ovate, supra-anal lamina trigonal, sub-genital lamina produced, ample. Cerci rather blunt, with 9 visible joints. Front femora with a complete row of strong spines on anterior margin, 3 spines in the distal half of the posterior margin, beneath; mid- and hind-femora with 6 spines on anterior margin, 4 spines on posterior margin, beneath; all the spines strong. Formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$.

Total length (♂) 12·5 mm., (♀) 13 mm.; greatest breadth of abdomen (♂) 4·5 mm., (♀) 5 mm.; length of tegmina 3·5 mm.; pronotum 3·2 mm. × 4·5 mm.

The three specimens are not in a very good state of preservation, and the ventral aspect of the abdomen in the male is obscured at the apex.

Subfam. Nyctiborinæ.

? Nyctibora succinica, sp. n.

♀. No. *5425* (larva).

This is a larval moult in a bad state of preservation, there being a large hole in the dorsal surface. Professor Klebs informs me that the specimen was found under fragments of wood enclosed in amber, and that he has never seen any other specimen like it in all the collections of amber-*inclusa* that he has examined. The specimen, though immature, is far larger than any other species of cockroach known from the amber fauna, and the adult form must have rivalled in size the modern representatives of the genus. I have already given reasons to account for the absence of large species in the amber fauna, and need not repeat them again.

It is rarely possible to place with absolute certainty any larval cockroach in its correct genus, and the systematic position of this species is open to considerable doubt. The unique specimen has a peculiar polished sheen on the thoracic tergites, and this appearance is due, I believe, to the presence of a minute sericeous pile (such as is highly characteristic of the Nyctiborinæ), in which air is enclosed. Except at the margins of the tergites it is not possible to detect the individual hairs of the sericeous pile even with a high-power lens; but when an insect is imbedded in a substance, such as amber, with the same refractive index as air, many minute details of sculpture and pilosity are lost, and the latter can only be inferred to be present by the optical effect produced when mechanically combined with air particles. At first I was inclined to place the species in the subfamily Blattinæ, but as the specimen is a female and in the structure of the sub-genital lamina exhibits none of the groovings which in larval Blattinæ foreshadow the valvular nature of the adult sub-genital lamina, it is certain that my first identification was incorrect. In its structure and facies the specimen agrees well with the characters of the Nyctiborinæ.

The following is a description of the unique specimen:—

♀. Piceous, with a silvery sheen on the thoracic tergites. Head damaged and distorted. Antennæ setaceous. Pronotum anteriorly parabolic, posteriorly truncate, wider than long. Meso- and metanotum with the posterior angles strongly produced backwards. Surface of the thoracic tergites punctate, of the anterior abdominal tergites striate, of the posterior abdominal tergites reticulate; the spaces between these points, striæ, and articulations silvery. Angle of the posterior abdominal tergites strongly produced backwards. Supra-anal lamina triangular. Cerci robust, 11-jointed. Subgenital lamina semi-orbicular, ample, posterior margin notched in the middle. Front femora with a complete row of short strong spines on the anterior margin beneath, other femora moderately armed, genicular spines long. Tibiæ stout, strongly armed, and with a sericeous pile. Tarsi with large pulvilli, metatarsi unarmed beneath, arolia large.

Length 21 mm.; pronotum 5·8 mm. × 10 mm.; mesonotum 3 mm. × 11·5 mm.

Subfam. Blattinæ.

Periplaneta succinica, sp. n.

♀. No. *5490*.

Rufo-castaneous. Antennæ fuscous at base, becoming rufous towards apex. Pronotum trapezoidal, not covering vertex of head, sides deflexed, posteriorly obtusely rounded. Tegmina semicorneous, extending to the antepenultimate abdominal tergite; 10 costals, the last 4 being ramose; discoidal sectors multiramose, some of the rami extending to the apex of the tegmen and also on to apex of marginal field; anal vein impressed, strongly bowed; surface of tegmina, especially in discoidal and anal fields, densely reticulated. Supra-anal lamina trigonal, sub-cucullate, apex emarginate. Sub-genital valves of the form typical of this subfamily. Cerci rather short, blunt, with 8 visible joints. Front femora with a complete row of strong spines on anterior margin beneath, only 1 on the posterior margin; mid- and hind-femora with 5 spines on both margins beneath, those on the posterior margin the longer. Genicular spines strong. Posterior metatarsus equal in length to the succeeding joints; pulvilli minute, apical.

Total length 18 mm.; length of tegmina 12 mm.

This is a beautifully preserved specimen, and there can be no doubt as to the correct systematic position of the species.

Subfam. Corydiinæ.

Polyphaga fossilis, sp. n. (Pl. 48. fig. 21.)

♂. No. *5489* (larva).

Ovate. Rufous with recumbent pubescence. Vertex of head not covered by pronotum. Eyes wide apart, not markedly reduced in size. Antennæ short, moniliform in apical half; second and third joints sub-equal, twice as long as fourth joint. Pronotum anteriorly arcuate, posteriorly truncate, sides strongly deflexed. Posterior angles of meso- and metanotum slightly produced backwards. Supra-anal lamina transverse with arcuate posterior margin. Cerci short, slenderly acuminate. Sub-genital lamina symmetrical, with two slender hirsute styles. Tibiæ short, equal to half the length of the femora; front tibiæ with 4 apical spines and 1 spine on the outer margin; mid-tibiæ with 5 apical spines, 2 on the inner margin near the apex and 4 on the outer margin; hind-tibiæ with 4 apical spines, 4 on the inner margin and 6 on the outer margin. Mid- and hind-femora with strong genicular spines.

Total length 4·1 mm.

This does not appear to correspond with any of the species figured by Germar and Berendt. The dorsal surface is marked by silvery streaks, due to the air entangled in the pubescence.

HOLOCOMPSA FOSSILIS, sp. n. (Pl. 48. fig. 22.)

♂. No. *5452*.

Castaneous. Eyes reniform, wide apart. Antennæ slender, about equal to the total length of the insect, not ciliated, apical joints moniliform. Vertex of head projecting considerably beyond the pronotum, which is trapezoidal, posteriorly truncate, and provided with an erect pubescence, sides deflexed. Scutellum exposed. Tegmina exceeding the apex of the abdomen; the mediastinal and anal fields, the basal two-thirds of the marginal field, and the extreme base of the discoidal field opaque, castaneous; the remainder of the tegmina hyaline. A sub-hyaline spot between the anal field and marginal field. The opaque part of the tegmina with a delicate recumbent pubescence. Veins very slender, about 7 or 8 costals, radial vein ramose at apex, about 9 discoidal oblique sectors, anal vein strongly angled. Wings with a prominent stigma on the anterior margin, formed by the incrassated rami of the mediastinal vein and by the fusion of some of the costal veins; rami of ulnar vein numerous, flexuose. Supra-anal lamina transverse, sub-bilobate; sub-genital lamina more produced, posteriorly emarginate, and with two slender styles. Cerci slender and rather elongate, with 9 joints. Legs and abdomen beneath rufous. Genicular spines on all the femora. Tibial spines stout.

Total length 7·1 mm.; length of tegmina 5·5 mm.

The single specimen is in an admirable state of preservation and is certainly the gem of the whole collection. By great good chance the right tegmen stands out at a considerable angle to the body, revealing perfectly the structure of the wing beneath. The species is undoubtedly most closely allied to the recent *H. minutissima*, de Geer, from Surinam.

LARVAL FORMS.

A large part of the collection is made up of immature forms and moults. The latter were doubtless left adhering to the bark of the trees whence the resin exuded, and became enclosed in it. All but three of the species enumerated below belong to the subfamily Phyllodromiinæ, and I find it impossible to allocate any of them with certainty to any of the adult forms that I have described. Germar and Berendt figure four distinct forms, which they merely label A, B, C, D. The second of these is the only one that I can identify with certainty.

? PHYLLODROMIA sp. (Larva B.)

Germar and Berendt, op. cit. pl. 4. fig. 3 B.

Nos. 5426, 5430, 5438, 5442, 5448, 5453, 5459, 5464, 5466, 5467, 5471, 5478, 5488, 5492, 5510, 5512, 5524, 5532, 5546, 5555, 6707, 6720, 6728, 6739, 6741.

I hoped to be able to identify this very abundant species with the equally abundant *P. lorenz-meyeri*, but the front femora are completely spined on the anterior margin beneath, and therefore the larvæ cannot belong to that species. The thoracic tergites are bordered laterally and in some examples posteriorly also with rufous. The third joint of the antennæ is very long, equal in length to about six of the succeeding joints. The body is provided with a sparse erect pubescence. The supra-anal lamina is triangular, and the sub-genital lamina of the older examples of the male sex is slightly asymmetrical and furnished with 2 styles. Superficially this larva bears a close resemblance to larvæ of the recent species *Loboptera nitida*, Germ.

? PHYLLODROMIA sp.

Polyzosteria tricuspidata, Germar & Berendt, op. cit. p. 35, pl. 4. fig. 1 (1856).

Nos. 5431, 5443, 5517, 6718.

These larvæ certainly do not belong to the genus *Polyzosteria* as now defined.

The following are very young larvæ, which it is not possible to refer to any of the species described above:—

Nos. 5485, 5499, 5506, 5514, 5516, 5518, 5526, 5536, 5541, 5550, 5552, 5553, 5559, 6725, 6727, 6729, 6733, 6736, 6737, 6738, 6742, α 3.

All of the above belong to the section Blattæ armatæ, but the following are Blattæ muticæ:—

No. 5435. Apparently identical with *Polyzosteria parvula*, Berendt (Ann. Soc. Ent. France, vol. v. p. 542, pl. 16. fig. 1 (1836); Germar & Berendt, op. cit. p. 35, pl. iv. fig. 2 (1856)). The species, of course, is not a *Polyzosteria*.

No. 6716. A larval moult. The supra-anal lamina is triangular, the sub-genital lamina is furnished with minute styles ; the genicular spines are long, and arolia are present between the tarsal claws.

No. 6735 (Pl. 48. fig. 23) is another very young larva which probably should be referred to the subfamily Perisphæriinæ. Since the species is more distinctive than any of the others enumerated above, it should be recognisable from the following description and figure, and eventually it may be possible to assign it to some adult form as yet undiscovered.

♂. Depressed, ovate, rufo-testaceous, without pubescence. Head completely concealed beneath the pronotum; eyes moderate, (?) approximated on vertex of head *; antennæ short, with 18 joints. Pronotum sub-cucullate, anteriorly parabolic, posteriorly truncate, a faint median sulcus extending on to the mesonotum. Posterior angles of the meso- and metanotum slightly produced backwards, those of the abdominal tergites more strongly produced. Supra-anal lamina subquadrate, posteriorly slightly emarginate, barely exceeding the sub-genital lamina, which is trapezoidal and furnished with two minute styles. Lateral margins of abdominal sternites overlapped by the tergites. Cerci very small, unjointed, and pointed. Legs short; femora unarmed beneath, their genicular spines minute ; posterior tibiæ with the spines on the outer aspect triseriately arranged, with an interior calcar almost equalling in length the metatarsus. All the metatarsi much shorter than the succeeding joints, their pulvilli and arolia large.

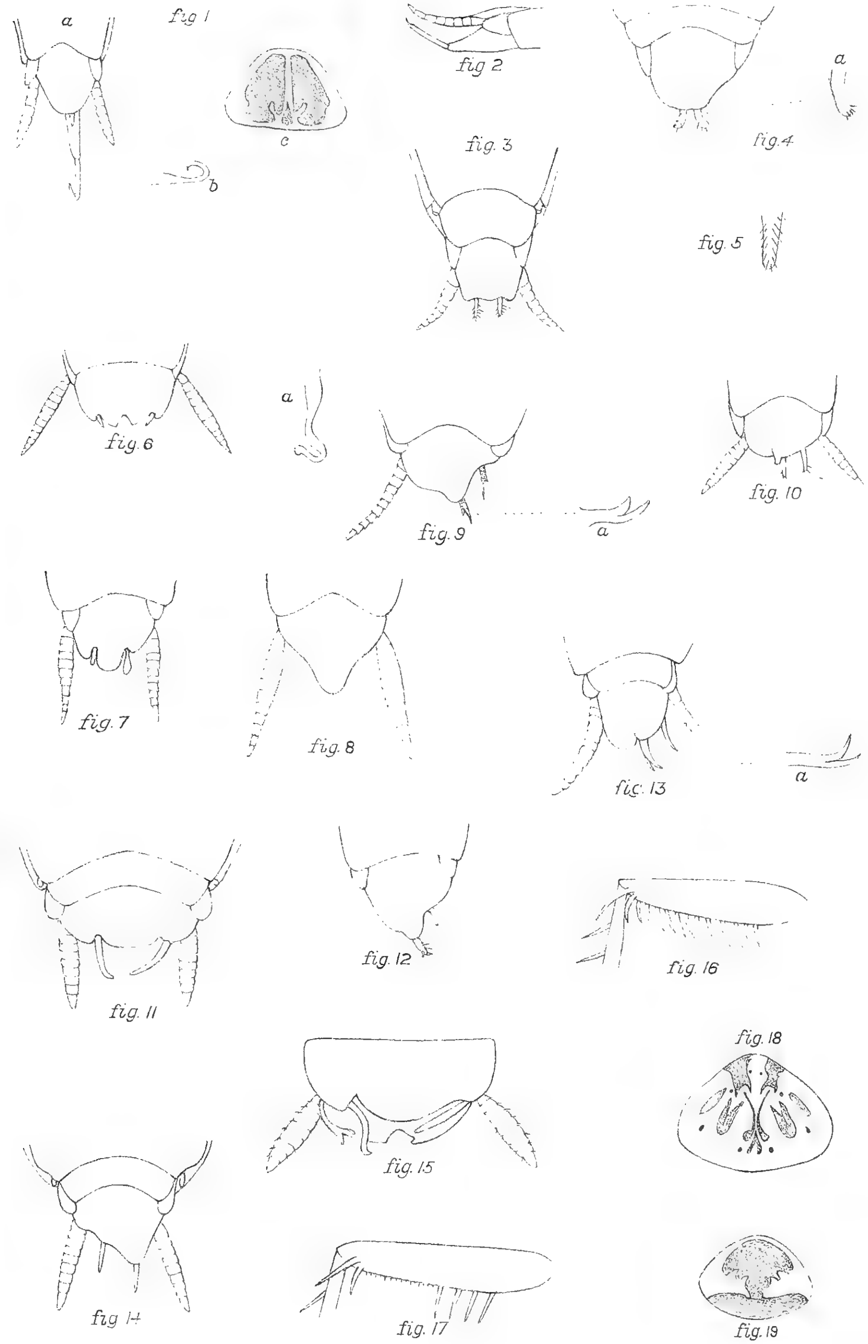
Total length 5·5 mm.; greatest breadth 3·5 mm.

EXPLANATION OF THE PLATES.

Plate 47.

Fig. 1. *Ectobius balticus,* Germ. & Ber. *a,* apex of abdomen of male from beneath; *b,* titillator penis ; *c,* pronotal pattern of specimen No. 5428.
2. *Ectobius inclusus,* sp. n., apex of abdomen of male from the side.
3. *Ischnoptera gedanensis,* Germ. & Ber., apex of abdomen of male from beneath.
4. *Ischnoptera klebsi,* sp. n., apex of abdomen of male from beneath. *a,* genital style.
5. Left genital style of *Ischnoptera perplexa,* sp. n.
6. *Phyllodromia lorenz-meyeri,* sp. n., apex of abdomen of male from beneath. *a,* titillator penis.
7. *Phyllodromia germari,* sp. n., apex of abdomen of male from beneath.
8. " " " " female from beneath.
9. *Phyllodromia yolanda,* sp. n., apex of abdomen of male from beneath.
10. *Phyllodromia antiqua,* sp. n., " " " "
11. *Phyllodromia latissima,* sp. n., " " " "
12. *Phyllodromia tenacula,* sp. n., " " " "

* This detail cannot be made out very clearly.



R.S. Del J.T. Rennie Reid, Lith. Edin.

BLATTIDAE IN AMBER.

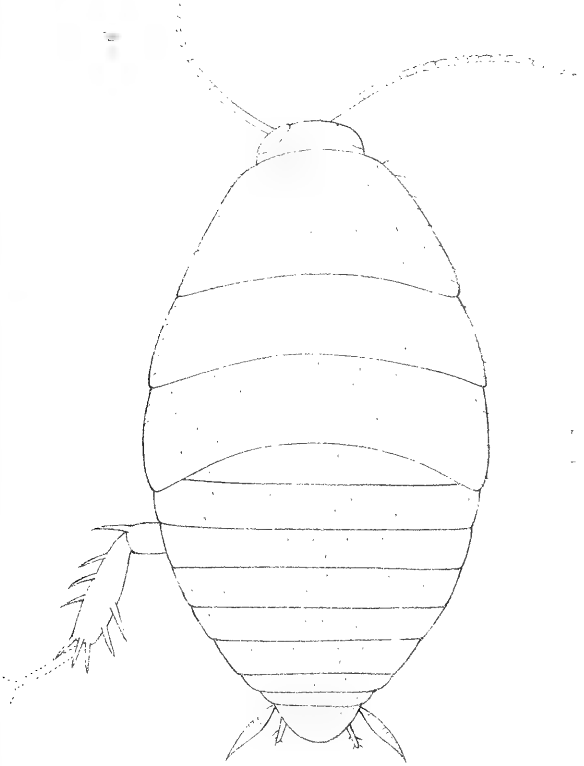


fig. 21

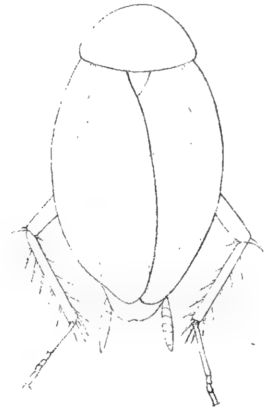


fig. 22

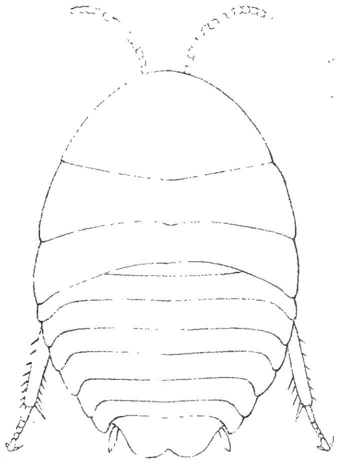


fig. 23

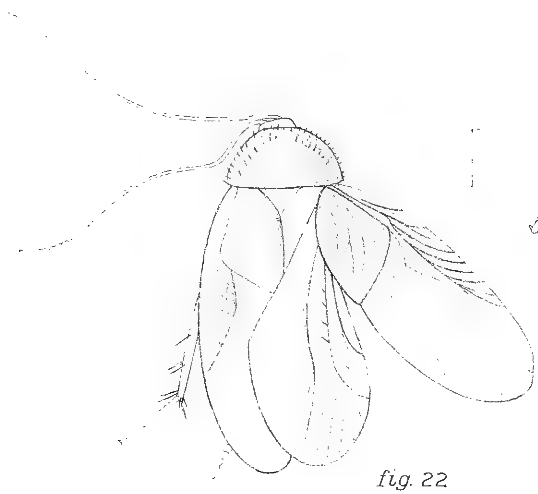


fig. 22

R. S. Del.

J. T. Rennie Reid, Lith. Edinr.

BLATTIDAE IN AMBER

Fig. 13. *Phyllodromia furcifera*, sp. n., apex of abdomen of male from beneath. *a*, genital style.
14. *Phyllodromia baltica*, sp. n., apex of abdomen of male from beneath.
15. *Phyllodromia klebsi*, sp. n., „ „ „ „
16. Front femur of *Phyllodromia antiqua*, ventral aspect.
17. „ *Phyllodromia lorenz-meyeri*, ventral aspect.
18. Pronotal pattern of *Phyllodromia germari*.
19. „ „ *Phyllodromia pristina*, sp. n.

PLATE 48.

Fig. 20. *Ceratinoptera cruenta*, sp. n. ♀.
21. *Polyphaga fossilis*, sp. n. ♂ larva.
22. *Holocompsa fossilis*, sp. n. ♂.
23. Perisphæriine larva.

On the new Tipulid Subfamily CERATOCHEILINÆ.

By W. WESCHÉ, F.R.M.S. (Communicated by JOHN HOPKINSON, F.L.S.)

(PLATE 49.)

[Read 18th November, 1909.]

IN 1903 the Linnean Society honoured me by publishing a number of observations on rudimentary—or, rather, vestigial—maxillary palpi in various Muscidæ.

From West Africa has now appeared a small group of the older Nematocerous Tipulidæ, the species of which have been found by two collectors in Southern Nigeria and Ashanti, with the labial palpi developed, and, contrary to the rule in all known Tipulidæ, the maxillary aborted. I now propose to describe this remarkable subfamily, as it presents fresh evidence that the thesis formulated in the former paper, that the single pair of developed palpi found throughout Diptera are not homologous, is correct.

While in Southern Nigeria, Lt.-Col. F. Winn Sampson made a number of preparations of insects for the purpose of studying the hair-structure. Among them were three, mounted whole without pressure, of a small Tipulid which carried remarkable bifid hairs on the legs. When examining these, I noticed that not only were the flies remarkable for the hair-structure, but that they had many other peculiarities. The mouth-parts were far removed from the normal Tipulid type, and differed in most respects from the specialized type found in *Geranomyia*. The venation differed, and later on was seen to be in an unsettled condition ; and the antennæ were quite characteristic, and also presented abnormalities, as the male appeared in one species to have eight joints, and the female eleven.

On examining the West African Diptera at the British Museum I found that Dr. W. M. Graham had brought home from Obuasi, Ashanti, four specimens (one ♂, two ♀, and one whose sex was difficult to determine as the abdomen was missing) of an insect with similar mouth-parts and antennæ, but with the wings differing in pigmentation and nervation. These flies were undetermined and had no relatives in the collection.

A comparison of the venation of my material showed me that they could not all be included in the limits of a single genus. I therefore propose to establish a new subfamily, the Ceratocheilinæ, containing the genera *Ceratocheilus* * and *Neoceratocheilus*.

The condition of the sixth longitudinal vein suggests affinities with the Ptychopterinæ, though a discal cell shows a closer relationship to *Gynoplistia*; but the differences of other veins, of antennæ, and of mouth are exceedingly marked. Apart from the condition of the sixth vein, the Ceratocheilinæ are distinguished from the Limnobinæ, to which they bear a certain resemblance, by the antennæ, and by the absence of the tooth on the claws; and from *Geranomyia* by the paraglossæ, which cohere, and by the situation of the palpi, at the distal end of the proboscis, whereas in *Geranomyia* they are situated at the base near the head.

Subfamily Ceratocheilinæ, nov.

Small flies with the usual snout or clypeus of the Tipulidæ absent or represented by a plate which projects above the proboscis.

Proboscis exceedingly long and fine, from eight to fourteen times as long as the head, the palpi inserted at the tip. Antennæ with the first joint shortly cylindrical, the second much larger, subcone-shaped, with the base in the anterior position, the third smaller, cone-shaped, with the base in the posterior position; the apex bearing a long style consisting of a variable number of joints, the last two bearing long bristles.

Wings having the sixth longitudinal vein in the same condition as in *Ptychoptera* and *Gynoplistia*, and the second absent or present.

Life-history unknown.

Neoceratocheilus, gen. nov.

Small dark grey flies with the characteristic antennæ and proboscis, but are distinguished by the wing-venation and absence of pigmentation.

Head globular, with a flat plate inserted at the dorsal base of the proboscis; the proboscis (labium) exceedingly long and thin; the tip pointed and the paraglossæ (labella) unseparated and minute, appearing in dry specimens to

* Horned lip or labium.

form a bulb with a pointed extremity. The palpi are labial, single-jointed, and inserted in the ventral side at the extreme end of the proboscis, forming part of the bulb mentioned.

Antennæ with first joint short, cylindrical; second cone-shaped, larger, with the base in the anterior position; third smaller, cone-shaped, with the base in the posterior position; the apex bearing a fairly thick annulated style, with the last two annulations or joints bearing 5 or 6 long bristles.

Eyes semi-globular, equally divided in both sexes, very large, bare, and continued right under the lower sides of the head; ocelli aborted.

Thorax much developed in front and projecting over the long neck; scutellum moderate in size, under plate of scutellum evident; halteres fairly long, with moderately large heads; tegulæ rudimentary.

Abdomen thin, cylindrical; genitalia well developed, particularly the ovipositor.

Legs long and thin, without tibial bristles; pulvilli and empodium absent or rudimentary, claws simple.

Wings as long as abdomen, hyaline; auxiliary (medastinal) and first longitudinal veins only very slightly separated and ending together in the costa, second medastinal cell obliterated. Second longitudinal vein aborted, third simple; the posterior transverse vein (*hinter querader* of Schiner) connects the fourth and fifth longitudinal before the establishment of the discal cell.

NEOCERATOCHEILUS GRAHAMI, sp. n. (Pl. 49. fig. 5.)

Head globular, dark grey; proboscis long and thin, almost as long as body and head combined; proboscis darker towards tip, and is usually carried hanging down, so that its extraordinary length is not a striking feature in a pinned specimen.

Thorax dark slaty grey, with the fore part projecting over the base of the long neck.

Abdomen thin, cylindrical, very dark grey, almost black, with fine pubescence and the genitalia a dark rusty red; the male has a pair of forcipes somewhat resembling those of *Culex*, while the female has very highly developed egg-guides with the upper blades longer than the ventral ones.

Legs same colour as the abdomen, with the coxæ lighter; long, thin, and thickened at the ends of the femora and tibiæ; metatarsus very long; second tarsal joint about a third of the length of the metatarsus; third tarsal joint half the length of the second; fourth and fifth tarsi about equal in length, half the length of the third. Appear to be of a lighter colour in the female.

Wings hyaline, with a rather long fringe of hair in the anal region; the first and auxiliary veins end in the hinder third of the costa; the fourth is connected at its base with the first by a transverse vein which continues and forms the usual basal connection with the fifth.

Length of head and proboscis $3\frac{3}{4}$ mm., length without proboscis $4\frac{1}{2}$ mm.

Habitat. Obuasi, Ashanti. ♂ caught on flower; ♀ in swamp, ♀ in bush-path, ? on flower.

Described from four specimens in the British Museum, bearing date 1 Sept., 1907, and collected by Dr. W. M. Graham.

Ceratocheilus, gen. nov.

Small flies with the characteristic antennæ and proboscis, but are distinguished by the wing-venation and pigmentation.

Head, proboscis, antennæ, eyes, thorax, legs, and abdomen as in *Neoceratocheilus*.

Wings with stigmata and clouded transverse veins; auxiliary and first vein clearly separated, the latter ending a short distance after the auxiliary and forming a small second medastinal cell; second vein short but present, third simple; no transverse vein at the base of the fourth longitudinal vein, which leaves the fifth at a sharp angle, and the posterior transverse vein joins the fourth longitudinal in the first third of the discal cell.

Ceratocheilus Winn-Sampsoni, sp. n. (Pl. **49**. figs. 1–3, 6–9.)

Head globular; proboscis more than half the length of head and body combined.

Antennæ of usual type, but seen with the microscope are found to have eight joints in the male and eleven in the female, without reckoning an atrophying distal joint.

The eyes occupy almost all the head, only leaving bare a narrow space *under* as well as on the front.

Thorax, abdomen, and legs as in *N. Grahami* as regards structure; colours cannot be given, as the species is described from bleached preparations.

Wings with the second longitudinal vein very short; all the transverse veins are clouded and the whole surface is somewhat smoky, except at the tip, where a clear space stretches across the ends of the third and fourth veins to the middle vein of the discal cell; there is a dark mark on the first and auxiliary vein near the middle of the wing, and a stigma at their junction with the costa; there are nebulæ at the ends of the fifth longitudinal and of the two lower veins that spring from the discal cell.

Length of head and proboscis ♂ 4 mm., of which more than 3 go to the proboscis; of ♀ 5 mm. Length of ♂ without proboscis $4\frac{1}{2}$ mm.; of ♀ 6 mm.

Habitat. Southern Nigeria. ♂ caught on dining-table; ♀ at Warri.

This species has been described from two preparations of Lt.-Col. Winn Sampson, one of which (♂) bears the date 25th May, 1900. They will be deposited in the British Museum as types.

Ceratocheilus longirostris, ♂, sp. n. (Pl. 49. figs. 4, 10.)

Only the male has been found; this has ten joints in the antennæ and the second joint is slightly larger than in *C. Winn-Sampsoni*; the proboscis is markedly longer than in that species; the eyes appear to be even less divided, but the head is rather pressed in the preparation and may mislead. Structure of other parts as in *Neoceratocheilus Grahami*.

Wings with the second longitudinal vein longer and consequently the subcostal cell larger than in *C. Winn-Sampsoni*; in addition to the darkening of the transverse veins, and the mark on the auxiliary and first vein, there are three small stigmata on the costa at the junctions with the auxiliary, the first, and the second longitudinal veins. The tip has not the markedly lighter portion that is found in the other species, but is not without a suggestion of its presence.

Length of head and proboscis 6 mm., of which over 5 go to the proboscis; length without proboscis $6\frac{1}{2}$ mm.

Habitat. S. Nigeria.

Described from a preparation of Lt.-Col. Winn Sampson deposited in the British Museum.

Table.

1 (2). Wings hyaline	*Neoceratocheilus Grahami.*
2. Wings clouded	3.
3 (4). Costa with one stigma	*Ceratocheilus Winn-Sampsoni.*
4. Costa with three stigmata, proboscis much longer....	*C. longirostris.*

The remarkable specialization of the mouth-parts is a strikingly ancient character, as the palpi cannot be other than labial, and therefore the specialization dates from a period when the ancestors of the Tipulidæ possessed a full armature of the trophi.

A comparison of the wing-venation in the two genera shows the second longitudinal vein in process of obliteration and complete obliteration, a common feature of the venation of many Nematocerous flies; while the tendency of the veins to leave the lower portion of the wing is seen by the position of the lower transverse vein in *Neoceratocheilus*, which genus is obviously later in type than *Ceratocheilus*.

Finally, the antennæ show a stage which must have been gone through in the progress from a filiform type to such a condition as exists in Brachycerous flies such as *Hilara* or *Empis*.

EXPLANATION OF PLATE 49.

Fig. 1. Head of *Ceratocheilus Winn-Sampsoni*, Wesché, ♂.
2. End of proboscis of *C. Winn-Sampsoni*, highly magnified and seen from the dorsal side.
3. Plate covering the base of the labium of same insect.
4. End of proboscis of *C. longirostris*, Wesché, highly magnified and seen from the ventral side.
5. Wing of *Neoceratocheilus Grahami*, Wesché.
6. Wing of *C. Winn-Sampsoni*.
7. Wing of *C. longirostris*.
8. Antenna of *C. Winn-Sampsoni*, ♂.
9. Antenna of *C. Winn-Sampsoni*, ♀.
10. Antenna of *C. longirostris*, ♂.
11. Bifid hair of leg found on the species of *Ceratocheilus*.

Freshwater Rhizopods from the English Lake District. By JAMES M. BROWN, B.Sc. (Communicated by Prof. A. DENDY, F.R.S., Sec.L.S.)

(PLATE 50.)

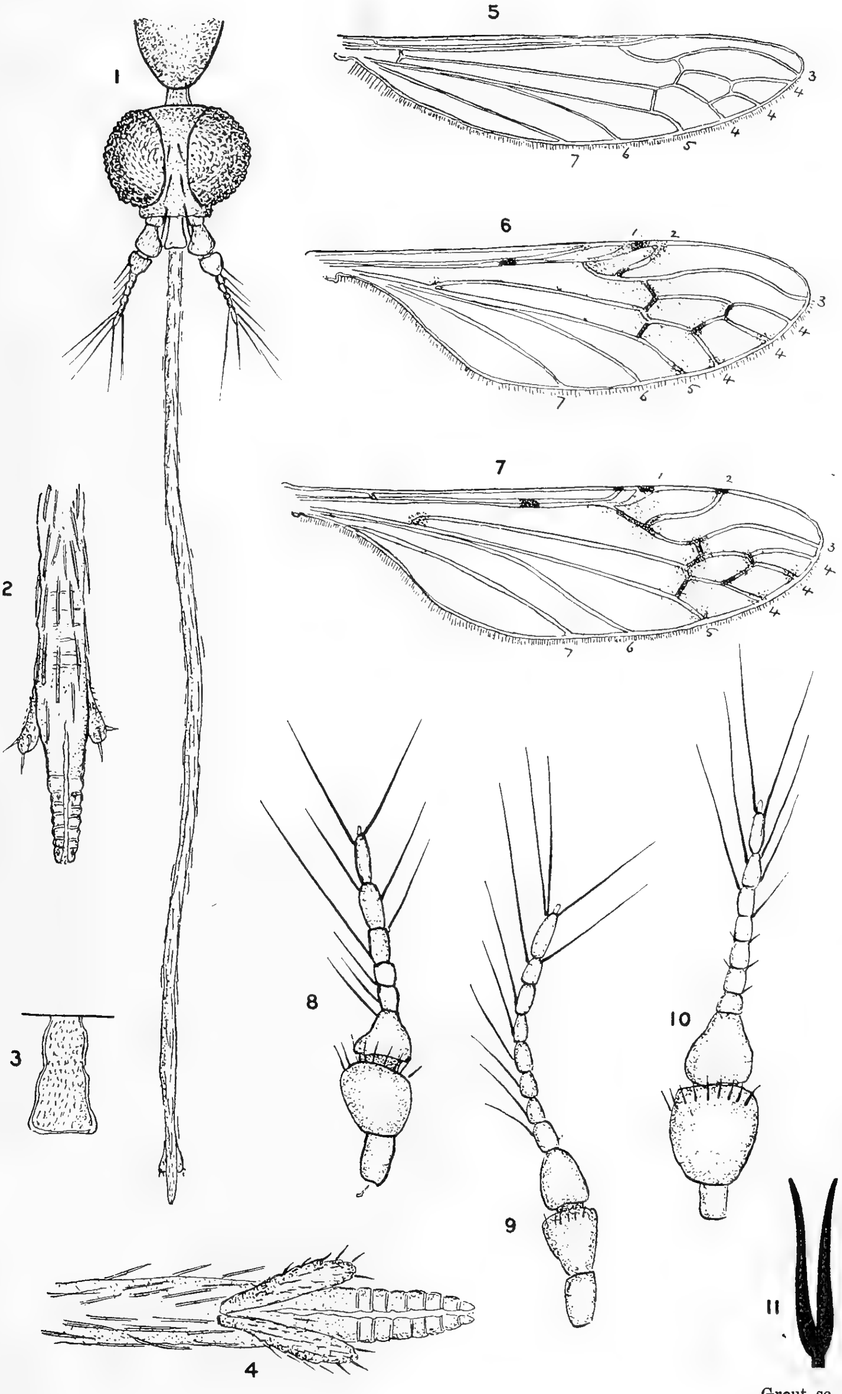
[Read 18th November, 1909.]

FOR the purpose of studying the variation and distribution of Freshwater Rhizopods, collections were made from various localities in the English Lake District. Though only a small area was explored, some interesting results have been obtained. The material, which consisted partly of collections of sphagnum and other bog-mosses, and partly of sediment and vegetation from tarns and lakes, was brought home and carefully washed and examined.

About 50 species of Rhizopods were identified, many of them common and familiar forms, but others, again, are less well known, while a few do not seem to have been recorded from this country. Among these, *Paulinella chromatophora*, Lauterborn, is of interest, having been found in only a few places on the Continent and in N. America, and only as a single specimen from Loch Ness in Scotland.

Naturally, many of the specimens found were empty tests, notably those of species of *Difflugia*, *Euglypha*, *Assulina*, and *Trinema*, but in most cases active individuals also occurred.

It will be seen that some species—e. g., *Difflugia oblonga* (=*D. pyriformis*), *D. constricta*, *Centropyxis aculeata*, *Nebela collaris*, *Quadrula symmetrica*, *Cyphoderia ampulla*, *Euglypha alveolata*, and *Trinema enchelys*—occur in all or nearly all the collections examined. This is probably due to the fact that,



W. W. del. Grout, sc.

NEW TIPULIDÆ.

Summary of the Species identified.

List of Species.	WESTMORLAND.			CUMBERLAND.					
	Above Easedale Tarn.	Easedale Tarn.	Blea Tarn.	Above Tilberthwaite Gill.	Yewdale.	Above Highlow Tarn.	Highlow Tarn.	Esthwaite Lake.	Windermere.
	1	2	3	4	5	6	7	8	9
AMŒBINA.									
Amœba proteus (*Pallas*), *Leidy*	×	. .	. .	. .	. .	. .	. .	. .	. .
,, limax, *Dujardin*	×	. .	. .	. .	. .	. .	. .	. .	. .
,, vespertilio, *Penard*	. .	. .	. .	. .	. .	. .	. .	×	. .
,, verrucosa, *Ehrenb.*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, striata, *Penard*	. .	×	. .	. .	. .	. .	. .	×	. .
Dactylosphærium radiosum (*Ehrenb.*), *Bütschli*	×	. .	. .	×	. .	. .	. .	×	. .
ARCELLINA.									
Arcella vulgaris, *Ehrenb.*	×	×	. .	. .	. .	. .	. .	. .	×
,, discoides, *Ehrenb.*	. .	. .	×	. .	. .	. .	×	. .	. .
Centropyxis aculeata (*Ehrenb.*), *Stein.*	×	×	. .	. .	×	. .	×	×	×
,, ,, *var.* ecornis (*Ehrenb.*), *Leidy*	. .	×	. .	. .	. .	. .	. .	×	. .
,, ,, *var.* spinosa, *Cash*	. .	. .	. .	×	. .	. .	. .	. .	. .
,, ,, *var.* discoides, *Penard.*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, lævigata, *Penard*	. .	. .	×	. .	. .	. .	. .	×	. .
DIFFLUGINA.									
Difflugia oblonga, *Ehrenb.*	×	×	×	. .	. .	×	×	×	×
,, acuminata, *Ehrenb.*	. .	. .	. .	. .	. .	. .	. .	×	. .
,, lanceolata, *Penard*	. .	. .	. .	. .	. .	. .	. .	×	. .
,, globulus, *Ehrenb.*	. .	. .	. .	×	. .	. .	. .	. .	. .
,, urceolata, *Carter*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, lobostoma, *Leidy*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, oviformis, *Cash*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, rubescens, *Penard*	×	. .	. .	. .	. .	. .	. .	. .	. .
,, constricta (*Ehrenb.*), *Leidy*	. .	×	. .	. .	×	×	×	×	×
Pontigulasia vas (*Leidy*), *Schout.*	. .	×	. .	. .	. .	. .	. .	×	. .
,, compressa (*Carter*), *Cash.*	. .	×	. .	. .	. .	. .	. .	. .	. .
Lesquereusia spiralis (*Ehrenb.*), *Bütschli*	. .	×	. .	. .	. .	. .	. .	. .	. .
,, modesta, *Rhumbler*	. .	×	. .	. .	. .	. .	. .	×	. .
NEBELINA.									
Hyalosphenia papilio, *Leidy*	×	×	. .	. .	. .	. .	. .	. .	. .
Nebela collaris (*Ehrenb.*), *Leidy*	×	×	×	×	×	. .	. .	. .	. .
,, bohemica, *Taránek*	. .	. .	×	. .	×	. .	. .	. .	. .
,, militaris, *var.* tubulata, *var. nov.*	×	×	. .	×	. .	. .	. .	. .	. .
,, carinata (*Archer*), *Leidy*	×	×	. .	×	. .	. .	. .	. .	. .
,, marginata, *Penard*	×	. .	. .	. .	. .	. .	. .	. .	. .

List of Species.	Westmorland.			Cumberland.					
	1	2	3	4	5	6	7	8	9
Nebelina (*cont.*).									
Nebela flabellulum, *Leidy*	×	..	..	×	×	..	..	..	..
„ dentistoma, *Penard*	×	×	..	×	..	×	..	..	..
Quadrula symmetrica (*Wallich*), *Schulze*	×	×	×	×	..	×	×	..	×
Heleopera petricola, *Leidy*	×	×	..	×	×	..	×	..	..
Cochliopodium bilimbosum (*Auerb.*), *Leidy*	..	..	..	..	..	..	×	×	..
Euglyphina.									
Euglypha alveolata, *Dujardin*	×	×	×	×	×	×	×	..	..
„ ciliata (*Ehrenb.*), *Leidy*	×	..	×	×	..	..	..	..	..
„ strigosa (*Ehrenb.*), *Leidy*	..	..	×	..	..	..	..	..	..
„ compressa, *Carter*	×	×	..	×	..	..	..	..	..
Placocysta spinosa (*Carter*), *Leidy*	×	..	..	..	..	..	..	..	..
Assulina seminulum, *Ehrenb.*	×	×	..	×	×	..	..	..	..
Cyphoderia ampulla (*Ehrenb.*), *Leidy.*	×	×	×	..	×	×	×	×	×
Trinema enchelys (*Ehrenb.*), *Leidy*	×	×	×	×	×	×	×	×	×
„ lineare, *Penard*	×	×	×	×	..	..	..	×	..
Corythion dubium, *Taránek*	×	..	..	×	×	..	..	..	..
Sphenoderia lenta, *Schlumb.*	×	×	..	×	×	..	×	..	×
Paulinella chromatophora, *Lauterb.*	..	..	..	..	..	..	×	..	..
Gromiina.									
Microgromia socialis, *Archer*	..	..	..	..	..	..	..	×	..

with the exception of Esthwaite Lake and Windermere, all the situations may receive drainage from sphagnum.

The following material was examined :—

1. Sphagnum taken from the moorlands above Easedale Tarn.
2. Vegetation (especially *Isoëtes*) and sediment from Easedale Tarn.
3. Scrapings from the surface of submerged stones in Blea Tarn (Little Langdale).
4. Sphagnum from the head of Tilberthwaite Gill.
5. Sphagnum and other bog-mosses from Yewdale (Coniston).
6. Vegetation from a stream entering "Highlow" Tarn (Tarn Hows), Coniston.
7. Vegetation and sediment from "Highlow" Tarn.
8. Vegetation and sediment from the western margin of Esthwaite Lake.
9. Vegetation and sediment from the western margin of Windermere.

Remarks on some of the Species.

AMŒBA VESPERTILIO, *Penard*, '*Faune rhizopodique du Bassin du Léman*,' 1902, p. 92. (Plate **50**. figs. 1 & 2.)

Though it is doubtful whether all the various forms of *Amœbæ* described by different authors are really distinct species, it seems to me that *A. vespertilio* is quite characteristic. I have found it, not only in Esthwaite Lake, but also in sediment from near Sheffield, and always having the same features. It is somewhat variable in form, but during movement always possesses a broad clear belt of ectoplasm in front, from which arise the characteristic sharp-pointed cone-shaped pseudopodia. The endoplasm is fairly granular and contains various inclusions, mostly food-bodies (Algæ). There are generally several vacuoles which tend to flow together, forming a large one. The nucleus is single, slightly oval, with a central mass of chromatin matter ("nucleolus") surrounded by a clear border. Size about 50 μ.

DIFFLUGIA RUBESCENS, *Penard*, '*Rocky Mountain Rhizopods*,' *in* '*American Naturalist*,' 1891; '*Faune rhizopodique &c.*,' p. 227. (Plate **50**. figs. 3, 4, 5.)

This species does not seem to have been recorded for this country before. The test is pyriform in outline, but shorter in proportion than that of *D. oblonga* (=*pyriformis*). It is transparent, consisting of thin flakes and broken diatom frustules. The neck is almost uniform in width and quite distinct. Within the margin of the mouth a series of blunt tubercles or tooth-like projections is to be noted (see fig. 4). This character is not mentioned by Dr. Penard, but all my specimens, whether collected in the Lake District or near Sheffield, showed it. The protoplasm does not nearly fill the test and is attached to the fundus by several clear epipodes. When the animal is active the protoplasm projects from the test as a distinct column, from which one, or occasionally two, finger-like pseudopodia arise.

A characteristic feature is the presence of numerous round, brick-red granules in the endoplasm, especially in the region towards the mouth. They are always present, and when the animal is extended they project to the origin of the pseudopodia, or even into them for a short distance. The nucleus is single and distinctly seen. Size 80 μ in length by 55 μ in breadth.

DIFFLUGIA LANCEOLATA, *Penard*, *in* '*Mém. Soc. phys. et hist. nat. Genève*,' 1890; '*Faune rhizopodique &c.*,' p. 250.

Associated with *D. oblonga* one often meets with individuals belonging to this species. The character and shape of the test readily distinguish it, being lanceolate and not pyriform, with generally a rounded, but occasionally a bluntly-pointed, fundus. There is no indication of a neck. The test is covered with thin flakes and rarely carries large grains, so that the outline is uniform. Size 146–160 μ in length.

Difflugia constricta (*Ehrenb.*); *Leidy, 'Freshwater Rhizopods of North America,'* 1879, p. 120; *Penard, 'Faune rhizopodique &c.,'* p. 298.

This appears to be one of the commonest and most widely distributed of the genus, occurring in almost all kinds of situations. It is very variable in size, ranging from 64 μ to 100 μ. Its shape, also, is most variable. It always, however, has an obliquely-placed mouth with inverted margin, a swollen posterior fundus, and flattened anterior end. The test is always covered with stones.

Difflugia oviformis, *Cash, 'British Freshwater Rhizopoda & Heliozoa,'* vol. ii. 1909, p. 52, pl. 20. figs. 8–12. (Plate **50**. figs. 6, 7, & 8.)

In Easedale Tarn numerous empty tests occurred belonging to this species, which was discovered by Cash in ponds at Chelford (Cheshire). The test is somewhat oval in shape, nearly twice as long as broad, with regularly curved outline. Anteriorly it is abruptly truncated by the borders of the wide mouth. Surrounding the mouth is a very prominent collarette, which in side view gives the appearance of a much-thickened rim. The mouth itself is very prominently and regularly 4-lobed (several specimens showed 5 lobes). The lobes are very regularly rounded, and separated by as many pointed prominences, appearing in side view as notches on the collarette. The test is distinctly brownish yellow and opaque, and is covered with irregularly shaped yellow flakes with very distinct brownish cementing substance between, appearing as brown punctated veins traversing the surface of the test. Unfortunately, none of the specimens were active and the characters of the protoplasm were not observed.

Size 86 μ long by 45 μ broad (Cash gives the size as 110 μ long by 80 μ broad).

D. oviformis appears most nearly related to *D. limnetica*, Levander, and *D. gramen*, var. *achlora*, Penard. With these two forms it agrees in the characters of the test and in the presence of the collarette, but differs in size and shape and in the shape and lobing of the mouth.

Pontigulasia vas (*Leidy*); *Schouteden, in 'Ann. Biol. Lacustre,'* i. 1906, p. 338, note.

Typical examples of this species, which is the *Difflugia pyriformis*, var. *vas*, of Leidy ('Freshwater Rhizopods of N. America'), were found in Esthwaite Lake. Size 150 μ. Dr. Penard ('Faune rhizopodique &c.,' p. 348) describes this form under the name *P. spectabilis.*

Pontigulasia compressa (*Carter*); *Cash, 'British Freshwater Rhizopoda & Heliozoa,'* vol. ii. p. 61.

In Easedale Tarn, and also in sediment collected near Sheffield, I have found active examples which, while obviously belonging to this species, are sufficiently large and broad to be identified with the form described by

Dr. Penard ('Faune rhizopodique &c.,' p. 322) as *P. bigibbosa*. This latter, now a variety of *P. compressa* (*P. compressa*, var. *bigibbosa*), Penard regards as occurring only in large lakes.

Size: length 250 μ, width 200 μ, depth 160 μ. Cash gives for *P. compressa*, length 130–150 μ, breadth 100 μ; while Penard gives for *P. bigibbosa*, length 250 μ.

NEBELA BOHEMICA, *Taránek, 'Monographie der Nebeliden Böhmens' (in Abhand. der kön. Böhm. Gesell. Wiss.*, 1882), p. 34; *Penard, 'Faune rhizopodique &c.,'* p. 351.

Amongst collections containing *N. collaris* in quantity, a form frequently occurs which appears to be this species. Compared with *N. collaris* it is somewhat broader in proportion. The borders of the mouth appear straight in the broad view of the test, and without the lateral notches characteristic of *N. collaris* in narrow view. Further, a distinct area surrounding the mouth is without the covering of plates and appears as a clearly defined, but not thickened lip. Its size varies up to 128 μ in length by 77 μ in breadth.

NEBELA MILITARIS, var. TUBULATA, var. nov. (Plate **50**. figs. 9 & 10.)

This variety is occasionally found amongst sphagnum, but never in large numbers. I have met with it, not only in this district, but also near Sheffield. The test is generally very regular in form, and has the shape of a somewhat compressed round-bottomed flask with prominent neck, which is of uniform width throughout and about one-half the total length of the test. The mouth is bordered by prominent "lips" with thickened margins, convex in broad view of the test, and showing a distinct notch in narrow view. The surface structure is like that of typical forms of *N. militaris*.

Size: length 64 μ, breadth 32 μ, length of neck about 32 μ.

The relationship of this form is rather doubtful, and at present it seems best to regard it as a variety of *N. militaris*, Penard. The general shape suggests *N. lageniformis*, Penard, and *N. barbata*, Leidy. From these, however, it differs distinctly, not only in size, being very much smaller, but also in the characters of the mouth and lips, in which respects it approaches *N. militaris*. From typical examples of this last, again, it is readily distinguished by its general shape, the characteristic parallel-sided neck, and slighter build.

HELEOPERA PETRICOLA, *Leidy, 'Freshwater Rhizopods of N. America,'* p. 165; *Penard, 'Faune rhizopodique &c.,'* p. 382.

This species occurs very commonly in sphagnum. Many of the specimens found exhibit the violet colour mentioned by Penard.

Euglypha compressa, *Carter, in 'Annals & Mag. of Nat. Hist.,'* 3rd ser., xiii. & xv. ; *Penard, 'Faune rhizopodique &c.,'* p. 507. (Plate **50.** figs. 11 & 12.)

Besides the features characterising this species, *i. e.* the very compressed nature of the test and the form of the plates, the presence of spines of special form is of interest. These spines are particularly long and prominent, averaging about 20 μ in length. They arise from the intervals between consecutive plates around the lateral margin of the fundus of the test. Each has the shape of a flattened blade tapering towards the free extremity, and narrowing more suddenly towards the base, where it enlarges abruptly to form the button-like structure by which it is held to the test. They arise generally in groups of two or three. They are quite different from the spines of *E. alveolata*, in which species they arise as outgrowths of the plates themselves, and also from the "cilia" of *E. ciliata.*

One example from Easedale Tarn was of particular interest. It appeared to be in the stage preparatory to division. The protoplasm contained many plates ready for the formation of the daughter test, and these were, at any rate in part, arranged definitely in position with reference to their relative places in the new test. This was especially seen in the toothed plates which surround the "mouth." Ten toothed plates, five above and five below, were seen lying side by side near the end of the fundus. Beyond these, ordinary oval plates were visible, alternating with them ; while lying between them were the large spines with pointed ends towards the mouth of the old test. It thus appears as if the plates and spines for the new test are to some extent arranged before the daughter protoplasm passes out from the old test. Unfortunately the process of division did not seem to be completed.

Placocysta spinosa (*Carter*); *Leidy, 'Freshwater Rhizopods of N. America,'* p. 221.

This species is very characteristic and is readily distinguished from the *Euglyphas* by the absence of teeth on the plates surrounding the mouth. The spines, however, are very similar in character to those of *Euglypha compressa.* It seems to be rarely met with, although it is also recorded by Prof. G. S. West from Bowness (Westmorland) and from Hawkshead (Lancashire) in this district.

Size : length 145 μ, breadth 100 μ.

Trinema lineare, *Penard, in 'Mem. Soc. phys. et hist. nat. Genève,'* 1890; & *'Faune rhizopodique &c.,'* p. 529.

This form appears quite distinct from *T. enchelys.* It is uniformly longer and narrower in proportion and more tube-like, with the mouth obliquely placed across the narrower end, and not so distinctly ventral as in *T. enchelys.*

Size : up to 25 $\mu \times 9$ μ.

CORYTHION DUBIUM, *Taránek*, '*Monographie der Nebeliden Böhmens, &c.*,' p. 43; *Penard*, '*Faune rhizopodique &c.*,' p. 531. (Plate **50.** figs. 13 & 13 *a*.)

This species seems to be generally overlooked or confused with *Trinema enchelys*, from which, however, it differs in the construction of the test. This consists of narrow oval plates somewhat irregularly arranged and difficult to see; while in *T. enchelys* the plates are round, and, at any rate in the larger forms, of two sizes, the intervals between the larger ones being filled up by the smaller ones, giving the characteristic beaded appearance to the margins of these plates.

Size $32\,\mu \times 22\,\mu$.

PAULINELLA CHROMATOPHORA, *Lauterborn*, '*Protozoënstudien*,' *in* '*Zeitschr. f. wiss. Zool.*,' Bd. 59, 1895, p. 537; *Penard*, '*Revue suisse de Zool.*,' 1905. (Plate **50.** figs. 14 & 15.)

This species has been reported from Loch Ness in Scotland (a single individual), but, so far as I have been able to discover, not from this country previously. It occurs in Highlow Tarn, but all the individuals I found were empty tests. These, however, correspond with Penard's description. The test is regular and oval in shape, terminating in a short collar surrounding the elliptical mouth; it is formed of five longitudinal rows of rectangular plates with rounded ends, there being about 12 plates in each row, placed in alternating series.

Size: from 27 to $32\,\mu$ long and from 20 to $23\,\mu$ broad.

I wish to express my thanks to Mr. J. Hopkinson, F.L.S., to whom I am indebted for much help and advice while revising this paper for publication; and to Dr. E. Penard, of Geneva, whose ready assistance is greatly appreciated.

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EXPLANATION OF PLATE 50.

Figs. 1 & 2. *Amœba vespertilio,* Penard. × 500. Active individuals. *n.*=nucleus, *c.v.*= contractile vacuoles, *vac.*=vacuoles.

Figs. 3–5. *Difflugia rubescens,* Penard. × 400. Fig. 3 is a surface view of the test. Fig. 4 is an optical section of an individual retracted. Fig. 5 is the same of an active individual. *n.*=nucleus, *c.v.*=contractile vacuole, *r.g.*=red granules.

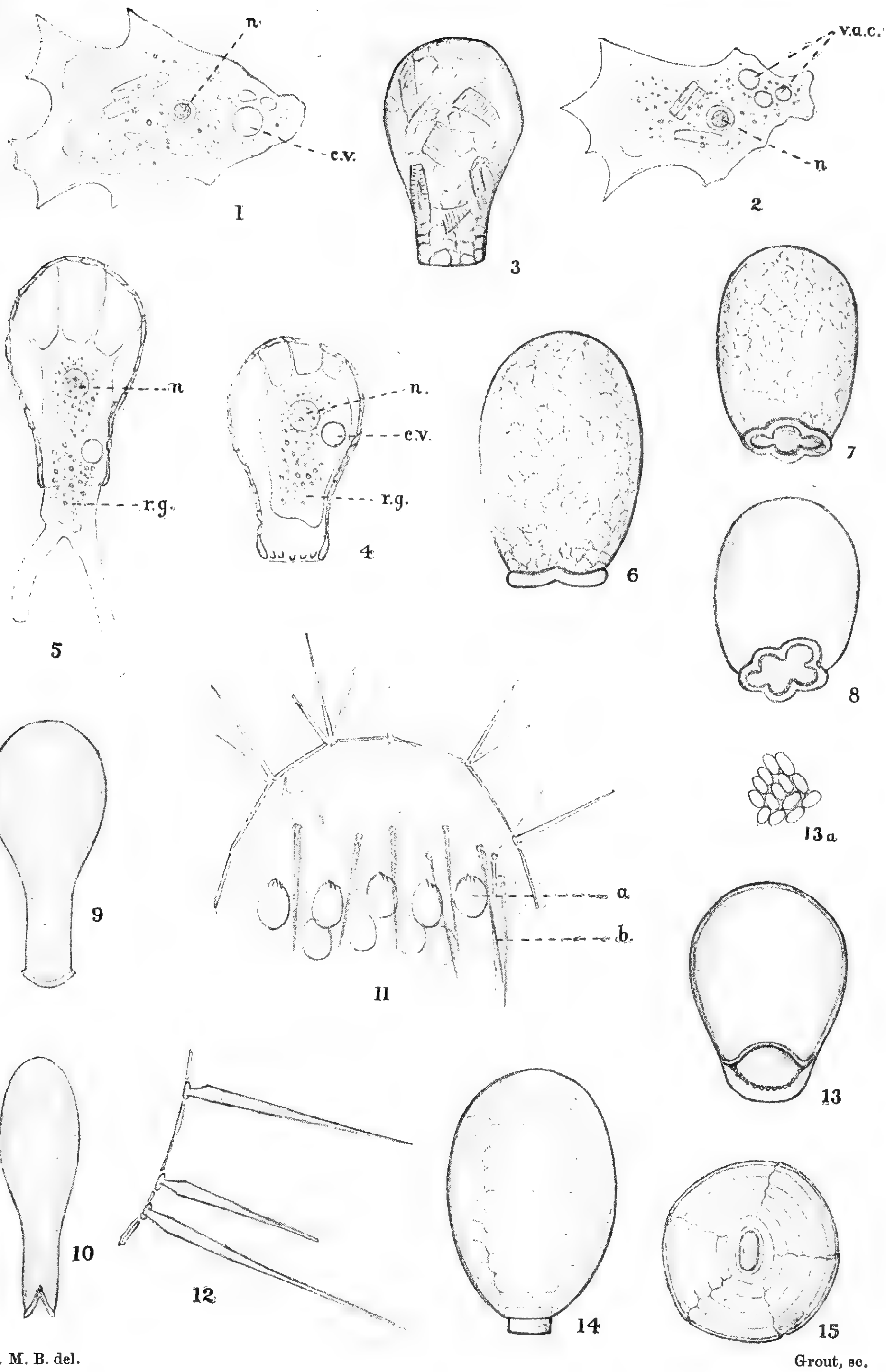
Figs. 6–8. *Difflugia oviformis,* Cash. × 400. Figs. 6 & 7 are different views of typical examples. Fig. 8 shows an individual with a somewhat irregularly 5-lobed mouth.

Figs. 9 & 10. *Nebela militaris,* var. *tubulata,* var. nov. × 600. Fig. 9 is the broad view and fig. 10 the narrow view of an empty test.

Figs. 11 & 12. *Euglypha compressa,* Carter. Fig. 11 shows a portion of an individual with mouth-plates (*a*) and spines (*b*) of the daughter animal. × 600. Fig. 12 shows the spines of a typical individual. × 1000.

Fig. 13. *Corythion dubium,* Taránek. × 1000. Surface view of an empty test. Fig. 13 *a* shows the arrangement of the plates.

Figs. 14 & 15. *Paulinella chromatophora,* Lauterborn. × 1000. Fig. 14 is an empty test in side view. Fig. 15 is the same seen from the oral end.



J. M. B. del. Grout, sc.

FRESHWATER RHIZOPODS.

A Contribution towards a Knowledge of the Neotropical THYSANOPTERA.

By RICHARD S. BAGNALL, F.L.S., F.E.S.

(PLATES 51–53.)

[Read 17th March, 1910.]

I HAVE recently had the pleasure of examining two small collections of Thysanoptera from Central America, which were submitted to me through the kindness of Dr. Meinert (Copenhagen) and Mr. G. C. Champion (on behalf of Messrs. Godman and Salvin), to whom my thanks are due. I am also grateful to Prof. Bouvier for the opportunity of examining the material in the Paris Museum, and include the description of a single species, *D. nitidus*, from this latter collection. Part of the material sent by these gentlemen has already been described *, and it will be noticed that, though the collections are small as regards the number of specimens, they include a large number of very interesting forms, the chief interest lying, perhaps, in the comparatively large number of species referable to certain genera or groups of genera. Thus in the allied genera *Idolothrips*, Haliday, and *Dicaiothrips*, Buffa, we find no less than twelve species: *I. longiceps*, Bagnall, *I. assimilis*, Bagnall, *I. affinis*, Bagnall, *I. angustatus*, sp. n., *D. foveicollis* (Bagnall), *D. nitidus*, sp. n., *D. grandis*, sp. n., *D. Championi*, sp. n., *D. lævicollis*, sp. n., *D. propinquus*, sp. n., *D. distinctus*, sp. n., and *D. brevicornis*, sp. n.; these genera apparently finding their headquarters in Central America. Again, in the closely allied genera *Liothrips*, Uzel, and *Diceratothrips*, Bagnall, we are able to record at least five forms.

So far as possible I have endeavoured to figure each of the species here described, so as to show more clearly differences that are difficult to explain in words. Owing to the small amount of material at my disposal, especially as regards the genus *Dicaiothrips*, I hesitated long before admitting the rights of certain forms to specific rank, but I firmly believe that in each case the characters I have used are good and valuable ones, the relative lengths of the abdominal segments being, in my opinion, especially useful.

Further, many of the specimens were dried and mounted, and others, again, were preserved in alcohol, some of these latter being distended, and thus demanding the utmost care in their discrimination and description. It would have been, in every way, more satisfactory if one could have examined a larger mass of material, and it is to be hoped that further collections may be made in the near future, together with observations as to the habits, etc., of these much-neglected insects.

* Trans. Nat. Hist. Soc. of Northumberland, Durham, and Newcastle-upon-Tyne, n. s. pp. 183–217, pls. 6 & 7 (1908); Journ. Linn. Soc., Zool. xxx. pp. 329–335, pl. 46 (1909).

I have attempted on Pl. **52.** figs. 5 *a* & 5 *b*, to figure the ventral side of the ninth abdominal segment of the male *Dicaiothrips lævicollis*, and believe that upon examination of an extensive series the genital characters in the male (and probably in the female also) will prove to be of some taxonomical importance.

I have also endeavoured (Pl. **53.** fig. 16) to delineate the basal part of the fore-wing in *Diceratothrips armatus*, drawing particular attention to a light patch that does not appear to be so strongly membranous as the surrounding parts, and is also protected by two bristles. I have thought that this may probably be a sense-area, and believe that it has not before been noted.

Genus Dicaiothrips, *Buffa*, 1909.

Dicaiothrips, Buffa, 'Redia,' v. fasc. 2, p. 169 (March 1st, 1909).

This genus was erected recently by Prof. Buffa and is a difficult one to diagnose with satisfaction, though there can be no doubt that the genus is a good one and quite distinct from *Idolothrips*. The species are, as a rule, larger and more massively built than in *Idolothrips*; the cheeks of the head, and the fore-legs also (which latter are often considerably enlarged in the male), are very profusely set with spines ; the fore-tarsal tooth is very large in the male, and scarcely noticeable in the female, whilst in the first-named sex the abdomen is exceptionally long and narrow, and the segments in most species are very much elongated. In the majority of species the male is without post-ocular spines ; but these are to be found in the female, which sex, so far as may be judged, is always more sparsely set with spines both on the lateral margins of the head and on the fore-legs, and has the abdomen broader and shorter than in the male, and the tube also decidedly stouter. The strong hook-like spine at the apex of each fore-femur without, pointed out by Buffa, is apparently not a characteristic of this genus, nor common to all the species. I cannot distinguish it in any of my Neotropical material, and have only observed it in two undescribed species of *Dicaiothrips*, one from the Malay Archipelago and the other from North Africa. This character, too, is not confined to this genus ; it is seen in two or three species of *Idolothrips*, whilst I have a specimen of an undescribed species belonging to a genus far removed from these last-named genera, which has these spines very strongly developed.

The type of the genus is undoubtedly *Idolothrips Schötti* (Heeger) Uzel *, described from Brazil, to which species Buffa erroneously refers my *Idolothrips foveicollis*, and at the same time ascribes a Malayan form to the same species. Both *D. Schötti* and Buffa's Malayan form have the third and fourth antennal joints subequal, which character alone at once separates

* Heeger, Sitzungsb. d. Akad. d. Wiss., Vienna, viii. p. 139, pl. 23 (1852); and Uzel, Monographie der Ordnung Thysanoptera, Königgrätz, p. 266 (1895).

them both from *D. foveicollis*, and from all the species (in which the antennæ are preserved) dealt with in this paper. I am fortunate enough to possess Heeger's original drawings of *Thrips*, and the plate " *Thrips*, L., *Physapus*, De G. Lat., *Sp. Schötti* " would make it appear that *D. Schötti* was a shining black insect, with the antennæ entirely concolorous with the body, whilst Buffa says that his species has the third antennal joint clear yellow. In any case *D. foveicollis* cannot be referred to either of these forms, nor do I feel justified in referring any of the other species that have passed through my hands to Heeger's *Schötti*. I hope that it will be possible to satisfy ourselves on the identity of Heeger's species by an examination of his type.

In the following Table the male characters (with but one exception) are adopted :—

I. Head produced beyond the eyes for at least the length of eye, and for more than the width at the base of the produced part; post-ocular bristles present in the male; bristles at apex of ninth abdominal segment as long as the tube .... ♂ *nitidus*, sp. n.

II. Head produced beyond the eyes for less than the length of eye, and for less than the width of the produced part; post-ocular bristles absent in the male (excepting in *D. Championi*); bristles at apex of ninth abdominal segment (excepting in *D. distinctus*) distinctly shorter than the tube.

1. Head more strongly produced beyond eyes; bristles at apex of ninth abdominal segment shorter than the tube; eighth abdominal segment either longer than, as long as, or only slightly shorter than the seventh.

i. Post-ocular bristles present .... ♂ *Championi*, sp. n.

ii. Post-ocular bristles apparently absent.

A. Eighth abdominal segment decidedly longer than the seventh; tube shorter than the eighth segment.

a. Size larger (13·0 mm.); head more than three times as long as broad; lateral cephalic spines very long and irregular; tube more than seven times as long as broad at base, and nearly as long as the head .. ♂ *grandis*, sp. n.

b. Size smaller (about 9·0 mm.); head less than three times as long as broad; lateral cephalic spines short and regular; tube less than five times as long as broad at base, and only two-thirds the length of head .... ♂ *propinquus*, sp. n.

B. Eighth abdominal segment as long as, or slightly shorter than the seventh; tube longer than either the seventh or eighth segments.

a. Head about two and one-half times as long as broad; third antennal segment one-half the length of head, and the three apical segments together as long as the fourth joint; prothorax foveolate; eighth abdominal segment shorter than the seventh .... ♂ *foveicollis* (Bagnall).

Tube more slender, and at least as long as head; bristles at apex of ninth abdominal segment three-quarters the length of tube .... ♀ *foveicollis* (Bagnall).

b. Head more slender, about three times as long as broad; third antennal segment less than one-half the length of head, and the three apical segments together one and two-thirds as long as the fourth joint; prothorax smooth; seventh and eighth abdominal segments subequal.................. ♂ *lævicollis*, sp. n.

Tube stouter, and not so long as the head; bristles at apex of ninth segments as long as tube........ ♀ *lævicollis*, sp. n.

2. Head very slightly produced beyond the eyes; bristles at apex of ninth abdominal segment longer, or at least as long as the tube; eighth abdominal segment considerably shorter than the seventh *.

i. Head longer, two and three-quarters as long as broad; eyes occupying laterally about one-quarter the length of head; tube a little more than two-thirds the length of head; bristle at each posterior angle of the prothorax weaker and not so long .... ♂ *distinctus*, sp. n.

ii. Head shorter, two and one-third times as long as broad; eyes occupying laterally not quite one-third the length of head; tube three-quarters the length of head; bristles at each posterior angle of prothorax longer and stronger .... ♀ *brevicornis*, sp. n.

DICAIOTHRIPS NITIDUS, sp. nov. (Pl. **51**. fig. 10 ; Pl. **52**. fig. 7.)

♂. Length 5·2 mm., breadth of mesothorax 0·75 mm.

Colour shining black, tarsi brownish.

Head cylindrical, nearly three and one-half times as long as wide at base ; narrowed behind eyes and slightly widened towards base ; vertex produced beyond eyes for about one-fifth the total length of head. Cheeks set with a few short, subequal spines, and a long lateral one behind each eye. Eyes comparatively large and finely facetted, bulging strongly, the width across them being one and one-quarter times the width of head near base ; post-ocular spines present, but not long. Ocelli large, posterior pair near to inner margins of eyes and placed above a line drawn across their anterior third, the space between the ocelli being only slightly more than the diameter of one of them ; anterior ocellus near the vertex, protected by a pair of long, strong, black bristles. Antennæ inserted at extreme apex of head, unfortunately broken ; two basal joints cylindrical and subequal in length.

Prothorax one-third the length of head, and nearly twice as broad as long ; strongly convex, shining and glabrous ; only very slightly widened to base ; fore-angles broadly rounded, depressed ; a rather deep, transverse depression before base, and a few irregular, shallow, and unimportant foveæ on each

* We do not know the male of *brevicornis*, and cannot therefore state whether these latter characteristics are applicable to that species or not.

side of median line. Spine at each posterior angle short and weak, set in slight protuberance. Outer margin of fore-coxa angular, with long, stout spine at apex of angle and two shorter ones below. Fore-femora long and stout, not quite one-quarter as broad as long; tibia not quite as long as femur, and the tarsus armed with a long, somewhat slender and acute tooth. The outer margin of the fore-femur is armed with six or seven moderately long, strong bristles, some of them being curved forwards, several shorter ones, chiefly behind a line drawn across the middle of the femur, and some slender ones near the apex, one or two of which are longer than any of the others; series on inner margin composed of short and slender setæ. Intermediate and hind-legs long and slender, femora armed with several long and comparatively stout bristles, and all tibiæ with slender hairs, a few, below each knee, being long ones. Pterothorax slightly broader than the width across fore-coxa, almost square, the dorsal surface of the mesothorax being very distinctly reticulate. Wings reaching to the sixth abdominal segment.

Abdomen about two-thirds the total length of insect, long and slender; none of the body-segments, however, being more than one and one-half times the length of breadth. Ninth segment short, one-third the length of the preceding. Tube four times the length of ninth segment, and two-thirds the length of the head; terminal hairs about as long as tube, weak. Bristles on ninth segment longer than tube, rather stout, the other abdominal hairs being short and weak.

Habitat. Brazil; Montagnes des Orgues, Rio de Janeiro. In the environs of Tuuca at an altitude of from 600 to 1000 metres (*E. R. Wagner*, 1901).

Type. One male in Paris Museum.

Apart from its shining black colour *D. nitidus* may be easily recognized by the strongly produced head and by the long hairs on the ninth abdominal segment which overreach the tip of the tube. The depressed fore-margin of the prothorax is, I believe, a valuable character, and it will be noticed that the post-ocular bristles are present. The tube is decidedly longer than either the seventh or eighth abdominal segment.

DICAIOTHRIPS GRANDIS, sp. nov. (Pl. **51**. fig. 4; Pl. **52**. fig. 4.)

♂. Length 13 mm.

General colour black, tibiæ and tarsi brownish.

Head cylindrical, nearly three and one-half times as long as wide, narrowed behind eyes and slightly widened before constriction at base; vertex produced beyond eyes for a little more than one-seventh the total length of head. Cheeks set with a few long spines and several shorter ones. Eyes moderately large and finely facetted, bulging; post-ocular spines absent. Ocelli large, posterior pair near to inner margins of eyes and just above the mid-line; anterior ocellus near vertex and protected by a pair of long bristles. Antennæ inserted at extreme apex of head, separated at base; long and slender, evidently considerably longer than the head, but unfortunately broken in the type-specimen, only five joints remaining intact. First and second joints short and cylindrical, black ; third, fourth, and fifth joints yellowish brown, and shining black at tips. Third more than three times the length of the two basal joints together ; fourth one-half the length of third, and fifth four-fifths the length of fourth. Sense-cones moderately long and acute.

Prothorax one-third the length of the head, and about one-third broader than long; irregularly foveolate, with distinct humeral depressions, a deep, transverse depression before base, and with somewhat shallow and irregular foveæ at each side of central channel. A spine-set tubercle at each posterior angle, a pair of short posterior-marginal spines, and minute spines at each anterior angle. Each fore-coxa set with one long, conspicuous spine and several shorter ones. Fore-femora much enlarged, with dorsal surface depressed ; inner margin armed with a series of moderately long and strong bristles, and the outer margin with several much longer bristles interspersed with short ones. Fore-tibia short and broad, and fore-tarsus armed with a long, strong tooth. Intermediate and hind tibiæ slender, and the hind pair exceptionally long. Wings reaching to fifth abdominal segment, cilia closely set but not heavy.

Abdomen more than three-quarters the length of the whole insect, extremely long and slender, canaliculate, exceedingly sparsely clothed with minute white setæ. Segments 5 to 8 each between four and five times as long as broad ; ninth segment short, only one-fifth the length of the preceding. Tube narrow, four times the length of ninth segment, but not quite so long as the head. Terminal hairs short and weak, not one-half the length of the tube. Bristles at apex of the ninth segment and at the basal third (or thereabouts) of the preceding segments moderately long, but weak.

Habitat. Cerro Zunil, 4000–5000 feet (*Champion*).

Type. In coll. Godman and Salvin, one ♂.

Dicaiothrips grandis may be separated from *D. foveicollis* (Bagnall) by its much larger size, the longer head as compared to its breadth, the very long lateral cephalic bristles, the less glossy surface of head and fore-femora, the much elongated eighth abdominal segment, and by the shorter and less strong bristles on the ninth abdominal segment. In *foveicollis*, moreover, the third antennal joint is less than twice the length of the fourth. These comparative remarks also apply, for the most part, to *D. Championi* and *D. lævicollis*, whilst the species is directly separated from *propinquus* in the table.

D. grandis is the largest known species of *Dicaiothrips* and a giant of the order.

DICAIOTHRIPS FOVEICOLLIS (*Bagnall*). (Pl. **51**. figs. 1 & 2; Pl. **52**. figs. 1 & 2.)

Idolothrips foveicollis, Bagnall, Trans. Nat. Hist. Soc. of Northumberland, Durham, and Newcastle-upon-Tyne, n. s. iii. p. 214, pl. 7. fig. 12 (1908).

I have already stated that this is a compound species as regards the male, the second species being herein separated under the name of *Championi*.

♂. The true *foveicollis* has the eighth abdominal segment distinctly shorter than the seventh, and the tube, which is slenderer than in *Championi*, is considerably longer than either the seventh or eighth segment. The post-ocular spines are apparently absent. This species bears a somewhat strong resemblance to *D. lævicollis*, but is at once recognized by the characters given in the table.

Type. Male and females in coll. Godman and Salvin.

Habitat. One male and three females collected by Mr. Champion at Cerro Zunil, 4000–5000 feet; and a single female, Teapa, Tabasco (March, *H. H. Smith*).

DICAIOTHRIPS CHAMPIONI, sp. nov. (Pl. **51**. fig. 3; Pl. **52**. fig. 3.)

D. foveicollis in part.

♂. Length 10·5 mm., breadth of mesothorax 0·8 mm.

Closely allied to *D. foveicollis*, slightly larger, with the abdomen longer but less slender, the prothorax less strongly foveolate, and the fore-legs slightly stronger. Post-ocular bristles (absent in the male of *foveicollis*) present. The seventh and eighth abdominal segments are considerably longer than in *foveicollis* and practically subequal, the eighth being but slightly shorter than the seventh, whilst the tube is the same length as the seventh body-segment.

Type. One male in coll. Godman and Salvin.

Habitat. Cerro Zunil, 4000–5000 feet (*Champion*).

DICAIOTHRIPS LÆVICOLLIS, sp. nov. (Pl. **51**. figs. 5 & 6; Pl. **52**. figs. 5, *a*, *b*, & 6.)

♂. Length 7·5 mm., breadth of mesothorax 0·7 mm.

Colour dark chestnut-brown; fore-tibiæ and all tarsi yellowish brown; third and fourth antennal segments yellow, tipped with brown, basal half of fifth and base of sixth also yellow.

Head cylindrical, almost three times as long as wide near base, narrowed behind eyes and very slightly widened before constriction at base; vertex produced beyond eyes for about one-ninth the total length of head. Cheeks set somewhat closely with short spines. Eyes bulging, moderately large and finely facetted; post-ocular spines absent; ante-ocular spines (protecting anterior ocellus) very long. Ocelli rather large, placed as in *D. foveicollis* (Bagnall), but the space between the eyes, and consequently between the posterior pair of ocelli, greater than in that species. Antennæ inserted at extreme apex of head and separated at base, long and slender ; one and one-half times the length of head ; joints 3 to 5 mildly claviform, 6 to 8 fusiform. Basal joint short ; third more than four times the length of second ; fourth about five-eighths of third ; fifth four-fifths of fourth ; sixth three-quarters of fifth ; seventh two-thirds of sixth ; and apical joint much narrower, but very slightly shorter, than the penultimate. Pair of sense-cones on both third and fourth joints moderately long and acute, pair on fifth and a single one on the outer side of sixth joint very short and blunt. Mouth-cone rounded at tip and not reaching halfway across prosternum. Maxillary palpi comparatively short, apical joint about three times the length of basal, narrower and furnished with three sensory filaments, which are shorter and stouter than is usual ; labial palpi short and stout, with three very short sensory filaments at tip.

Prothorax one-half the length of head and very slightly wider at base than long ; transverse depression before base ; surface smooth, but not shining ; the fovea on each side are obsolete, and the sides of prothorax gradually rounded from anterior margin to middle. Spine at each posterior angle short and weak, and inner posterior-marginal pair slightly shorter and more slender ; other prothoracic spines apparently obsolete. One long, strong bristle on each fore-coxa and several shorter ones. Fore-femur enlarged, broadest through basal third, where it is less than one-half as broad as long ; series of spines on inner edge, and several larger ones on the outer edge interspersed with short ones, some of these latter being stouter than the others ; tibia broad, and tarsus armed with a somewhat acute tooth. Pterothorax broader than the width across fore-coxæ, almost square ; the sides of metathorax gently arcuate and narrowed to base of abdomen. Wings reaching to fourth abdominal segment, cilia shortest at ends. Intermediate and hind legs long ; femora with a few short spines, and the tibiæ furnished for the entire length with several regular rows of short white hairs.

Abdomen about three-fifths the total length of body, having all segments elongated ; eighth segment twice as long as broad, and ninth only a little more than one-half the length of eighth. Tube long and slender, evenly narrowed from base to tip ; about twice as wide at base as at apex ; two and one-quarter times the length of the preceding segment, and five-sixths the length of head. Terminal hairs short and weak, bristles at apex of ninth segment only about four-fifths the length of tube, and other abdominal bristles colourless and comparatively short and weak.

♀. The female has the cheek more sparsely set with setæ ; the post-ocular spines are present. The abdomen is broader as in *foveicollis* female, the tube is stouter, whilst the bristles at apex of the ninth segment are as long as the tube.

Habitat. One male and one female, Los Tejes, Venezuela, September 20th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

This species most closely resembles *D. foveicollis*; both sexes may be readily recognized by the characters given in the table.

DICAIOTHRIPS PROPINQUUS, sp. nov. (Pl. **51**. fig. 7; Pl. **52**. fig. 9.)

♂. Length a little more than 9 mm., breadth of mesothorax 0·85 mm.

Colour dark chestnut-brown, all tibiæ and tarsi reddish yellow; antennæ as in *D. lævicollis*.

Head not quite three times as long as wide near base, narrowed behind eyes and from thence parallel to base; vertex slightly raised and produced beyond eyes for one-seventh the total length of head. Cheeks set with several moderately long spines, a few of which are slightly longer and more conspicuous than the others, and a lateral one behind each eye the longest and, unlike the others, forwardly curved. Eyes bulging, moderately large and finely facetted; post-ocular spines absent. Ocelli rather large and the ante-ocular spines very long. Antennæ long and slender, inserted at extreme apex of head and separated at base; almost one and three-quarter times the length of head; joints 3 to 5 mildly claviform, 6 to 8 fusiform. Third joint nearly four times the length of second, stalk comparatively stout; fourth five-eighths of third; fifth four-fifths of fourth; sixth three-quarters of fifth; apical joint almost as long as penultimate but more slender, and both together slightly longer than the sixth. A pair of moderately long sense-cones on segments 3 to 5, and apparently only a single one on the outer side of segment 6. Mouth-cone rounded at tip and reaching halfway across prosternum; maxillary palpi moderately long, sensory filaments stout.

Prothorax one-half the length of head, somewhat convex; transverse channel near hind margin wide and very shallow, almost obsolete; surface smooth and slightly shining; fovea on each side of the median line obsolete. Spine at each posterior angle long and stout; inner posterior-marginal pair short and weak, and other prothoracic spines obsolete. Fore-coxa with one very long and strong spine and several shorter ones; fore-femur strongly incrassate, broadest through basal third, where it is a little less than one-half as broad as long; several short spines about the basal margin within, and a regular series for the entire length of the inner margin; many long ones on the outer edge, one in the centre being longer than any of the others, a few shorter but stronger ones near base without and numerous short ones for the entire length of the outer edge, being much weaker apically than nearer the base of the femur. Fore-tibia broad and depressed, hairs on the inner and outer edges set in minute warts, and one long bristle below knee. Fore-tarsal tooth long and stout. Pterothorax almost square, broader than the width across fore-coxæ. Hind and intermediate legs long and slender, femora with several stout spines, a subapical series of longer ones and a very long one at the apical third without; tibiæ furnished from knee to tip with rows of moderately long white hairs, and a single long bristle below each knee.

Abdomen more than three-quarters the length of the whole insect, all segments elongate and gradually tapering from the base to tube. Eighth segment three times as long as broad, and ninth about one-third the length of eighth. Dorsal surface sparsely furnished with minute white setæ. Tube gently narrowed from base to near apex; not quite five times as long as broad at base, and only very slightly broader at base than at extreme apex; not quite two and one-half times the length of the preceding segment and about two-thirds the length of the head. Terminal hairs rather long and tapering, three-quarters the length of tube. Bristles on the ninth segment stronger and about as long as tube; other abdominal bristles colourless and moderately strong.

Habitat. One male, Los Trincheras, Venezuela, December 11th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

D. propinquus is distinct on account of the very long eighth abdominal segment and the comparatively short tube.

DICAIOTHRIPS DISTINCTUS, sp. nov. (Pl. **51**. fig. 8; Pl. **52**. fig. 10.)

Length 6·0 mm., breadth of mesothorax 0·7 mm.

Colour black, intermediate and hind-tibiæ dark chestnut-brown; tarsi yellowish to brown, fore-tibiæ and tarsi reddish yellow, with inner and outer margins of tibia shaded with dark brown.

Head two and three-quarters as long as wide near base and a little more than twice the length of prothorax; almost imperceptibly narrowed behind eyes and from thence, with the exception of a slight constriction near base, parallel-sided; vertex raised and just overreaching the insertion of antennæ, produced beyond eyes for only about one-tenth of the total length of head. Cheeks sparsely set with short spines. Eyes moderately large and finely facetted and not bulging strongly, occupying laterally about one-quarter the total length; post-ocular bristles absent. Ocelli moderately large, placed as in *lævicollis*, but having the anterior one nearer to the posterior pair, the space between the latter being about three times the diameter of the ocellus. Ante-ocular bristles very long. Antennæ inserted just below vertex, basal joints separated; second joint longer than the first, brown; rest of antennæ unfortunately broken in the single specimen.

Prothorax one and one-half times as wide through middle as long; anterior margin emarginate, sides rounded; bristles at each posterior angle moderately long and prominent; roundly raised to posterior third, with the disc flat and a distinct and somewhat deep fovea on each side of the mid-line on a line drawn through the posterior third. Anterior femur twice as long as broad, hairs on tibiæ strong and fore-tarsal tooth well developed ; intermediate and posterior legs slender, with the femora slightly swollen at their distal thirds. Pterothorax wider than the width across fore-coxæ, with sides of metathorax roundly narrowed to base of abdomen. Wings reaching to the fifth abdominal segment, hyaline, with median veins and ciliæ brown.

Abdomen gradually narrowing to tube, long and slender, with the segments elongate ; seventh segment nearly twice as long as the eighth. Tube short and broad, scarcely four times as long as broad near base, a little more than two-thirds the length of head and slightly shorter than the seventh segment ; terminal hairs not quite so long as the tube. Abdominal bristles long and moderately slender, those on the ninth segment longer than tube and reaching to the tip.

Type. One male in coll. Godman and Salvin.

Habitat. Chontales, Nicaragua (*Janson*).

D. distinctus may be easily recognized by the form of the head, which is less produced beyond the eyes than in any of the other species, excepting *brevicornis*, and by the shortness of the eighth abdominal segment and of the tube.

The characters given in the table readily separate *distinctus* and *brevicornis*.

DICAIOTHRIPS BREVICORNIS, sp. nov. (Pl. **51**. fig. 9 ; Pl. **52**. fig. 8.)

♀. Length 5·0 mm., breadth of mesothorax 0·62 mm.

Colour dark chestnut-brown ; fore-tibiæ and all tarsi reddish brown ; second and base of sixth antennal joints tinged with yellow, 2 to 5 yellow, third slightly tipped, and the apical third of fourth and half of fifth shaded with brown.

Head two and one-third times as long as broad, and two and one-quarter times as long as the prothorax ; shaped as in *D. distinctus*, with the vertex raised and only slightly produced beyond the eyes. Cheeks sparsely set with short spines. Eyes large and finely facetted, occupying laterally a little less than one-third the total length of the head. Ocelli moderately large, posterior pair above a line drawn through centre of eyes ; post-ocular bristles long. Antennæ one and two-thirds the length of head ; fourth joint three-quarters of third, fifth five-sixths of fourth ; joints 3 to 5 claviform and 6 to 8 fusiform. A pair of sense-cones on each of the joints 3 to 5, but apparently only a single cone on the inner side of joint 6. Mouth-cone blunt, and reaching more than halfway across prosternum.

Prothorax with the bristle at each posterior angle long and strong. Pterothorax only slightly broader than long ; sides of metathorax slightly rounded and furnished with a strong sub-lateral spine near each posterior angle. Legs moderately long ; fore-femur slightly incrassate, with a few long bristles on outer edge ; fore-tarsal tooth obsolete ; fore-coxa with one prominent spine. Hind and intermediate femora with bristles as in *D. propinquus*, but decidedly weaker ; each intermediate tibia with two bristles, and hind tibia with one bristle below the knee. Wings present, reaching to the fifth abdominal segment ; iridescent ; median vein running almost to middle.

Abdomen gradually narrowing to tube from the fifth segment ; ninth segment apparently possessing a pair of elongate dorsal foveæ, which are, however, indistinct and very difficult to make out. Tube stout, three-quarters the length of the head, and about twice and one-half as long as broad at base. Bristles at apex of the ninth segment longer than the tube ; other abdominal bristles light-coloured, with one very long pair on each of the segments 3 to 7.

Type. In the Copenhagen Museum.

Habitat. Two females, Los Trincheras, Venezuela, one on the 11th and the other on the 12th of December, 1891, and one female, Caracas, Venezuela, October 6th, 1891 (*Meinert*).

From the shortly produced head it will be seen that this species is closely allied to *D. distinctus.* The head is, however, much shorter, the eyes are comparatively larger, whilst the tube, in proportion to the head, is longer.

Genus Idolothrips, *Haliday*.

Elaphrothrips, Buffa, ' Redia,' v. fasc. 2, p. 162 (March 1st, 1909).

I have already pointed out my reasons for regarding the species (*I. marginata*, Hal.) of Haliday's first division of his genus *Idolothrips* as the generic type, and at the same time erected the genus *Acanthinothrips* for the species of his second division, *spectrum* and *lacertina.* Despite these reasons, Prof. Buffa, apparently following Froggatt in regarding Haliday's three species as one, making *Idolothrips spectrum* the type of that genus, has erected for most of the species that were previously referred to the genus *Idolothrips*, a new genus, *Elaphrothrips.* As stated, Froggatt does not, in my opinion, give sufficient data in support of his views, and in these circumstances we must sink Buffa's genus *Elaphrothrips* as a synonym of *Idolothrips*, and retain the genus *Acanthinothrips*, Bagnall, for Haliday's *I. spectrum.* To do otherwise would, I consider, cause unnecessary confusion.

Idolothrips angustatus, sp. nov. (Pl. **51.** fig. 11 ; Pl. **52.** fig. 11.)

♂. Length about 4·65 mm., breadth of mesothorax 0·55 mm.

General colour brown ; tarsi yellowish brown ; antennal joints 3 and 4 yellow, shaded with brown at apices, and basal half of sixth joint also yellow.

Head long, cylindrical ; more than two and one-half times as long as broad at basal third, and a little more than twice the length of the prothorax. Cheeks set with a few short stout spines, a lateral spine behind each eye being longer than the others ; head only very slightly broadened towards basal third ; vertex produced into a conical hump in front of eyes, reaching to the insertion of antennæ. Eyes moderately large, finely facetted, and distinctly bulging ; post-ocular spines absent ; ante-ocular spines exceptionally long, overreaching the apex of the second antennal joint. Ocelli large, placed as in *I. longiceps*. Antennæ narrowly separated at base, about one-half as long again as the head ; first joint cylindrical ; second longer than first and slightly constricted at base ; third to fifth claviform, and sixth to eighth fusiform. Third joint nearly three times the length of the second ; fourth three-quarters of third ; fifth five-sixths of fourth ; sixth three-quarters of fifth; and seventh about three-quarters of preceding and half as long again as the apical joint. The three apical joints are covered with numerous short sense-hairs. Sense-cones moderately long, acute, and apparently only one on the sixth joint. Mouth-cone rounded, scarcely reaching more than one-third way across prosternum.

Prothorax one and three-eighths as broad (excluding fore-coxæ) as long, widened gradually from anterior margin to middle, the sides being gently arcuate, and as wide across base as through middle. Spine at each hind-angle and the inner posterior marginal pair moderately long and stout ; mid-lateral and anterior marginal spines obsolete, and spine at each fore-angle very short, but stout. Fore-coxa projecting considerably, armed with one long, conspicuous spine, and two or three short ones behind. Fore-femur moderately broad, broadest at basal third, where it is two-fifths as broad as long ; armed with several short spines, five or six longer and stouter ones on the outer margin of basal third, and two or three long ones near middle. Fore-tibia and tarsus together equal the length of femur ; tibia rather broad, and the tarsus long, and armed with a moderately long and stout tooth near base. Intermediate and posterior legs long ; a few long and strong spines on femora, and short ones at tip of each tibia, protecting the tarsus. Pterothorax slightly wider than the width across the fore-coxæ, almost square ; sides of metathorax gently arcuate, and narrowing to base of abdomen. A pair of rather long bristles at the outer edge of each of the meso-metathoracic stigmata, and a longer one on each lateral margin of the metathorax. Wings reaching to the fifth abdominal segment, and no segments furnished with wing-retaining spines beyond the fifth one ; wings rather lightly fringed, and median vein extending for more than half the length.

Abdomen long and very slender, gradually narrowing from the base to tube ; slightly more than two-thirds the total length of insect. Tube about three-fifths the length of the preceding segment and two-thirds the length of head; three times as broad at base as at apex, and evenly narrowing from base to tip. Terminal hairs not quite the length of tube; those on the ninth segment long and stout, being longer than the tube, and the other abdominal bristles rather short and weak.

Habitat. One male, Los Trincheras, Venezuela, December 11th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

I. angustatus most closely approaches *I. longiceps*, Bagnall, and may be separated by the colour, the shorter head, the absence of post-ocular spines, the very short spine at each anterior prothoracic angle, the strongly projecting fore-coxæ, the fewer and decidedly less strong spines on the fore-femora, the longer and even more slender body, and by the shorter and stouter tube.

IDOLOTHRIPS LONGICEPS, *Bagnall.*

Idolothrips longiceps, Bagnall, Trans. Nat. Hist. Soc. of Northumberland, Durham, and Newcastle-on-Tyne, n. s. iii. p. 211, pl. 7. fig. 10 (1908).

Elaphrothrips longiceps, Buffa, 'Redia,' v. fasc. 2, p. 164 (1909).

Buffa records this species from Mexico, and there is a second specimen in the Godman and Salvin collection from Chontales, Nicaragua.

Genus LIOTHRIPS, *Uzel.*

LIOTHRIPS ELONGATUS, sp. nov. (Pl. **53**. figs. 1–3.)

♀. Length 3·3 mm., breadth of mesothorax at base 0·5 mm.

Colour black, tips of tibiæ and all tarsi brownish; antennæ with the third joint clear yellow.

Head with the anterior margin slightly rounded, narrowed anteriorly, narrowest at base and widest across eyes; twice as long as the prothorax and slightly more than twice as long as wide at base. Cheeks straight, set with a few minute and inconspicuous setæ. Eyes large and rather finely facetted; space between them equal to the width of one of them; post-ocular spines long, longer than the length of eye. Ocelli large; posterior pair set above a line through centre of eyes and close to their margins, anterior one set on the extreme vertex; ante-ocular spines long (two-thirds the length of eye) and stout. Antennæ separated at base, inserted under the vertex and one and one-half times the length of head; first joint cylindrical, second elongate and constricted at base, 3 to 5 claviform, and 6 to 8 fusiform; relative lengths of joints practically the same as in *D. armatus*.

Prothorax not twice as wide at base (excluding the fore-coxæ) as long, widened from anterior margin for one-half the length, and from thence parallel to base. Spines at posterior angles very long, inner posterior-marginal pair short, and the mid-lateral and the anterior-marginal pairs apparently obsolete. Chief spine on fore-coxa short and inconspicuous. Fore-femur not strongly thickened, three times as long as the breadth through the centre, where it is widest; tibia very slightly longer than the femur; tarsus unarmed. Intermediate and hind-legs long and slender, with coxæ projecting. Pterothorax wider than the prothorax and broadest at the juncture of the meso- and metathorax, sides of the metathorax gently arcuate and narrowing to base of abdomen. Wings reaching to the fifth abdominal segment.

Abdomen narrower than the pterothorax, sides parallel to the fifth segment and from thence very gradually narrowed to tube. Segments not strongly transverse, each being long and very slightly wider than the length, with the exception of the eighth segment, which is slightly longer than broad. Tube very short, only slightly longer than the preceding segment and two-fifths the length of the head; twice as broad at base as at apex and evenly narrowed from base to tip. Terminal hairs about the length of tube, weak. Abdominal hairs long, those at the hind margin of the ninth segment being nearly twice the length of the tube.

Habitat. One female, Los Adjuntas, Venezuela, September 10th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

L. elongatus may be easily recognized by the form of the body-segments, the long head, and the short and broad tube.

LIOTHRIPS SIMILIS, sp. nov. (Pl. **53**. figs. 4–7.)

♀. Length 3·5 mm., breadth of mesothorax 0·55 mm.

Colour dark chestnut-brown, almost black, all tarsi brownish; antennæ dark brown, second joint lighter and third joint clear yellow; tip of tube shaded to brown.

Head one and three-quarters times as long as broad behind eyes and as the length of prothorax, slightly widened anteriorly, and vertex broadly produced in the form of a depressed hump; cheeks set with a few minute and inconspicuous setæ, roundly and rather sharply constricted at base. Eyes small and moderately finely facetted, less than one-quarter the length of head. Post-ocular spines long and ante-ocular spines apparently obsolete. Ocelli rather large and the posterior pair on a line drawn through the anterior third of eyes. Antennæ inserted under vertex, approximate at base, and more than half as long again as the head; third and fourth joints mildly claviform, fifth to eighth fusiform; third joint three times the length of second; fourth five-sixths of third; fifth, sixth, and seventh four-fifths of the fourth, fifth, and sixth respectively; penultimate joint somewhat broadened, and the apical one rounded at tip. Sense-cones slender, and the two apical joints furnished with numerous sense-hairs. Mouth-cone nearly reaching to base of prosternum; maxillary palpi long and rather stout.

Prothorax five-eighths the length of head; spines at posterior angles longest; posterior-marginal pair shorter, and those at the anterior angles and the mid-lateral and anterior-marginal pairs shorter again, but moderately stout. Fore-coxa with one somewhat conspicuous spine. Fore-femur two and one-quarter times as long as broad, without any conspicuous spines and furnished with a long hair near base within; tibia slightly longer than the femur; tarsus unarmed. Intermediate and hind-legs long and slender, with a short spine at tip within, with a moderately long hair at tip on the outer side of each tibia. Pterothorax a little broader than the width across fore-coxæ; mesothorax wider than the metathorax and with the sides parallel. Wings reaching to the seventh abdominal segment.

Abdomen about as wide as the mesothorax, sides parallel to the seventh segment; eighth segment broadest at fore-part and gently narrowed to hind-margin, and ninth segment narrowed to base of tube. Tube three times as long as the breadth at base, twice the length of the preceding segment and about three-quarters the length of the head. Terminal hairs not quite so long as tube, weak. Abdominal bristles long, those of the ninth segment being longer than tube.

Habitat. One female, Los Adjuntas, Venezuela, September 10th, 1891; and one female, Dos Caminos, June 14th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

The long tube and the apparent absence of the ante-ocular bristles readily distinguish this form.

LIOTHRIPS INTERMEDIUS, sp. nov. (Pl. **53**. figs. 8–11.)

♀. Length 3·5 mm., breadth of mesothorax 0·55 mm.

This species closely resembles both *L. elongatus* and *L. similis*. Like *L. elongatus* it possesses a very short tube, which is only one-half as broad at base as long and a little more than two-fifths the length of the head. The insect is broader, however, than *elongatus*; the antennæ are shorter as compared with the length of the head; the fore-legs are stouter and slightly shorter, and the femur furnished with a few rather conspicuous bristles on the outer edge; the abdomen is broader than the prothorax, whilst the eighth abdominal segment is decidedly shorter than the seventh and not longer as in *elongatus*.

It perhaps resembles *similis* more closely than *elongatus*; the head in *similis*, however, is slightly more slender and the rest of the body comparatively broader. *L. intermedius* possesses prominent ante-ocular bristles, also bristles on the outer edge of the fore-femur, and a pair of dorsal bristles on the seventh abdominal segment which we cannot distinguish in *similis*; whilst the tube in the last-named insect is more slender and half as long again as in *intermedius*, being three times as long as the breadth at base and three-quarters the length of head.

Habitat. Two females, Los Adjuntas, Venezuela, September 10th, 1891 (*Meinert*).

Type. In the Copenhagen Museum.

Genus Diceratothrips, *Bagnall*, 1908.

Diceratothrips armatus, sp. nov. (Pl. **53**. figs. 12–16.)

♀. Length 5·0 mm., width of mesothorax 0·65 mm.

Colour brownish black.

Head nearly one-half as long again as the width at base and about one-third longer than the prothorax; widened anteriorly, being widest behind eyes. Frons truncate; cheeks set with a few moderately stout spines. Eyes small and moderately finely facetted; post-ocular spines long. Ocelli large, posterior pair set on a line with the centre of eyes and close to their margins, and the anterior ocellus set in centre of forehead and protected by a pair of forwardly-directed spines, which are rather long and set close to the margins of eyes in front. Antennæ separated at base, inserted under vertex, and about twice the length of the head; first joint cylindrical, concealed at base; second elongate and slightly constricted at basal joints; 3 to 5 claviform and 6 to 8 fusiform. Third joint three times the length of the second; fourth two-thirds of third; fifth, sixth, and seventh four-fifths of the fourth, fifth, and sixth respectively; and the apical joint five-eighths the length of the penultimate. Sense-cones moderately long and acute, light-coloured, and a series of sense-hairs from tip to base of apical joint and continued down the apical third of the penultimate joint. Mouth-cone long and somewhat sharp, almost reaching to the base of the prosternum.

Prothorax not quite twice as broad across fore-coxæ as long, smoothly widened from anterior margin to basal third. Spines at each hind-angle very long; posterior-marginal spines short but stout; anterior-marginal pair and those at each anterior angle short and set well back, and the mid-lateral pair apparently absent. Pterothorax almost square, widest before the juncture of the meta- and mesothorax. Fore-coxa with one conspicuous spine; fore-femur twice as long as broad, set with a few strong, short spines near the base without and about the middle within, and two long bristles on the outer margin, one on the mid-line and the other before apex. Fore-tibia rather long and stout and the tarsus armed with a small tooth. Intermediate and posterior femora armed with several short but strong spines, and tibiæ set with similar spines at apices and with one or two long hairs. Wings long and broad, smoky yellow.

Abdomen almost as broad as the pterothorax, gradually narrowed to tube from the sixth segment. Tube about one-eighth longer than head, tapering gradually, and only twice as broad at base as at apex; terminal hairs weak and less than one-half the length of tube. Bristles at apex of ninth segment longer than tube; extreme lateral pair on eighth segment as long again as the inner ones, and two pairs on seventh segment and a single pair on segments 5 and 6 very long.

♂. The male has the fore-femur strongly incrassate and swollen, whilst the strong spines about the middle within take the form of strong tooth-like protuberances; the fore-tibia has the short spines on the inner edge stronger and set in warts, whilst the fore-tarsal tooth is very long and acute. The body is also more slender than in the female.

Habitat. Six specimens (two males and four females) and larvæ collected by Dr. Meinert at La Moka, Venezuela, March 1891.

Types. In the Copenhagen Museum.

D. armatus may be easily recognised by its size and by the strongly characterised fore-legs in both sexes.

Penshaw Lodge, Penshaw,
December 1st, 1909.

EXPLANATION OF THE PLATES.

Plate 51.

Fig. 1. *Dicaiothrips foveicollis* (Bagnall), ♂. Head, prothorax, and right antenna and fore-leg. × 14.
2. " " " ♀. Part of head, prothorax, and right fore-leg. × 14.
3. " *Championi*, sp. nov., ♂. Head, prothorax, and right fore-leg. × 14.
4. " *grandis*, sp. nov., ♂. Do. do. do. × 14.
5. " *lævicollis*, sp. nov., ♂. Head, prothorax, and right antenna and fore-leg. × 14.
6. " " ♀. Part of head, prothorax, and right fore-leg. × 14.
7. " *propinquus*, sp. nov., ♂. Head, prothorax, and right antenna and fore-leg. × 14.
8. " *distinctus*, sp. nov., ♂. Head, prothorax, and right fore-leg. × 14.
9. " *brevicornis*, sp. nov., ♀. Head, prothorax, and right antenna and fore-leg. × 14.
10. " *nitidus*, sp. nov., ♂. Head, prothorax, and right fore-leg. × 14.
11. *Idolothrips angustatus*, sp. nov., ♂. Head, prothorax, and right antenna and fore-leg. × 14.
12. " *longiceps*, Bagnall, ♂. Do. do. do. × 14.

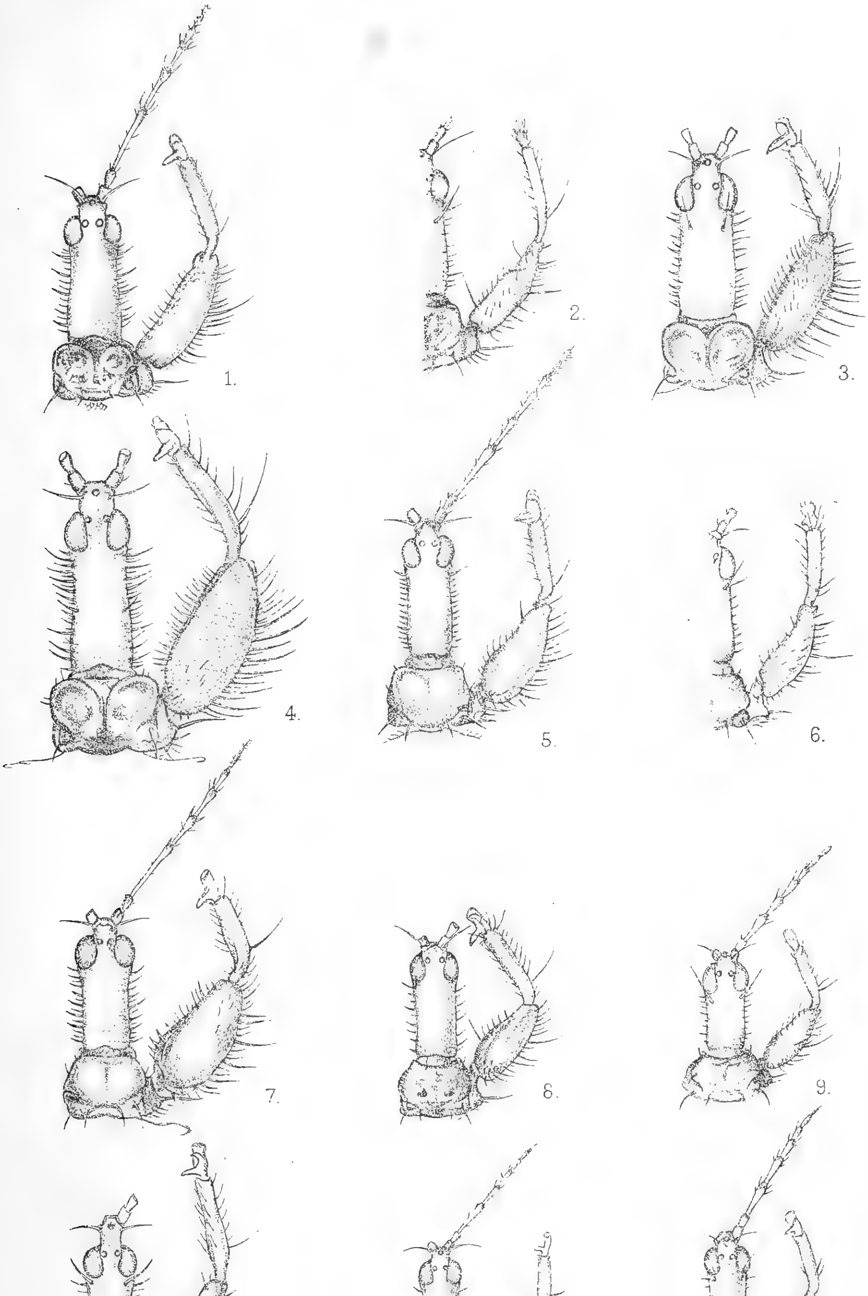
Plate 52.

Fig. 1. *Dicaiothrips foveicollis* (Bagnall), ♂. End of abdomen. × 14.
2. " " " ♀. Do. do. × 14.

Fig. 3. *Dicaiothrips Championi*, sp. nov., ♂. End of abdomen. × 14.
4. „ *grandis*, sp. nov., ♂. Do. do. × 14.
5. „ *lævicollis*, sp. nov., ♀. Do. do. × 14.
5 *a*. „ „ ♂. Ventral view of ninth abdominal segment: *t*, tergite; *s*, sternite; *x*, *y*, basal plate and bladder in the male organ. × 28.
5 *b*. „ „ ♂. Do. do. do. × 60.
6. „ „ ♀. End of abdomen. × 14.
7. „ *nitidus*, sp. nov., ♂. Do. do. × 14.
8. „ *brevicornis*, sp. nov., ♀. Do. do. × 14.
9. „ *propinquus*, sp. nov., ♂. Do. do. × 14.
10. „ *distinctus*, sp. nov., ♂. Do. do. × 14.
11. *Idolothrips angustatus*, sp. nov., ♂. Do. do. × 38.
12. „ *longiceps*, Bagnall, ♂. Do. do. × 38.

PLATE 53.

Fig. 1. *Liothrips elongatus*, sp. nov., ♀. Head, prothorax, and right antenna and fore-leg. × 38.
2. „ „ End of abdomen. × 38.
3. „ „ Posterior leg. × 19.
4. „ *similis*, sp. nov., ♀. Head, prothorax, and right antenna and fore-leg. × 38.
5. „ „ End of abdomen. × 38.
6. „ „ Posterior leg. × 19.
7. „ „ Intermediate tarsus. × 60.
8. „ *intermedius*, sp. nov., ♀. Head, prothorax, and right antenna and fore-leg. × 38.
9. „ „ End of abdomen. × 38.
10. „ „ Posterior leg. × 19.
11. „ „ Maxillary palpus. × 60.
12. *Diceratothrips armatus*, sp. nov., ♀. Head, prothorax, and right antenna and fore-leg. × 38.
13. „ „ End of abdomen. × 38.
14. „ „ ♂. Fore-femur, tibia, and tarsus. × 19.
15. „ „ Posterior leg. × 19.
16. „ „ Portion of left upper wing near base. × 120.



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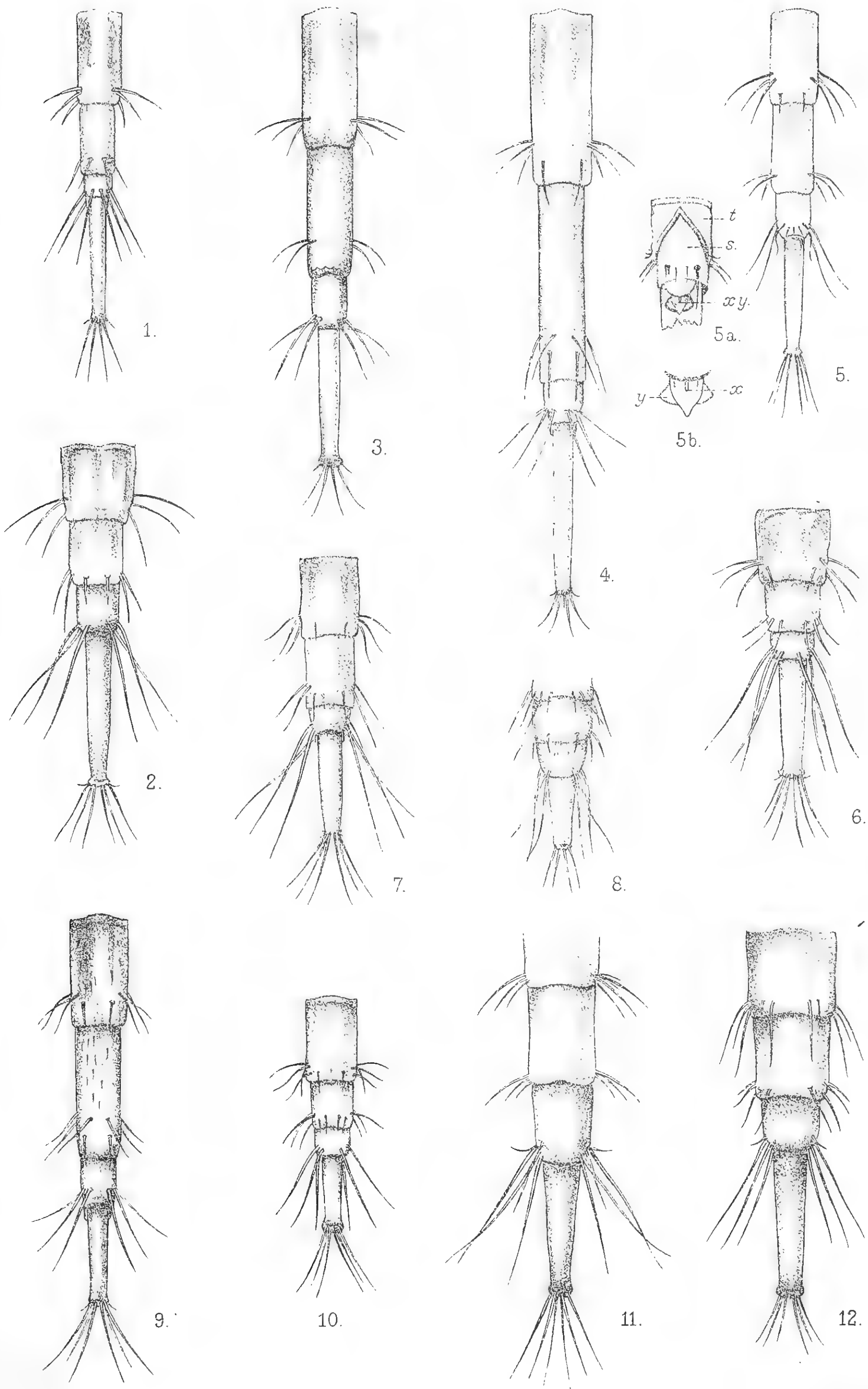
West, Newman lith.

NEOTROPICAL THYSANOPTERA.



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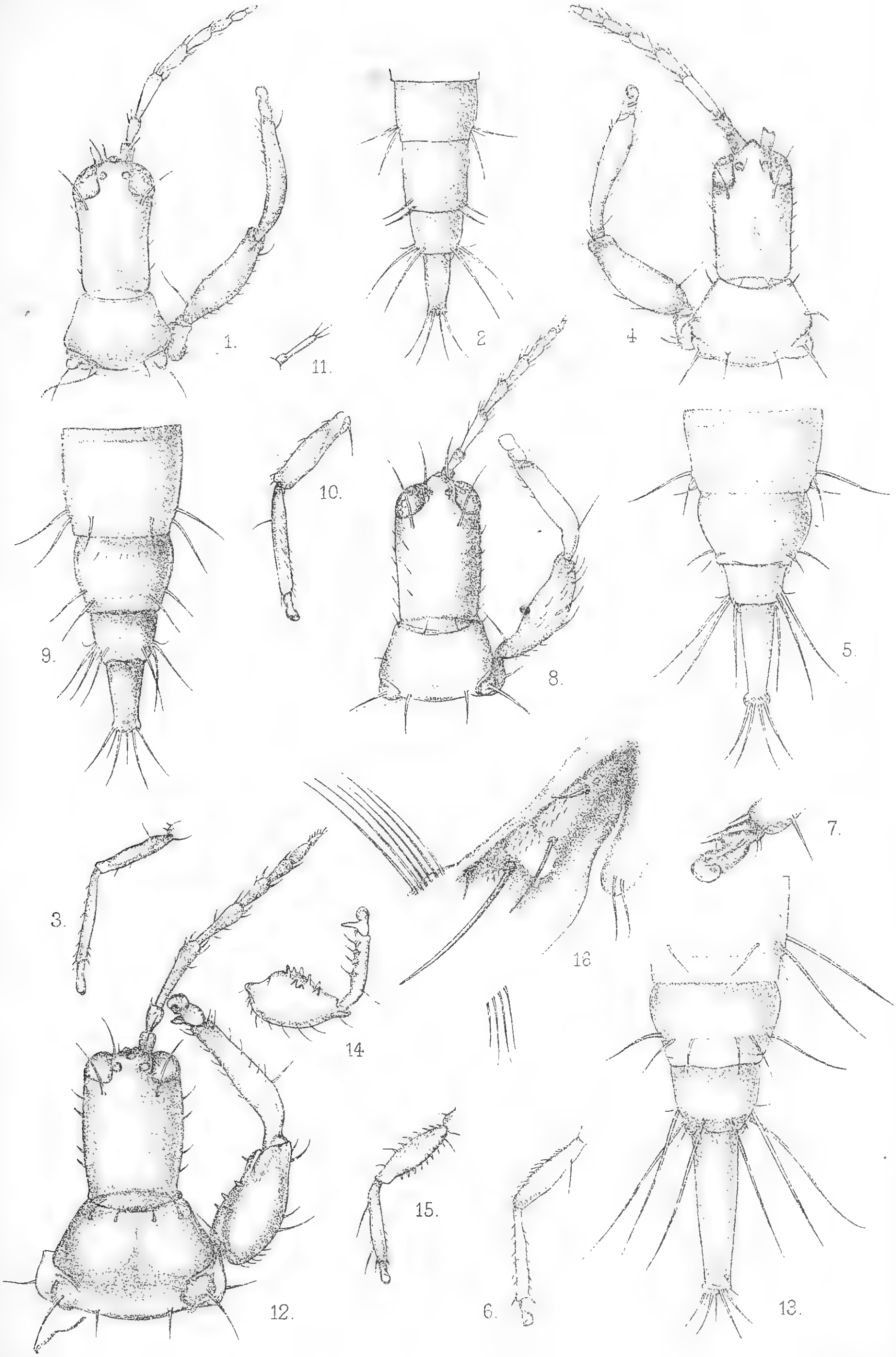
NEOTROPICAL THYSANOPTERA.



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NEOTROPICAL THYSANOPTERA.

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Vol. **30**. Nos. 195–200 have been already published. No. 201 is the present number.

No. 202 is reserved for the completion of this volume.

Vol. **31**. Nos. 203–207.

This volume is reserved for reports on collections from the Sudanese Red Sea.

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Fig. 3. *Dicaiothrips Championi*, sp. nov., ♂. End of abdomen. × 14.
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Plate 53.

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On the Foraminifera and Ostracoda from Soundings (chiefly Deep-water) collected round Funafuti by H.M.S. 'Penguin.'

By FREDERICK CHAPMAN, A.L.S., F.R.M.S., of the National Museum, Melbourne.

(PLATES 54–57.)

[Read 7th April, 1910.]

Introduction.—The following Report deals with the Microzoa obtained from the deep-sea soundings collected round Funafuti in 1896 by H.M.S. 'Penguin,' Captain A. M. Field, R.N., commanding.

I have previously published four reports on the Foraminifera and Ostracoda of the various dredgings made by the Funafuti Expeditions between 1896 and 1898 *; and the present report is practically final as regards the recent material. For the privilege of examining the present very interesting series of soundings I am indebted to Prof. J. W. Judd, C.B., LL.D., F.R.S., and the Coral Reef Committee of the Royal Society. The samples were sent on to Melbourne, and reached me in January 1904.

Condition of Material.—The collection of soundings made by H.M.S. 'Penguin' consists of 23 samples of dry Globigerina ooze and shell or "coral sands," and 37 samples of soundings in grease, taken by the sounding-lead. The former, and a few of the latter, were contained in glass bottles and tubes, whilst the remainder of the samples in tallow were in paper envelopes. After spending some time in cleaning the tallow samples, which, by the way, were of an especially refractory nature, and examining them microscopically, it was seen that the result did not justify the trouble, since the cleaned material often yielded only a few specimens of the commonest and most ubiquitous types of Foraminifera, chiefly of pelagic forms. The present work is therefore mainly based on the results from the dry soundings, although some of the more interesting of the tallow samples are included.

Two of the dried soundings in this collection, viz. Nos. 3 and 19, were partially examined by me when working in the Geological Laboratory at the Royal College of Science, London; and the results of a search for the Ostracoda were embodied in my paper published in 1902, entitled "Some Ostracoda from Funafuti." Those samples were then only partially worked over and none of the Foraminifera noted, so that they have now been examined more exhaustively, and the entire results herein included.

* Chapman, F. ('00, '01, '02[1], '02[2]).

General Details of Soundings by H.M.S. 'Penguin' round Funafuti.

Station 2.—May 20th, 1896. Latitude 11° 5′ 0″ S., longitude 178° 40′ 0″ E. Depth, 1489 fathoms. Globigerina Ooze. Dry, of a pale fawn-colour; wet, pale reddish brown; somewhat incoherent. A few valves of Ostracoda present, belonging to the genera *Argillœcia*, *Bairdia*, and *Krithe*. Also some Radiolaria of the following genera:—*Rhopalastrum* and *Hymeniastrum*. With the exception of a solitary specimen of *Biloculina depressa*, a *Textularia*, and a few hyaline forms, the bulk of this sample is composed of pelagic Foraminifera, chiefly of the following species:—*Globigerina conglobata*, *G. sacculifera*, *G. rubra*, *Pullenia obliquiloculata*, and *Pulvinulina menardii*.

Station 3.—May 21st, 1896. Lat. 10° 12′ 53″ S., long. 178° 52′ 0″ E. Depth, 2715 fathoms. Globigerina Ooze. Dry, pale fawn; wet, slightly darker; incoherent. Ostracoda rare; the genera are represented by *Argillœcia*, *Cythere*, *Krithe*, and *Xestoleberis*. Also some Radiolaria of the following genera:—*Cenosphæra*, *Rhopalastrum*, *Hymeniastrum*, and Echinoid spines.

The foraminiferal fauna is exceptionally rich in species. Of the porcellanous forms the deep-water species *Biloculina depressa* and its variety *murrhyna*, and also *Miliolina venusta*, are conspicuous. The textularids are fairly well represented, and the rare *Ehrenbergina hystrix* occurs here. The family Lagenidæ is represented by twelve species of the type-genus *Lagena*; whilst the subfamily Polymorphininæ appears in the genera *Polymorphina* and *Uvigerina*. Besides a few rotaline forms, the bulk of the material is composed of pelagic Foraminifera, as *Orbulina universa*, *Globigerina conglobata*, *G. æquilateralis*, *Pullenia obliquiloculata*, and *Pulvinulina menardii*.

Station 4.—May 21st, 1896. Lat. 8° 52′ 0″ S., long. 179° 11′ 30″ E. Depth, 2728 fathoms. Globigerina Ooze. Dry, pale yellowish brown; wet, reddish brown; a sticky calcareous mud. No Ostracoda were noted in this sample. Radiolaria (*Hymeniastrum*) and Alcyonarian spicules occur. Echinoid spines are fairly numerous, also Fish-teeth. Foraminifera other than pelagic not common, the most interesting being the curious deep-water species *Pulvinulina favus*. The most abundant species are *Globigerina bulloides*, *G. dutertrei*, *G. triloba*, *G. subcretacea*, *Pullenia obliquiloculata*, *Truncatulina pygmæa*, *Pulvinulina tumida*, and *P. exigua*.

Station 10.—June 25th, 1896. Lat. 15° 31′ 6″ S., long. 177° 31′ 2″ E. Depth, 1485 fathoms. Globigerina Ooze. Dry, pale fawn; wet, pale reddish brown; coherent. Ostracoda frequent, generically represented by *Pontocypris*, *Bairdia*, *Cythere* (with a new sp., *C. sweeti*), and *Krithe*. Radiolaria (*Rhopalastrum*) also occur. Of the Foraminifera, besides the pelagic forms, the commonest genera are *Lagena* and *Truncatulina*. The pelagic Foraminifera are chiefly represented by *Orbulina universa*, *Globigerina conglobata*, *G. triloba*, *G. sacculifera*, *Pullenia obliquiloculata*, *Pulvinulina menardii*, *P. tumida*, *P. crassa*, *P. canariensis*, and *P. patagonica*.

Station 11.—July 2nd, 1896. Lat. 16° 20′ 0″ S., long. 176° 50′ 5″ E. Depth, 1417 fathoms. Globigerina Ooze. Dry, pale fawn; wet, pale reddish brown; coherent. Ostracoda are moderately common, represented by *Argillœcia*, (?) *Bythocypris* (with a new sp. *heterodoxa*), *Bairdia*, *Cythere* (with a new sp. *sweeti*), *Krithe*, *Cytherura* (with a new sp. *tenuicosta*), and *Cytheropteron*. Radiolaria of the genus *Rhopalastrum*. Teeth and otoliths of Fishes.

Of the Foraminifera the families Miliolidæ, Astrorhizidæ, Textulariidæ, Lagenidæ, Rotaliidæ, and Nummulinidæ are sparingly represented. The rare *Rotalia broeckhiana* occurs here. The pelagic Foraminifera form the bulk of the material, the chief of which are *Orbulina universa*, *Globigerina subcretacea*, *G. sacculifera*, *G. æquilateralis*, *G. conglobata*, *Pullenia obliquiloculata*, *Sphæroidina dehiscens*, *Candeina nitida*, *Pulvinulina patagonica*, and *P. truncatulinoides*.

In this sample a piece of pumice of whitish appearance, measuring about 3 × 2 cm., occurred.

Station 13.—July 2nd, 1896. Lat. 15° 39′ 5″ S., long. 177° 3′ 0″ E. Depth, 1050 fathoms. Globigerina Ooze. Dry, pale fawn; wet, pale reddish brown; incoherent. Ostracoda numerous; the following genera occur:—*Aglaia*, *Pontocypris* (with a new sp. *davidiana*), *Argillœcia* (with a new sp. *gracilior*), *Bythocypris* (and the new spp. *sollasi* and *heterodoxa*), *Bairdia*, *Cythere* (and the new sp. *sweeti*), *Krithe*, *Loxoconcha*, *Xestoleberis*, *Cytheropteron* (and a new var. *C. assimile* var. *funafutiensis*), *Bythocythere* (and the new sp. *retiolata*), and *Pseudocythere* (with the new sp. *funafutiensis*). Hexactinellid Sponge-spicules, Echinoid spines, Pteropods (*Styliola*), and Fish-otoliths.

This sample is very rich in Foraminifera, miliolid and rotaline forms being especially well represented. The abundant pelagic fauna is chiefly composed of *Orbulina universa*, *Globigerina rubra*, *G. bulloides*, *G. sacculifera*, *G. conglobata*, *G. triloba*, *Sphæroidina dehiscens*, *Pullenia obliquiloculata*, and *Pulvinulina menardii*. A noteworthy species occurring in this sample is the beautifully ornate *Lagena juddiana*.

Station 19.—July 4th, 1896. Lat. 15° 26′ 2″ S., long. 177° 17′ 0″ E. Depth, 1995 fathoms. Globigerina Ooze. Dry, pale fawn; wet, reddish brown; coherent. Ostracoda rare, only the usual deep-water form *Krithe tumida* occurring here.

The Foraminifera are not numerous as regards species, but the non-pelagic forms are of especial interest, and include *Rhizammina algæformis*, *Haplophragmium canariense*, *H. latidorsatum*, and *Ammodiscus gordialis*. The chief pelagic species are *Globigerina conglobata*, *G. æquilateralis*, *G. sacculifera*, *G. rubra*, *Sphæroidina dehiscens*, *Pullenia obliquiloculata*, *Pulvinulina menardii*, *P. haueri*, and *P. crassa*.

Station 20.—July 4th, 1896. Lat. 13° 22′ 0″ S., long. 178° 8′ 5″ E. Depth, 1215 fathoms. Globigerina Ooze. Dry, whitish or cream-colour; wet, pale yellowish brown; coherent. An abundant Ostracodal fauna; genera present:—*Aglaia*, *Pontocypris*, *Argillœcia* (with the new sp. *gracilior*), *Bythocypris* (with the new sp. *heterodoxa*), *Bairdia*, *Cythere* (with the new sp. *sweeti* and the new var. *C. curvicostata* var. *funafutiensis*), *Krithe*, *Loxoconcha*, *Cytherura* (with new sp. *tenuicosta*), *Bythocythere* (with new sp. *tuberculata*), and *Pseudocythere*.

The Foraminifera are represented by a fair number of deep-water miliolids, 8 spp. of *Lagena*, and other interesting forms, as *Reophax adunca* and *Bulimina subteres*. The pelagic Foraminifera form the greater bulk of the material, chief among which are *Orbulina universa*, *Globigerina conglobata*, *G. sacculifera*, *G. subcretacea*, *G. æquilateralis*, *G. digitata*, *G. bulloides*, *G. rubra*, and *Pulvinulina menardii*.

Station 21.—July 4th, 1896. Lat. 12° 41′ 5″ S., long. 178° 19′ 2″ E. Depth, 2195 fathoms. Globigerina Ooze. Dry, pale pinkish yellow; wet, reddish brown; coherent. Ostracoda not common; referable to *Cythere* and *Krithe*. Also small Fish-teeth.

Pelagic Foraminifera comprise *Orbulina universa*, *Globigerina conglobata*, *G. sacculifera*, *G. rubra*, *G. bulloides*, *G. subcretacea*, *Sphæroidina dehiscens*, *Pullenia obliquiloculata*, *Pulvinulina menardii*, *P. tumida*, and *P. patagonica*. Of especial interest are *Hyperammina ramosa* and *H. elongata*, *Polymorphina longicollis* and *Rotalia broeckhiana*.

Station 23.—July 5th, 1896. Lat. 11° 39′ 5″ S., long. 178° 38′ 0″ E. Depth, 735 fathoms. Globigerina Ooze (sample in tallow). Only Foraminifera noticed. The genera *Sigmoïlina*, *Cassidulina*, *Truncatulina*, and *Amphistegina* are present, together with the commoner pelagic forms of *Globigerina* and *Pulvinulina*.

Station 24.—July 13th, 1896. Lat. 8° 35′ 6″ S., long. 179° 9′ 5″ E. Depth, 987 fathoms. "Coral Sand" (sample in tallow). Foraminifera of two genera only, viz. *Globigerina* and *Amphistegina*. Other organisms present are Echinoid spines and Alcyonarian spicules.

Station 28.—July 13th, 1896. Lat. 8° 42′ 3″ S., long. 179° 7′ 6″ E. Depth, 1505 fathoms. Globigerina Ooze (sample in tallow). Genera present: *Globigerina*, *Sphæroidina*, *Pulvinulina*, and *Amphistegina*.

Station 29.—July 14th, 1896. Lat. 8° 35′ 7″ S., long. 179° 7′ 8″ E. Depth, 475 fathoms. "Coral Sand" (sample in tallow). Foraminifera represented by *Spirillina obconica*, *Pulvinulina*, and *Amphistegina*. Alcyonarian spicules abundant.

Station 31.—July 14th, 1896. Lat. 8° 37′ 9″ S., long. 179° 9′ 3″ E. Depth, 1158 fathoms. Volcanic Sand with Foraminifera. The latter chiefly comprise the pelagic genus *Globigerina*; *Amphistegina* is also present.

Station 45.—July 15th, 1896. Lat. 8° 39′ 0″ S., long. 179° 16′ 6″ E. Depth, 2107 fathoms. Globigerina Ooze. Dry, white, almost chalky in appearance; wet, pale yellowish brown; coherent. Ostracoda very rare, the genera *Cythere* and *Krithe* present. Other organic remains are fragments of the mesh of Siliceous Sponges and Echinoid spines. The usual pelagic Foraminifera are abundant: chiefly *Globigerina conglobata*, *G. sacculifera*, *G. æquilateralis*, *G. subcretacea*, *Pullenia obliquiloculata*, *Pulvinulina menardii*, and *P. tumida*. Other noteworthy species are *Lagena alveolata*, *Bulimina buchiana*, *Cassidulina parkeriana*, *Ehrenbergina serrata*, and *Truncatulina culter*.

Station 48.—July 16th, 1896. Lat. 8° 35′ 5″ S., long. 179° 17′ 5″ E. Depth, 2298 fathoms. Globigerina Ooze. Dry, whitish or chalky; wet, pale yellowish brown; incoherent. Ostracoda very rare, represented by only one genus, *Krithe*. This sample is very rich in species of the Foraminifera, the more interesting being *Spiroloculina tenuis*, *Sigmoïlina schlumbergeri*, *Tritaxia lepida*, *Bulimina rostrata*, *Bolivina reticulata*, *Virgulina texturata*, *Ehrenbergina serrata*, *Lagena formosa*, *L. quadrata*, *L. quinquelatera*, *L. staphyllearia*, *L. spumosa*, *Rhabdogonium minutum*, *Polymorphina seguenzana*, and *Patellina corrugata*. The most abundant species are *Globigerina sacculifera*, *G. digitata*, *Sphæroidina dehiscens*, *Pullenia obliquiloculata*, *Truncatulina pygmæa*, *Pulvinulina menardii*, and *P. truncatulinoides*.

Station 55.—July 16th, 1896. Lat. 8° 29′ 37″ S., long. 179° 13′ 0″ E. Depth, 507 fathoms. "Coral Sand." The remains of *Halimeda* are abundant. Other organisms are Corals, Pelecypods, Gasteropods, and Ostracodes, the latter comprising 3 spp. of *Bairdia*. The Foraminifera form a small but interesting series, showing an admixture of pelagic with bottom-living moderately shallow-water species, amongst which latter kind may be noticed: *Miliolina alveoliniformis*, *Spirillina decorata* var. *unilatera*, *Tinoporus baculatus*, *Polytrema miniaceum*, *Heterostegina depressa*, *Cycloclypeus carpenteri*, and *Amphistegina lessoni*.

Station 60.—July 10th, 1896. Lat. 8° 25′ 0″ S., long. 179° 5′ 0″ E. Depth, 451 fathoms. "Coral Sand." This material consists largely of coral rock and débris, with *Halimeda*, Corals, Pteropods (*Styliola*), and Bivalves (*Arca*). The Foraminifera are very rare, there being only two genera present, *Pulvinulina* and *Amphistegina*.

Station 68.—July 7th, 1896. Lat. 8° 22′ 0″ S., long. 179° 56′ 2″ E. Depth, 1143 fathoms. Foraminiferal Sand. Ostracoda not common, represented by *Krithe* and *Loxoconcha*. The Foraminifera are mainly pelagic, as *Globigerina*, *Pullenia*, *Candeina*, and *Pulvinulina*.

Station 78.—July 20th, 1896. Lat. 8° 21′ 0″ S., long. 179° 2′ 0″ E. Depth, 1570 fathoms. "Coral Sand." This sample contains a curious admixture of comparatively shallow-water Foraminifera with a good series of pelagic forms. There is strong reason for supposing that we have here an accidental meeting of two samples, one of quite shallow-water habitat, the other normally deep, since *Tinoporus baculatus* and *Orbitolites complanata* are limited to soundings of 155 and 450 fathoms respectively, but usually occur at much less depths.

Station 83.—July 21st, 1896. Lat. 8° 29′ 5″ S., long. 179° 14′ 9″ E. Depth, 1340 fathoms. Globigerina Ooze. Foraminifera of the pelagic types, together with a few examples of *Sagraina raphanus* and *Amphistegina lessoni*. Coral fragments occur in this sample.

Station 84.—July 21st, 1896. Lat. 8° 29′ 4″ S., long. 179° 13′ 5″ E. Depth, 913 fathoms. ? Globigerina Ooze. A single example of *Globigerina conglobata* occurred in this material.

Station 86.—July 21st, 1896. Lat. 8° 31′ 8″ S., long. 179° 13′ 6″ E. Depth, 513 fathoms. Volcanic Sand with Foraminifera. Some pelagic Foraminifera, with *Amphistegina lessoni*.

Station 88.—July 21st, 1896. Lat. 8° 31′ 1″ S., long. 179° 13′ 6″ E. Depth, 731 fathoms. Volcanic Sand with Foraminifera. The latter are all pelagic forms. Pumice occurs in this sample.

Station 90.—July 15th, 1896. Lat. 8° 34′ 5″ S., long. 179° 57′ 20″ E. Depth, 590 fathoms. Halimeda Sand. Contains *Globigerina digitata* and *Sphæroidina dehiscens*. Abundant *Halimeda* fragments and remains of Echinoids.

Station 96.—July 22nd, 1896. Lat. 8° 26′ 0″ S., long. 179° 15′ 0″ E. Depth, 1245 fathoms. "Coral Sand" with volcanic particles and Foraminifera. The latter are rare; besides pelagic forms, *Bulimina contraria* and *Amphistegina lessoni* occur here. There are also present Alcyonarian spicules and fragments of Corals.

Station 105.—July 23rd, 1896. Lat. 8° 26′ 5″ S., long. 178° 55′ 4″ E. Depth, 2400 fathoms. Globigerina Ooze. Dry, pale and chalky; wet, cream-colour. Ostracoda rare, viz. *Cythere* and *Krithe*. This sample is rich in Foraminifera, and contains, besides the pelagic forms of *Orbulina*, *Globigerina*, *Candeina*, *Sphæroidina*, *Pullenia*, and *Pulvinulina*, the following noteworthy species among others :—*Haplophragmium latidorsatum*, *Cyclammina cancellata*, *Bulimina buchiana*, *Cassidulina calabra*, *Lagena alveolata*, *L. wrightiana*, *Nodosaria filiformis*, *Cristellaria gibba*, *Sagraina bifrons*, *Truncatulina dutemplei*, *Pulvinulina favus*, *Rotalia soldanii*, and *Polystomella crispa*.

Station 109.—July 23rd, 1896. Lat. 8° 30′ 9″ S., long. 179° 0′ 7″ E. Depth, 604 fathoms. Globigerina Ooze. Ostracoda rare, one genus only, viz. *Loxoconcha*. Also Echinoid spines and Pteropods (*Styliola*). Foraminifera chiefly pelagic. Among other species the following are worth noting :—*Verneuilina spinulosa*, *Anomalina ammonoides*, *Planorbulina mediterranensis*, and *Truncatulina akneriana*.

Station 138.—July 27th, 1896. Lat. 7° 20′ 0″ S., long. 177° 28′ 5″ E. Depth, 2688 fathoms. Globigerina Ooze. Dry, reddish brown ; wet, dark purple-brown ; coherent. This sample yielded only a small series of pelagic Foraminifera, in which *Globigerina* is conspicuously absent. Species present are *Cassidulina subglobosa*, *Pullenia quinqueloba*, *Truncatulina haidingeri*, *Nonionina umbilicatula*, and *N. pompilioides*. Other organic remains are fragments of the mesh of a hexactinellid Sponge and numerous small Fish-teeth. Amongst the inorganic particles are crystals of Phillipsite and an ovoid chondre of meteoritic origin, showing characteristic curved, radial, and plumose markings.

Station 140.—July 28th, 1896. Lat. 8° 16′ 0″ S., long. 178° 16′ 0″ E. Depth, 2476 fathoms. Globigerina Ooze. Dry, pale pinkish brown ; wet, dark brown ; coherent. The Foraminifera comprise a small but interesting series of pelagic and bottom-living forms, the latter including *Biloculina depressa* var. *murrhyna*, *Cassidulina subglobosa*, *Lagena lævis*, *L. marginata*, *L. fimbriata*, *Truncatulina pygmæa*, *T. ungeriana*, *T. haidingeri*, *Anomalina grosserugosa*, and *Nonionina depressula*. Other organic remains include Fish-teeth and some ovoid pellets either of Fishes or Echinoderms.

Station 141.—August 1st, 1896. Lat. 8° 55′ 30″ S., long. 179° 26′ 45″ E. Depth, 2741 fathoms. Globigerina Ooze. Dry, brown mottled with white particles ; incoherent. Alcyonarian spicules present. Foraminifera chiefly pelagic, and also the following :—*Hyperammina elongata*, *Cassidulina subglobosa*, *Nodosaria consobrina*, and *Amphistegina lessoni*.

Station 142.—August 1st, 1896. Lat. 9° 10′ 0″ S., long. 179° 48′ 5″ E. Depth, 2435 fathoms. Globigerina Ooze. Dry, pale creamy brown ; coherent. A small series of Foraminifera, including, besides pelagic forms, the following :—*Biloculina depressa* var. *murrhyna*, *Verneuilina pygmæa*, *Cassidulina subglobosa*, *Lagena globosa*, *Discorbina araucana*, and *Truncatulina ungeriana*.

Station 148.—August 5th, 1896. Lat. 9° 54′ 0″ S., long. 179° 28′ 0″ E. Depth, 2620 fathoms. Globigerina Ooze. Dry, pale cream-colour; wet, pinkish brown; coherent. Fish-teeth and otoliths. The Foraminifera are chiefly pelagic, and comprise five species of *Globigerina*, together with other forms, and a few bottom-living examples of the genera *Biloculina*, *Lagena*, *Truncatulina*, and *Nonionina*.

Station 149.—August 5th, 1896. Lat. 10° 24′ 0″ S., long. 179° 7′ 30″ E. Depth, 2250 fathoms. Globigerina Ooze. Dry, nearly white; wet, pale brown; coherent. Foraminifera chiefly pelagic. Other genera represented :—*Miliolina, Cassidulina, Truncatulina,* and *Nonionina*.

Station 150.—August 5th, 1896. Lat. 10° 37′ 0″ S., long. 179° 6′ 0″ E. Depth, 2438 fathoms. Globigerina Ooze. Dry, white with scattered brown particles; coherent. Fish-teeth; also Ostracoda (*Cythere*). Foraminifera chiefly pelagic, as *Orbulina universa*, *Globigerina dubia*, *G. digitata*, *G. bulloides*, *G. sacculifera*, *G. conglobata*, *G. æquilateralis*, *G. subcretacea*, *Sphæroidina dehiscens*, *Pullenia obliquiloculata*, *Pulvinulina menardii*, and *P. tumida*. The more interesting of the bottom-living forms are *Gaudryina rugosa*, *G. pupoides*, *Bulimina pupoides*, *Ehrenbergina serrata*, *E. hystrix*, *Lagena formosa*, *L. botelliformis*, and *Polymorphina angusta*.

The Foraminifera, with Notes on the New or Remarkable Species.

Family MILIOLIDÆ.

Genus BILOCULINA, *Orb.*

BILOCULINA DEPRESSA, *Orb.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 10, 1485 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 105, 2400 fms.

BILOCULINA DEPRESSA, *Orb.*, var. MURRHYNA, *Schwager.*

This bicaudate variety is more abundant in the Funafuti soundings than the specific form, and is apparently more at home in the greatest depths. The variety *murrhyna* shows a strong tendency, in an extensive series of specimens, to become elongated, whereas the species keeps remarkably constant to the discoid shape. The 'Challenger' recorded this variety from the S. Pacific at one station only.

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 140, 2476 fms.; 142, 2435 fms.; 148, 2620 fms.

BILOCULINA DEPRESSA, *Orb.*, var. SERRATA, *Brady.*

Occurrence.—Sta. 11, 1417 fms.

BILOCULINA TUBULOSA, *Costa.*

This is a species usually found in moderately shallow water. The present occurrence constitutes a record for great depths. It is represented in the soundings by a few examples of a small elongate variety.

Occurrence.—Sta. 10, 1485 fms.; 20, 1215 fms.; 48, 2298 fms.

BILOCULINA LUCERNULA, *Schwager.*

Biloculina lucernula, Schwager ('66), p. 202, pl. 4. figs. 17 *a, b.*
B. bulloides, Brady (non d'Orbigny), ('84) p. 142, pl. 2. figs. 5, 6.

The above species must not be confused with d'Orbigny's *B. bulloides,* which has a rounder peripheral border, without the prolonged neck, and with a distinct T-shaped valve. *B. lucernula* has been previously met with in the Pacific, but it is always rare.

Occurrence.—Sta. 13, 1050 fms.

BILOCULINA LUCERNULA, *Schwager,* var. STRIATA, nov. (Plate **54**. fig. 1.)

This variety is distinguished by the surface of the test being ornamented with moderately fine longitudinal striæ. The shape of the test is comparable with the type-form.

Occurrence.—Sta. 20, 1215 fms.

Genus SPIROLOCULINA, *Orb.*

SPIROLOCULINA EXCAVATA, *Orb.*

Occurrence.—Sta. 55, 507 fms.

SPIROLOCULINA DORSATA, *Reuss.*

Occurrence.—Sta. 13, 1050 fms.

SPIROLOCULINA ACUTIMARGO, *Brady.*

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.

SPIROLOCULINA TENUIS, *Czjzek.*

Occurrence.—Sta. 4, 2728 fms.; 48, 2298 fms.; 105, 2400 fms.

SPIROLOCULINA ROBUSTA, *Brady.*

Spiroloculina robusta, Brady; Flint ('99), p. 296, pl. 42. fig. 1.

This species was originally found at Culebra Island in the West Indies, at 390 fathoms. Dr. Flint, who regards this as a transitional form near *Biloculina depressa*, records it from the Gulf of Mexico at 200 to 1200 fathoms. Since then it has occurred at Funafuti, off Tutanga, at a depth of 200 fathoms.

The present occurrence in deep water, close to Funafuti, is from a still greater depth than that given by Dr. Flint.

The only example found is of moderate size, and otherwise typical.

Occurrence.—Sta. 10, 1485 fms.

Genus Miliolina, *Williamson.*

Miliolina oblonga, *Montagu*, sp.

The examples in the present series are less than the average size, as usual with those from deep water.

Occurrence.—Sta. 48, 2298 fms. ; 149, 2550 fms.

Miliolina bosciana, *Orb.*, sp.

Miliolina bosciana, Orb., sp. ; Millett ('98), p. 267, pl. 6. fig. 1.

This species has been admirably illustrated by Mr. Millett, who records three varieties besides the smooth type-form. The latter only is found in the deep-water soundings at Funafuti.

Occurrence.—Sta. 20, 1215 fms. ; 21, 2195 fms.

Miliolina circularis, *Bornemann*, sp.

Occurrence.—Sta. 3, 2715 fms.

Miliolina subrotunda, *Montagu*, sp.

Occurrence.—Sta. 13, 1050 fms. ; 68, 1143 fms.

Miliolina tricarinata, *Orb.*, sp.

Occurrence.—Sta. 10, 1485 fms. ; 11, 1417 fms. ; 13, 1050 fms.; 20, 1215 fms. ; 48, 2298 fms. (specimens small).

Miliolina trigonula, *Lamarck*, sp.

Occurrence.—Sta. 13, 1050 fms.

Miliolina seminulum, *Linné*, sp.

Occurrence.—Sta. 48, 2298 fms.

Miliolina vulgaris, *Orb.*, sp.

Quinqueloculina vulgaris, Orb. ('26), p. 302. no. 33.
Q. auberiana, Orb. ('39), p. 167, pl. 12. figs. 1–3.

Although typically a shallow-water form, this species has been recorded by Dr. Brady from the great depth of 2435 fathoms in the N. Atlantic, and one of the present occurrences is from a still greater depth, viz. 2715 fathoms.

Occurrence.—Sta. 3, 2715 fms. ; 48, 2298 fms.

MILIOLINA VENUSTA, *Karrer*, sp.

This is by far the commonest miliolid in the present series; and this is only to be expected from its well-known preference for deep water. It was this species, among others, which gave the aspect of a fairly deep-water deposit to the Upper Gault of Folkestone (see Chapman, '91, p. 9).

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 48, 2298 fms.

MILIOLINA FERUSSACII, *Orb.*, sp.

Occurrence.—Sta. 3, 2715 fms.

MILIOLINA ALVEOLINIFORMIS, *Brady.*

This form is nearly always found in the neighbourhood of coral reefs; but Millett records it from the Malay Archipelago, from anchor mud. The deepest habitat previously noted was 420 fathoms.

Occurrence.—Sta. 55, 507 fms.

Genus SIGMOÏLINA, *Schlumberger.*

SIGMOÏLINA SCHLUMBERGERI, *Silvestri.*

Sigmoïlina schlumbergeri, Silvestri ('04), p. 267; Chapman ('07), p. 21, pl. 2. fig. 42.

Our specimens represent the smooth, non-agglutinate variety. The sand-encrusted form was described by Brady as *Planispirina celata,* Costa, from which it differs in having a more even contour and inconspicuous sutures. The above species has not been recorded from so great a depth as the present, the maximum limit of the 'Challenger' examples being 1630 fathoms.

Occurrence.—Sta. 48, 2298 fms.

SIGMOÏLINA SIGMOIDEA, *Brady*, sp.

Dr. H. B. Brady has given the bathymetrical range of this species as 300–900 fathoms, so that the present series shows it to be of exceptionally deep-water habitat in this area. Dr. Flint has recorded its deepest limit, from the W. Indies, as 1170 fathoms.

Occurrence.—Sta. 3, 2715 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.

Genus OPHTHALMIDIUM, *Kübler.*

OPHTHALMIDIUM INCONSTANS, *Brady.*

Two typical specimens occur in the sample recorded below.

Occurrence.—Sta. 13, 1050 fms.

Genus Planispirina, *Seguenza.*

Planispirina sphæra, *Orb.*, sp.

This species occurs only at one depth in this area, and the shells are all of small size. Dr. Brady states that it is rare at depths greater than 1000 fathoms.

Occurrence.—Sta. 13, 1050 fms.

Genus Cornuspira, *Schultze.*

Cornuspira crassisepta, *Brady.*

Cornuspira crassisepta, Brady ('84), p. 202, pl. 113. fig. 20; Chapman ('07), p. 22, pl. 2. fig. 45.

It is extremely interesting to note the occurrence of an example of this species from Funafuti, since it has been found previously only in one locality, viz. the Færoe Channel, in the "warm area," at a depth of 530 fathoms. This species, by the way, is the commonest of the *Cornuspiræ* in the Australian Tertiary deposits in the neighbourhood of Melbourne and elsewhere in Victoria.

Occurrence.—Sta. 13, 1050 fms.

Genus Orbitolites, *Lamarck.*

Orbitolites complanata, *Lam.*, sp.

A fragment only, somewhat worn and iron-stained, occurs here.

Occurrence.—Sta. 78, 1570 fms.

Orbitolites marginalis, *Lam.*

A fragment of a test, somewhat iron-stained, and having the appearance of being derived. This and the previous species are usually of moderately shallow-water habitat, and the present occurrence looks open to the suspicion that some accidental mixing of samples has taken place. The utmost care has been exercised, however, during the present examination.

Occurrence.—Sta. 78, 1570 fms.

Family ASTRORHIZIDÆ.

Genus Hyperammina, *Brady.*

Hyperammina elongata, *Brady.*

Occurrence.—Sta. 21, 2195 fms.; 48, 2298 fms.; 141, 2741 fms.

Hyperammina ramosa, *Brady.*

Occurrence.—Sta. 19, 1995 fms. ; 21, 2195 fms. ; 48, 2298 fms.

Hyperammina friabilis, *Brady.*

This species has a restricted geographical range, and does not appear to have been previously recorded from the Pacific.

Occurrence.—Sta. 13, 1050 fms.

Genus Rhizammina, *Brady.*

Rhizammina algæformis, *Brady.*

Fragments of this slender tubular form are not uncommon, and can be distinguished from *Hyperammina elongata* by their slightly contorted shape.

Occurrence.—Sta. 11, 1417 fms. ; 19, 1995 fms. ; 20, 1215 fms.

Family LITUOLIDÆ.

Genus Reophax, *Montfort.*

Reophax difflugiformis, *Brady*, var. lagenarium, *Berthelin.*

Haplophragmium lagenarium, Berthelin ('80), p. 21, pl. 24. fig. 2.

Reophax difflugiformis, Brady, var. *lagenarium,* Berthelin; Millett ('99), Rep. Malay Foram. p. 253, pl. 4. fig. 8.

A typical specimen of this variety was found ; and, as in the case of the Malay specimens described by Mr. Millett, the test is rather rougher or looser in structure than that of the specific form.

Occurrence.—Sta. 68, 1143 fms.

Reophax nodulosa, *Brady.*

Occurrence.—Sta. 21, 2195 fms.

Reophax dentaliniformis, *Brady.*

Occurrence.—Sta. 3, 2715 fms.

Reophax adunca, *Brady.*

Occurrence.—Sta. 20, 1215 fms.

Genus Haplophragmium, *Reuss.*

Haplophragmium canariense, *Orb.*, sp.

Occurrence.—Sta. 19, 1995 fms. ; 20, 1215 fms. ; ? 48, 2298 fms.

HAPLOPHRAGMIUM LATIDORSATUM, *Bornemann*, sp.

Occurrence.—Sta. 19, 1995 fms.; 105, 2400 fms.

HAPLOPHRAGMIUM SPHÆROIDINIFORME, *Brady*.

Haplophragmium sphæroidiniforme, Brady ('84), p. 313.
H. sphæroidiniformis, Brady; Howchin ('89), p. 6.
H. sphæroidiniforme, Brady; Chapman ('07), p. 24, pl. 3. figs. 50, 51.

This distinct species has already been recorded from recent dredgings, although from less depths, viz. 70–120 fathoms, in the Mediterranean. It frequently occurs in the shallow-water deposits of L. Miocene or Oligocene (Balcombian) age, at Muddy Creek, Hailton, Victoria.

Occurrence.—Sta. 20, 1215 fms.

HAPLOPHRAGMIUM FONTINENSE, *Terquem*.

Occurrence.—Sta. 3, 2715 fms.

Genus AMMODISCUS, *Reuss*.

AMMODISCUS *cf.* TENUIS, *Brady*.

A single example was found, somewhat imperfect, which represents a laterally compressed or subdiscoidal form, the component tube being hardly so thin and flat as in a typical shell of the above species.

Occurrence.—Sta. 19, 1995 fms.

Family TEXTULARIIDÆ.

Genus TEXTULARIA, *Defrance*.

TEXTULARIA CONCAVA, *Karrer*, sp.

Occurrence.—Sta. 48, 2298 fms.

TEXTULARIA CONCAVA, var. HETEROSTOMA, *Fornasini*.

Textularia heterostoma, Fornasini ('96), p. 4, pl. 1. figs. 6, 12, 13.
T. concava, Karrer, sp., var. *heterostoma*, Fornasini; Millett ('99), Rep. Malay Foram. p. 560, pl. 7. figs. 6, 7.

In this variety the siphonate aperture is placed usually upon the summit of the last chamber. In our specimens the segments are inclined to be swollen and the aboral end of the test is always sharply pointed as in the type fossil form of the species, figured by Karrer.

Occurrence.—Sta. 2, 1489 fms.; 48, 2298 fms.

TEXTULARIA GRAMEN, *Orb.*

These are all small specimens.
Occurrence.—Sta. 3, 2715 fms.; 11, 1427 fms.

TEXTULARIA GIBBOSA, *Orb.*

It is curious to note this species, hitherto confined to shore-sands, in water of so great a depth as recorded below. As a fossil species also, it occurs, perhaps without exception, in undoubted shallow-water deposits.
Occurrence.—Sta. 11, 1417 fms.

Genus VERNEUILINA, *Orb.*

VERNEUILINA SPINULOSA, *Reuss.*

Occurrence.—Sta. 55, 507 fms.; 109, 604 fms.

VERNEUILINA PYGMÆA, *Egger.*

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.; 105, 2400 fms.; 142, 2435 fms.

VERNEUILINA PROPINQUA, *Brady.*

Two examples of this handsome form were found. It has hitherto been recorded from the S. Pacific from one locality only, at 610 fathoms.
Occurrence.—Sta. 13, 1050 fms.

Genus TRITAXIA, *Reuss.*

TRITAXIA LEPIDA, *Brady.*

A single typical example of this rare form occurs here. Dr. Brady notes it from one locality only, off the coast of N. America, at 1240 fathoms, and Mr. Millett states that he found several specimens in the Torres Strait material from 155 fathoms, and a single example from the Malay Archipelago.
Occurrence.—Sta. 48, 2298 fms.

Genus SPIROPLECTA, *Ehrenberg.*

SPIROPLECTA AMERICANA, *Ehrenberg.*

This species has hitherto been known in the living condition from Raines Islet, Torres Strait.
Occurrence.—Sta. 3, 2715 fms.

SPIROPLECTA SAGITTULA, *Defrance*, sp.

A very minute hyaline variety occurs in some abundance.
Occurrence.—Sta. 2, 1489 fms.

Genus Gaudryina, *Orb.*

Gaudryina rugosa, *Orb.*

Occurrence.—Sta. 150, 2438 fms.

Gaudryina pupoides, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 13, 1050 fms.; 21, 2195 fms.; 48, 2298 fms.; 150, 2438 fms.

Genus Bulimina, *Orb.*

Bulimina pupoides, *Orb.*

Occurrence.—Sta. 150, 2438 fms.

Bulimina buchiana, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.

Bulimina rostrata, *Brady.*

Occurrence.—Sta. 48, 2298 fms.

Bulimina subteres, *Brady.*

Occurrence.—Sta. 20, 1215 fms.

Bulimina contraria, *Reuss.*

Occurrence.—Sta. 13, 1050 fms.; 96, 1245 fms.

Genus Virgulina, *Orb.*

Virgulina subsquamosa, *Egger.*

Occurrence.—Sta. 2, 1489 fms.; 48, 2298 fms.; 105, 2400 fms.; 150, 2438 fms.

Virgulina subdepressa, *Brady.*

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.

Virgulina texturata, *Brady.*

Occurrence.—Sta. 48, 2298 fms.

Virgulina pertusa, *Reuss.* (Plate **54**. fig. 2.)

Virgulina pertusa, Reuss ('60), p. 362, pl. 2. fig. 16.

This species was described from an Antwerp Crag specimen by Reuss, and its present occurrence is especially interesting from the fact that it does not appear to have been previously noticed in recent dredgings. It is distinguished from the nearly related *V. texturata* in having considerably fewer chambers proportionately to its size.

Occurrence.—Sta. 3, 2715 fms.

Genus Bifarina, *Parker & Jones.*

Bifarina porrecta, *Brady*, sp.

Bolivina porrecta, Brady ('84), p. 418, pl. 52. fig. 22.
Bifarina porrecta, Brady, sp.; Millett ('00), Rep. Malay Foram. p. 540, pl. 4. fig. 3.

This species is usually restricted to depths of less than 500 fathoms, and is more frequent in moderately shallow water. A single, slightly damaged specimen was found.

Occurrence.—Sta. 11, 1417 fms.

Genus Bolivina, *Orb.*

Bolivina punctata, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.

Bolivina textilarioides, *Reuss.*

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.; 55, 507 fms.; 109, 604 fms.

Bolivina limbata, *Brady.*

Occurrence.—Sta. 105, 2400 fms.

Bolivina lobata, *Brady.*

Occurrence.—Sta. 48, 2298 fms.

Bolivina obsoleta, *Eley.*

Occurrence.—Sta. 3, 2715 fms.; 11, 1417 fms.

Bolivina robusta, *Brady.*

The S. Pacific records of this species hitherto extended only to a depth of 800 fathoms.

Occurrence.—Sta. 105, 2400 fms.

Bolivina karreriana, *Brady.*

It is quite exceptional to find this species in such deep water, the previous records attaining only to a little over 700 fathoms.

Occurrence.—Sta. 48, 2298 fms.

Bolivina nobilis, *Hantken.*

This species has already been noted from the S. Pacific, the Malay Archipelago, and off the W. Coast of Africa.

Occurrence.—Sta. 11, 1417 fms.

Bolivina reticulata, *Brady.*

Occurrence.—Sta. 48, 2298 fms.

Genus Pleurostomella, *Reuss.*

Pleurostomella subnodosa, *Reuss.*

Occurrence.—Sta. 13, 1050 fms.; 48, 2298 fms.

Pleurostomella alternans, *Schwager.*

Occurrence.—Sta. 48, 2298 fms.

Genus Cassidulina, *Orb.*

Cassidulina lævigata, *Orb.*

Occurrence.—Sta. 4, 2728 fms.; 13, 1050 fms.; 47, 2107 fms.; 48 2298 fms.; 105, 2400 fms.

Cassidulina crassa, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 13, 1050 fms.; 20, 1215 fms.; 55, 507 fms

Cassidulina subglobosa, *Brady.* (Plate **54**. fig. 3.)

This is by far the commonest *Cassidulina* of these deep-sea oozes, and the present records are the deepest known for this species. The 'Challenger' noted it from one station in the Pacific, from 1450 fathoms. The example here figured has fewer chambers than usual.

Occurrence.—Sta. 3, 2715 fms.; 4, 2728 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 105, 2400 fms. 138, 2688 fms.; 140, 2476 fms.; 141, 2741 fms.; 142, 2435 fms.; 149, 2550 fms.

Cassidulina oblonga, *Reuss.*

Cassidulina oblonga, Reuss ('50), p. 376, pl. 48. figs. 5, 6.
C. oblonga, Reuss; Egger ('93), p. 303, pl. 7. figs. 33, 34.

Distinguished from *C. crassa* by its oblong contour in both aspects, and also by the smooth shell-surface, which is only very finely punctate. Dr. Egger, who pointed out the confusion of the two species mentioned, has recorded *C. oblonga* from the south-west of Timor at a depth of 5523 metres and also from other soundings at less depths.

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.; 105, 2400 fms.

Cassidulina calabra, *Seguenza*, sp.

Occurrence.—Sta. 105, 2400 fms.

Cassidulina bradii, *Norman*.

The present records are from unusually deep water, since the 'Challenger' gives its deepest limit, in the S. Pacific, at 1450 fathoms. The examples are typical and show all stages of growth.

Occurrence.—Sta. 3, 2715 fms. ; 45, 2107 fms. ; 105, 2400 fms.

Cassidulina bradii, var. attenuata, nov. (Plate **54**. fig. 4.)

Test smooth, almost cylindrical in section, elongate ; coiled commencement inconspicuous, followed by a long, reflexly curved series. Aperture resembling that of the specific form, but longer. Length 1 mm. ; greatest breadth, near middle of upper third, ·212 mm.

Occurrence.—Sta. 105, 2400 fms.

Genus Ehrenbergina, *Reuss*.

Ehrenbergina pupa, *Orb.*

Occurrence.—Sta. 13, 1050 fms.

Ehrenbergina serrata, *Reuss*.

Some of our specimens, from great depths, are furnished with very delicate spines.

Occurrence.—Sta. 2, 1489 fms. ; 3, 2715 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 105, 2400 fms. ; 150, 2438 fms.

Ehrenbergina hystrix, *Brady*.

This rare and handsome species appears to be restricted to the S. Pacific, in deep water.

Occurrence.—Sta. 3, 2715 fms. ; 150, 2438 fms.

Family CHEILOSTOMELLIDÆ.

Genus Seabrookia, *Brady*.

Seabrookia pellucida, *Brady*.

Seabrookia pellucida, Brady ('90), p. 570, fig. 60, 1 *a–c*, 2.
S. pellucida, Brady ; Wright ('91), p. 476, pl. 20. fig. 5.
S. pellucida, Brady ; Millett ('01), Rep. Malay Foram. p. 3, pl. 1. fig. 4.

As hitherto recorded, the bathymetrical range of this species was not great, the deepest dredgings being 435 fathoms off Bermudas.

Occurrence.—Sta. 20, 1215 fms.

Family LAGENIDÆ.

Genus Lagena, *Walker & Boys.*

Lagena globosa, *Montfort*, sp.

Occurrence.—Sta. 10, 1485 fms.; 13, 1050 fms.; 20, 1215 fms.; 45, 2107 fms.; 48, 2298 fms.; 142, 2435 fms.

Lagena stelligera, *Brady.*

Occurrence.—Sta. 10, 1485 fms.; 45, 2107 fms.

Lagena longispina, *Brady.*

Of this rare form only one example was found, which is of the globose variety.

Occurrence.—Sta. 21, 2195 fms.

Lagena apiculata, *Reuss.*

The examples found are of the elongate and slightly curved type, as figured by Dr. Brady in the 'Challenger' Report.

Occurrence.—Sta. 48, 2298 fms.; 105, 2400 fms.

Lagena botelliformis, *Brady.* (Plate **54**. fig. 5.)

Lagena botelliformis, Brady ('84), p. 454, pl. 56. fig. 6.

Our example nearly agrees with Brady's figured specimen, but that the oral extremity in the former is slightly tapered. The orifice is carried internally by an entosolenian tube directed towards the convex side.

Occurrence.—Sta. 150, 2438 fms.

Lagena elongata, *Ehrenberg*, sp.

Occurrence.—Sta. 48, 2298 fms.

Lagena hispida, *Reuss.*

The examples are typical, having a finely hispid surface. From Sta. 48 there is a compressed variety, as figured by Dr. H. B. Brady.

Occurrence.—Sta. 10, 1485 fms.; 13, 1050 fms.; 48, 2298 fms.; 105, 2400 fms.

Lagena aspera, *Reuss.*

Occurrence.—Sta. 3, 2715 fms.; 20, 1215 fms.; 45, 2107 fms.

Lagena acuticosta, *Reuss.*

Occurrence.—Sta. 3, 2715 fms.; 20, 1215 fms.; 48, 2298 fms.

LAGENA SPUMOSA, *Millett.* (Plate **54**. fig. 6.)

Lagena spumosa, Millett ('01), Foram. Malay Arch. p. 9, pl. 1. fig. 9.

Only a single example of this interesting species was found. It was also rare in Mr. Millett's Malay Archipelago dredgings.

Occurrence.—Sta. 48, 2298 fms.

LAGENA LÆVIS, *Montagu,* sp.

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 13, 1050 fms.; 140, 2476 fms.

LAGENA LÆVIS, *Montagu,* sp., var. DISTOMA, *Silvestri.*

Lagena lævis, Mont., sp., var. *distoma,* Silvestri ('00), p. 244, pl. 6. figs. 74, 75; Millett ('01), Rep. Malay Foram. p. 10, pl. 1. fig. 10.

One example was found which agrees exactly with the specimen figured by Mr. Millett.

Occurrence.—Sta. 48, 2298 fms.

LAGENA STRIATA, *Orb.,* sp.

Besides several typical examples, a compressed variety was found at Sta. 3.

Occurrence.—Sta. 3, 2715 fms.; 13, 1050 fms.; 48, 2298 fms.

LAGENA SULCATA, *Walker & Jacob.*

Occurrence.—Sta. 3, 2715 fms.; 13, 1050 fms.; 20, 1215 fms.; 48, 2298 fms.

LAGENA HEXAGONA, *Williamson,* sp.

Occurrence.—Sta. 48, 2298 fms.

LAGENA JUDDIANA, sp. nov. (Plate **54**. fig. 7.)

Description.—This species is allied to *Lagena striatopunctata,* Parker and Jones *, but is more elaborate in the surface-ornament. The perforations on the riblets are triangular, each being partially closed by a pointed or cusp-like valve. Beneath each perforated area there is a depression or excavation. The intercostal area is a moderately deep groove. Length of figured specimen ·725 mm.; greatest width ·5 mm.

I have much pleasure in naming this interesting species after Professor J. W. Judd, C.B., to whom I am especially indebted for the privilege of working out portions of the material from Funafuti.

Occurrence.—Sta. 13, 1050 fms. Two examples.

* *L. sulcata,* var. *striatopunctata,* Parker & Jones, Phil. Trans. vol. clv. 1865, p. 350, pl. 13. figs. 25–27.

LAGENA FOVEOLATA, *Reuss*. (Plate **55**. fig. 11.)

Lagena foveolata, Reuss ('63), p. 332, pl. 5. fig. 65; Millett ('01), Rep. Malay Foram. p. 11, pl. 1. fig. 15.

As a recent species this beautiful little *Lagena* has only lately been recorded for the first time by Mr. Millett from the Malay Archipelago. Our example also, like the former, is more closely ornamented than Reuss's figured specimen from the Septarienthon (Oligocene).

Occurrence.—Sta. 15, 1050 fms.

LAGENA FEILDENIANA, *Brady*.

Occurrence.—Sta. 48, 2298 fms.

LAGENA GRACILIS, *Williamson*.

Occurrence.—Sta. 2, 1489 fms.; 48, 2298 fms.; 105, 2400 fms.

LAGENA QUINQUELATERA, *Brady*.

Occurrence.—Sta. 10, 1485 fms.; 48, 2298 fms.

LAGENA LÆVIGATA, *Reuss*, sp.

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.

LAGENA LÆVIGATA, var. ACUTA, *Reuss*.

Occurrence.—Sta. 10, 1485 fms.; 48, 2298 fms.

LAGENA LUCIDA, *Williamson*, sp. (Plate **54**. fig. 8.)

Entosolenia marginata, var. *lucida*, Williamson ('48), p. 17, pl. 2. fig. 17.
Lagena lucida, Williamson, sp.; Millett ('01), Rep. Malay Foram. p. 494.

This neat little species is suboval or pyriform in shape. In our example it has a slightly concave base; the middle of the test is clear, and a marginal band commences from near the aperture. The surface of this specimen is finely granulate. Mr. Millett remarks that it is a form apparently overlooked by many writers on the subject.

Occurrence.—Sta. 13, 1050 fms.

LAGENA FASCIATA, *Egger*, sp.

Oolina fasciata, Egger ('57), p. 270, pl. 5. figs. 12–15.
Lagena quadricostulata, Reuss, Brady ('84), p. 486, pl. 59. fig. 15.
Lagena fasciata, Egger, sp.; Millett ('01), Rep. Malay Foram. p. 495, pl. 8. fig. 19.

Occurrence.—Sta. 10, 1485 fms.; 20, 1215 fms.; 21, 2195 fms.

LAGENA QUADRATA, *Williamson*.

Occurrence.—Sta. 10, 1485; 48, 2298 fms.

LAGENA MARGINATA, *Walker & Boys.*

Occurrence.—Sta. 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.; 140, 2476 fms.; 148, 2620 fms.

LAGENA MARGINATA, *Walker & Boys*, var. SEMIMARGINATA, *Reuss.*

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.

LAGENA MARGINATA, *Walker & Boys*, var. SEMINIFORMIS, *Schwager.*

Lagena seminiformis, Schwager ('66), p. 208, pl. 5. fig. 21.

L. marginata, Walker & Boys, var. *seminiformis*, Schwager; Millett ('01), Rep. Malay Foram. p. 620, pl. 14. fig. 3.

Although regarded as an essentially deep-water species by Brady, Millett obtained it from shallow-water dredgings in the Malay Archipelago.

Occurrence.—Sta. 21, 2195 fms.

LAGENA VENTRICOSA, *Silvestri.* (Plate **54.** fig. 9.)

Lagena ventricosa, Silvestri ('03), p. 10, woodcuts figs. 6 *a–e*.

Our examples exactly agree with Silvestri's figures of *L. ventricosa*, from the Miocene of Piedmont. Dr. Silvestri points out, in his description, the probable alliance of this form with Brady's so-called *Lagena apiculata* ('84, pl. 56. figs. 17, 18), a species which is normally subcylindrical and elongate, whilst *L. ventricosa* is depressed and subovate.

Occurrence.—Sta. 11, 1417 fms.; 48, 2298 fms.; 148, 2620 fms.

LAGENA STAPHYLLEARIA, *Schwager*, sp.

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 20, 1215 fms.; 48, 2298 fms.

LAGENA TRIGONO-MARGINATA, *Parker & Jones.*

Occurrence.—Sta. 105, 2400 fms.

LAGENA WRIGHTIANA, *Brady.*

Our specimen is rounder in outline than Brady's figured example, and has a rather sharp marginal keel.

Occurrence.—Sta. 105, 2400 fms.

LAGENA LAGENOIDES, *Williamson*, sp.

Occurrence.—Sta. 105, 2728 fms.; 19, 1485 fms.

LAGENA QUADRALATA, *Brady.* (Plate **55.** fig. 10.)

Lagena quadralata, Brady ('94), p. 464, pl. 61. figs. 3 *a, b*.

This rare species has been found only in two localities previously, viz., south of Australia and in the S. Atlantic; both in deep water.

Only one example occurs here, and is a three-winged variety; in all other characters it agrees with Brady's figured example.

Occurrence.—Sta. 3, 2715 fms.

LAGENA FORMOSA, *Schwager.*

Our specimens are good, well-formed examples of this truly beautiful species.

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 21, 2195 fms.; 48, 2298 fms.; 150, 2438 fms.

LAGENA AURICULATA, *Brady.*

Occurrence.—Sta. 11, 1417 fms.

LAGENA FIMBRIATA, *Brady.*

This is a rare form and almost essentially of deep-water habitat.

Occurrence.—Sta. 4, 2728 fms.; 11, 1417 fms.; 48, 2298 fms.; 105, 2400 fms.; 140, 2476 fms.

LAGENA ALVEOLATA, *Brady.*

This essentially deep-water form is here moderately frequent. Some very fine examples are present.

Occurrence.—Sta. 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.

LAGENA ALVEOLATA, var. SUBSTRIATA, *Brady.*

Occurrence.—Sta. 45, 2107 fms.

LAGENA ORBIGNYANA, *Seguenza,* sp.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 20, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.; 48, 2298 fms.; 105, 2400 fms.

LAGENA ORBIGNYANA, *Seg.*, sp., var. CASTRENSIS, *Schwager.*

Occurrence.—Sta. 48, 2298 fms.

LAGENA ORBIGNYANA, *Seg.*, sp., var. LACUNOSA, *Burrows & Holland.*

Occurrence.—Sta. 48, 2298 fms.

Genus NODOSARIA, *Lamarck.*

NODOSARIA CALOMORPHA, *Reuss.*

Occurrence.—Sta. 48, 2298 fms.

NODOSARIA (DENTALINA) COMMUNIS, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 21, 2195 fms.; 48, 2298 fms.; 55, 507 fms.; 205, 2400 fms.

NODOSARIA (DENTALINA) CONSOBRINA, *Orb.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 45, 2107 fms.; 141, 2741 fms.

NODOSARIA (DENTALINA) FILIFORMIS, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 105, 2400 fms.

NODOSARIA (DENTALINA) MUCRONATA, *Neugeboren*, sp.

Occurrence.—Sta. 11, 1417 fms.; 45, 2107 fms.

Genus RHABDOGONIUM, *Reuss.*

RHABDOGONIUM MINUTUM, *Reuss.*

The only example found consists of two chambers, the globular primordial segment having a costate surface. This species is recorded only from one locality by the 'Challenger,' off Ki (Kei) Islands, 129 fathoms.

Occurrence.—Sta. 48, 2298 fms.

Genus VAGINULINA, *Orb.*

VAGINULINA LEGUMEN, *Linné*, sp.

Occurrence.—Sta. 13, 1050 fms.; 150, 2438 fms.

Genus CRISTELLARIA, *Lam.*

CRISTELLARIA ROTULATA, *Lam.*, sp.

Occurrence.—Sta. 4, 2728 fms.; 13, 1050 fms.; 48, 2298 fms.

CRISTELLARIA RENIFORMIS, *Orb.*

Occurrence.—Sta. 20, 1215 fms.; 105, 2400 fms.

CRISTELLARIA ORBICULARIS, *Orb.*, sp.

It is unusual to find this species at great depths.

Occurrence.—Sta. 68, 1143 fms.

CRISTELLARIA CONVERGENS, *Bornemann.*

Occurrence.—Sta. 4, 2728 fms.; 11, 1417 fms.

CRISTELLARIA VARIABILIS, *Reuss.*

Occurrence.—Sta. 48, 2298 fms.

CRISTELLARIA ARTICULATA, *Reuss.*

Occurrence.—Sta. 48, 2298 fms.

CRISTELLARIA TENUIS, *Bornemann,* sp.

Occurrence.—Sta. 48, 2298 fms.

Genus POLYMORPHINA, *Orb.*

POLYMORPHINA LACTEA, *Walker & Jacob,* sp.

Occurrence.—Sta. 10, 1485 fms.; 48, 2298 fms.

POLYMORPHINA LACTEA, *Walker & Jacob,* sp., var. OBLONGA, *Williamson.* (Plate **55**. fig. 12.)

All previous occurrences of this interesting variety have been noted from moderately shallow water, and from higher latitudes than the present, excepting Millett's locality in the Malay Archipelago.

Occurrence.—Sta. 20, 1215 fms.

POLYMORPHINA ANGUSTA, *Egger.*

A typically deep-water species.

Occurrence.—Sta. 19, 1995 fms.; 21, 2195 fms.; 48, 2298 fms.; 150, 2438 fms.

POLYMORPHINA LANCEOLATA, *Reuss.*

The greatest depth previously given for this species, by Dr. Brady, is 1825 fathoms.

Occurrence.—Sta. 13, 1050 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.

POLYMORPHINA SORORIA, *Reuss.*

Occurrence.—Sta. 13, 1050 fms.; 45, 2107 fms.; 48, 2298 fms.

POLYMORPHINA OVATA, *Orb.*

The 'Challenger' obtained this species from one locality only, viz., off Culebra Isl., W. Indies, 390 fathoms.

Occurrence.—Sta. 11, 1417 fms.

POLYMORPHINA SEGUENZANA, *Brady.*

Polymorphina seguenzana, Brady; Egger ('93), p. 309, pl. 9. figs. 22, 23.

This is a very rare form. Besides the two localities given by Brady, all in shallow water, Egger records it from New Amsterdam at 1485 metres.

Occurrence.—Sta. 48, 2298 fms.

POLYMORPHINA LONGICOLLIS, *Brady.*

Polymorphina longicollis, Brady ('84), p. 572, pl. 73. figs. 18, 19; Egger ('93), p. 310, pl. 9. fig. 12.

Dr. Brady states that no examples in the 'Challenger' collection were found at a less depth than 1100 fathoms. Dr. Egger records this species from the Mauritius at 411 metres.

Occurrence.—Sta. 3, 2715 fms.; 21, 2195 fms.

Genus DIMORPHINA, *Orb.*

DIMORPHINA (?) LINGULINOIDES, *Millett.*

Dimorphina lingulinoides, Millett ('03), Rep. Malay Foram. p. 266, pl. 5. fig. 6.

Our example has lost the terminal portion of the test, but sufficient remains to refer it to the above species. Millett described it from the anchor-muds of the Malay Archipelago.

Occurrence.—Sta. 13, 1050 fms.

Genus UVIGERINA, *Orb.*

UVIGERINA CANARIENSIS, *Orb.*

This is a species usually inhabiting water of moderate depths, although Brady records it from 1900 fathoms E. of Buenos Ayres.

Occurrence.—Sta. 3, 2715 fms.

UVIGERINA PYGMÆA, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 4, 2728 fms.

UVIGERINA ANGULOSA, *Williamson.*

Occurrence.—Sta. 48, 2298 fms.

UVIGERINA PORRECTA, *Brady.*

This form is recognised as almost peculiar to the coral-reef fauna. It is interesting to note the great depth from whence it was obtained in this area. The deepest sounding hitherto yielding this species was 1850 fathoms. It is not uncommon in the present samples.

Occurrence.—Sta. 13, 1050 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.; 109, 604 fms.

UVIGERINA ACULEATA, *Orb.*

This roughly spinous form is rarer than the succeeding, hispid, type. The 'Challenger' obtained the deepest specimens from 1900 fathoms.

Occurrence.—Sta. 3, 2715 fms.; 48, 2298 fms.

UVIGERINA ASPERULA, *Czjzek.*

The greatest depths of the earlier records of this common and widely distributed species fall somewhat short of the present deepest limit, Brady having obtained it from the Southern Ocean at 2600 fathoms.

Occurrence.—Sta. 3, 2715 fms. ; 4, 2728 fms. ; 10, 1485 fms. ; 11, 1417 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 105, 2400 fms.

UVIGERINA ASPERULA, *Czjzek*, var. AMPULLACEA, *Brady.*

It is remarkable that this variety has never before been recorded from very deep water. Brady gives the limits of depth as 350 to 725 fathoms. Dr. Egger found it off the Mauritius at 411 metres, and off Western Australia at 1187 metres.

Occurrence.—Sta. 2, 1489 fms. ; 4, 2728 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 105, 2400 fms.

UVIGERINA INTERRUPTA, *Brady.*

The above species is usually observed at moderate depths, the only deep-water occurrence noted by Brady was N. of Juan Fernandez at 1375 fathoms.

Occurrence.—Sta. 3, 2715 fms.

Genus SAGRAINA, *Orb., emend. Parker & Jones.*

SAGRAINA BIFRONS, *Brady.*

For this rare form only four localities are known, viz. : S. of Japan, 345 fathoms ; off Western Australia, 560 fathoms ; the Malay Archipelago from shallow water ; and the present occurrence W. of Funafuti.

Occurrence.—Sta. 105, 2400 fms.

SAGRAINA VIRGULA, *Brady.*

Occurrence.—Sta. 10, 1485 fms. ; 13, 1050 fms. ; 48, 2298 fms.

SAGRAINA RAPHANUS, *Parker & Jones.*

Our specimens are typical in every respect. It is remarkable that the present occurrences are mainly from much greater depths than previously known, the maximum of which was 260 fathoms.

Occurrence.—Sta. 3, 2715 fms. ; 4, 2728 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 68, 1143 fms. ; 83, 1340 fms. ; 105, 2400 fms. ; 109, 604 fms.

Family GLOBIGERINIDÆ.

Genus Globigerina, *Orb.*

Globigerina bulloides, *d'Orbigny.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 24, 987 fms.; 31, 1158 fms.; 45, 2107 fms.; 48, 2298 fms.; 55, 507 fms.; 68, 1143 fms.; 83, 1340 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 141, 2741 fms.; 142, 2435 fms.; 150, 2438 fms.

Globigerina triloba, *Reuss.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 31, 1158 fms.; 45, 2107 fms.; 48, 2298 fms.; 55, 507 fms.; 68, 1143 fms.; 78, 1570 fms.; 83, 1340 fms.; 88, 731 fms.; 96, 1245 fms.; 105, 2400 fms.; 109, 604 fms.; 148, 2620 fms.; 149, 2550 fms.

Globigerina rubra, *Orb.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 24, 987 fms.; 31, 1158 fms.; 48, 2298 fms.; 105, 2400 fms.; 109, 604 fms.

Globigerina trochoides, *Reuss.* (Plate **55**. fig. 13.)

Globigerina trochoides, Reuss ('45), p. 36, pl. 12. fig. 22; id. ('51), p. 37, pl. 3. fig. 5; Egger ('93), p. 367, pl. 13. figs. 39–41.

This species is distinguished from the nearly related *G. rubra* by the more acuminately grouped series of chambers and their lesser inflation, as well as by the absence of colour. Some of the tests found here are quite pointed at the apex. Dr. Egger recorded this species from the Fiji Islands at 3200 metres.

Occurrence.—Sta. 4, 2728 fms.; 11, 1417 fms.; 45, 2107 fms.

Globigerina conglobata, *Brady.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 28, 1505 fms.; 31, 1158 fms.; 45, 2107 fms.; 48, 2298 fms.; 55, 507 fms.; 68, 1143 fms.; 78, 1570 fms.; 83, 1340 fms.; 84, 913 fms.; 86, 513 fms.; 88, 731 fms.; 96, 1245 fms.; 105, 2400 fms.; 109, 604 fms.; 140, 2476 fms.; 141, 2741 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

Globigerina æquilateralis, *Brady*.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 78, 1570 fms.; 83, 1340 fms.; 86, 513 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 142, 2435 fms.; 148, 2620 fms.; 150, 2438 fms.

Globigerina dubia, *Egger*.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 13, 1050 fms.; 32, 735 fms.; 105, 2400 fms.; 141, 2741 fms.; 150, 2438 fms.

Globigerina dutertrei, *Orb.*

Occurrence.—Sta. 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 96, 1245 fms.; 105, 2400 fms.; 109, 604 fms.; 140, 2476 fms.

Globigerina subcretacea, *Chapman*.

The examples found here are quite comparable with Brady's figured specimens, and are easily distinguished from the Cretaceous fossils by the depressed spire and more heavily built test.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

Globigerina inflata, *Orb.*

Occurrence.—Sta. 11, 1417 fms.

Globigerina sacculifera, *Brady*.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 78, 1570 fms.; 83, 1340 fms.; 105, 2400 fms.; 109, 604 fms.; 141, 2741 fms.; 150, 2438 fms.

Globigerina digitata, *Brady*.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 90, 590 fms.; 150, 2438 fms.

Genus Orbulina, *Orb.*

Orbulina universa, *Orb.*

Occasional aberrant forms are found here, having two chambers.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 55, 507 fms.; 105, 2400 fms.; 141, 2741 fms.; 150, 2438 fms.

Genus Hastigerina, *Wyville Thomson.*

Hastigerina pelagica, *Orb.*, sp.

A few specimens of this fragile foraminifer were found, more or less broken, in these bottom-dredgings.

Occurrence.—Sta. 13, 1050 fms.; 20, 1215 fms.

Genus Pullenia, *Parker & Jones.*

Pullenia obliquiloculata, *Parker & Jones.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 55, 507 fms.; 68, 1143 fms.; 78. 1570 fms.; 83, 1340 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 138, 2688 fms.; 140, 2476 fms.; 141, 2741 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

Pullenia quinqueloba, *Reuss.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 13, 1050 fms.; 21, 2195 fms.; 48, 2298 fms.; 105, 2400 fms.; 138, 2688 fms.; 142, 2435 fms.

Pullenia sphæroides, *Orb.*, sp.

Occurrence.—Sta. 4, 2728 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 140, 2476 fms.

Genus Sphæroidina, *Orb.*

Sphæroidina bulloides, *Orb.*

Occurrence.—Sta. 48, 2298 fms.

Sphæroidina dehiscens, *Parker & Jones.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 28, 1505 fms.; 47, 2107 fms.; 48, 2298 fms.; 78, 1570 fms.; 88, 731 fms.; 90, 590 fms.; 105, 2400 fms.; 109, 604 fms.; 141, 2741 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

Genus Candeina, *Orb.*

Candeina nitida, *Orb.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 96, 1245 fms.; 105, 2400 fms.

Family ROTALIIDÆ.

Genus Spirillina, *Ehrenberg.*

Spirillina obconica, *Brady.*

Only once before does this species appear to have been recorded from the Pacific, at the Admiralty Islands, 17 fathoms ('Challenger').

Occurrence.—Sta. 29, 475 fms.

Spirillina decorata, *Brady,* var. unilatera, *Chapman.*

Spirillina decorata, Brady, var. *unilatera,* Chapman ('02), p. 410, pl. 36. figs. 17 *a, b.*

This variety has been previously described from the dredgings at 200 fathoms off Tutanga, Funafuti Atoll.

Occurrence.—Sta. 55, 507 fms.

Genus Patellina, *Williamson.*

Patellina corrugata, *Williamson.*

The subjoined record is by far the deepest sounding which has yielded the above-named typically shallow to moderately-shallow water foraminifer. The greatest depths at which the 'Gazelle' obtained it were, at the Mauritius, 411 metres, and off Western Australia at 1187 metres. It was previously noticed from Funafuti (off Tutanga) at 200 fathoms.

Occurrence.—Sta. 48, 2298 fms.

Genus Discorbina, *Parker & Jones.*

Discorbina globularis, *Orb.*, sp. (Plate **55.** figs. 14 *a, b.*)

The deepest sounding hitherto yielding this species is that recorded by the 'Challenger' at 450 fathoms.

Occurrence.—Sta. 45, 2107 fms.; 48, 2298 fms.

Genus Planorbulina, *Orb.*

Planorbulina mediterranensis, *Orb.*

Occurrence.—Sta. 109, 604 fms.

Genus Truncatulina, *Orb.*

Truncatulina lobatula, *Walker & Jacob*, sp.

Occurrence.—Sta. 109, 604 fms.

Truncatulina variabilis, *Orb.*, sp.

Occurrence.—Sta. 10, 1485 fms.

Truncatulina refulgens, *Montfort*, sp.

The range in depth of this species is very great, and previous records extend down to 2400 fathoms.

Occurrence.—Sta. 4, 2728 fms.; 109, 604 fms.

Truncatulina akneriana, *Orb.*, sp.

Dr. Egger records this species from the 'Gazelle' soundings at depths from 347–951 metres.

Occurrence.—Sta. 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 109, 604 fms.

Truncatulina ungeriana, *Orb.*, sp.

This and the following species are by far the commonest of the present genus in the Funafuti deep-sea deposits. The 'Challenger' obtained the deepest examples of *T. ungeriana* from 2600 fathoms.

Occurrence.—Sta. 4, 2728 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 140, 2476 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.

Truncatulina wuellerstorfi, *Schwager*, sp.

The deepest examples hitherto recorded were from 2435 fathoms, by the 'Challenger.'

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 48, 2298 fms.; 105, 2400 fms.; 148, 2620 fms.

Truncatulina haidingeri, *Orb.*, sp.

Occurrence.—Sta. 11, 1417 fms.; 68, 1143 fms.; 138, 2688 fms.

Truncatulina humilis, *Brady.*

This is a deep-water form, first found in the 'Challenger' soundings from the North Atlantic and North Pacific.

Occurrence.—Sta. 3, 2715 fms.; 140, 2476 fms.

TRUNCATULINA TENERA, *Brady*.

A small but otherwise typical specimen.

Occurrence.—Sta. 45, 2107 fms.

TRUNCATULINA DUTEMPLEI, *Orb.*, sp.

Occurrence.—Sta. 4, 2728 fms. ; 105, 2400 fms.

TRUNCATULINA CULTER, *Parker & Jones*, sp.

The examples here recorded from 2107 fathoms are from the deepest habitat known for this species.

Occurrence.—Sta. 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms.

TRUNCATULINA PYGMÆA, *Hantken*.

Occurrence.—Sta. 3, 2715 fms. ; 4, 2728 fms. ; 11, 1417 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 68, 1143 fms. ; 105, 2400 fms. ; 138, 2688 fms. ; 140, 2476 fms. ; 148, 2620 fms. ; 149, 2550 fms. ; 150, 2438 fms.

TRUNCATULINA RETICULATA, *Czjzek*, sp.

Occurrence.—Sta. 4, 2728 fms. ; 109, 604 fms.

Genus ANOMALINA, *Parker & Jones*.

ANOMALINA AMMONOIDES, *Reuss*, sp.

Occurrence.—Sta. 109, 604 fms.

ANOMALINA GROSSERUGOSA, *Gümbel*, sp.

Occurrence.—Sta. 10, 1485 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 45, 2107 fms. ; 140, 2476 fms. ; 150, 2438 fms.

ANOMALINA POLYMORPHA, *Costa*.

Two examples only occur in the Funafuti deep-sea soundings. The previous records of the species show no very great depth of habitat, the maximum being 450 fathoms off Sombrero Isl. by the 'Challenger' (*Brady*) and 677 metres off West Africa by the 'Gazelle' (*Egger*).

Occurrence.—Sta. 4, 2728 fms. ; 13, 1050 fms.

Genus PULVINULINA, *Parker & Jones*.

PULVINULINA ELEGANS, *Orb.*, sp.

These are generally well-formed examples with the high, stout test of the deeper-water variety.

Occurrence.—Sta. 3, 2715 fms. ; 4, 2728 fms. ; 11, 1417 fms. ; 13, 1050 fms. ; 19, 1995 fms. ; 20, 1215 fms. ; 21, 2195 fms. ; 48, 2298 fms. ; 105, 2400 fms. ; 140, 2476 fms. ; 148, 2620 fms.

PULVINULINA REPANDA, *Fichtel & Moll*, sp.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.

PULVINULINA EXIGUA, *Brady*.

Common in most of the soundings at great depths.

Occurrence.—Sta. 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.; 140, 2476 fms.; 148, 2620 fms.; 150, 2438 fms.

PULVINULINA MENARDII, *Orb.*, sp.

Excessively abundant in nearly all the samples.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 28, 1505 fms.; 29, 475 fms.; 45, 2107 fms.; 48, 2298 fms.; 78, 1570 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 141, 2741 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

PULVINULINA MENARDII, *Orb.*, sp., var. FIMBRIATA, *Brady*.

A single example only, with a very finely spinose margin.

Occurrence.—Sta. 45, 2107 fms.

PULVINULINA TUMIDA, *Brady*.

This form is almost as common in these soundings as the related *P. menardii*.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 60, 451 fms.; 68, 1143 fms.; 78, 1570 fms.; 83, 1340 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 138, 2688 fms.; 140, 2476 fms.; 141, 2741 fms.; 142, 2435 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

PULVINULINA PATAGONICA, *Orb.*, sp.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 21, 2195 fms.; 23, 735 fms.; 48, 2298 fms.; 68, 1143 fms.; 105, 2400 fms.

PULVINULINA CANARIENSIS, *Orb.*, sp.

Occurrence.—Sta. 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.

PULVINULINA CRASSA, *Orb.*, sp.

Occurrence.—Sta. 2, 1489 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 45, 2107 fms.; 105, 2400 fms.; 141, 2741 fms.; 150, 2438 fms.

PULVINULINA TRUNCATULINOIDES, *Orb.*, sp.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 28, 735 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 86, 513 fms.

PULVINULINA HAUERII, *Orb.*, sp.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 48, 2298 fms.; 68, 1143 fms.; 88, 731 fms.; 105, 2400 fms.; 109, 604 fms.; 142, 2435 fms.; 150, 2438 fms.

PULVINULINA PAUPERATA, *Parker & Jones.*

Examples rather small.

Occurrence.—Sta. 2, 1489 fms.; 10, 1485 fms.; 13, 1050 fms.; 20, 1215 fms.; 23, 735 fms.; 45, 2107 fms.; 48, 2298 fms.

PULVINULINA FAVUS, *Brady.* (Plate **55**. fig. 15.)

This peculiar little species is fairly common in these soundings. Dr. Brady remarks that it is almost entirely confined to the Pacific, and appears to be an almost essentially deep-water form. The surfaces of young examples are very distinctly honeycombed, and show a tendency to become spinous on the margin. Dr. Egger notes this species off Cape Town and the Mauritius in moderately deep water.

Occurrence.—Sta. 3, 2715 fms.; 4, 2728 fms.; 10, 1485 fms.; 13, 1050 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 105, 2400 fms.; 138, 2688 fms.; 150, 2438 fms.

Genus ROTALIA, *Lamarck.*

ROTALIA BROECKHIANA, *Karrer.*

Rotalia broeckhiana, Karrer; Egger ('93), p. 421, pl. 19. figs. 19–21; Millett ('04), Rep. Malay Foram. p. 503.

The examples found here are characteristic in form, but small. The present occurrences constitute a record for deep water. It has been previously noticed off the Ki Islands at 580 fathoms, off Western Australia at 196 fathoms, and in anchor-mud in the Malay Archipelago.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.; 21, 2195 fms.; 48, 2298 fms.

ROTALIA SOLDANII, *Orb.*

This species is here typical and fairly common. It appears to be most at home in deep-water habitats.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 20, 1215 fms.; 21, 2195 fms.; 48, 2298 fms.; 105, 2400 fms.

ROTALIA ORBICULARIS, *Orb.*

Occurrence.—Sta. 4, 2728 fms.; 13, 1050 fms.; 19, 1995 fms.

ROTALIA *cf.* DENTATA, *Parker & Jones.* (Plate **55.** fig. 16.)

Rotalia dentata, Parker & Jones ('65), p. 387, pl. 19. figs. 13 *a–c.*

A somewhat obscure rotaline form, with reticulate secondary growth on the shell-surface and with a few short spines on the periphery, may be provisionally referred to this species.

Occurrence.—Sta. 11, 1417 fms.

Genus CALCARINA, *Orb.*

CALCARINA SPENGLERI, *J. F. Gmel.*, sp.

The specimens found here are more or less abraded, and resemble those from a detrital and shallow-water deposit. Nevertheless the species has been once recorded from deep water, off Amboyna at 1425 fathoms.

Occurrence.—Sta. 78, 1570 fms.

Genus TINOPORUS, *Montfort.*

TINOPORUS BACULATUS, *Montfort.*

This species is usually found in moderately shallow water. The examples from Funafuti are all somewhat abraded.

Occurrence.—Sta. 55, 507 fms.; 78, 1570 fms.

Genus POLYTREMA, *Risso.*

POLYTREMA MINIACEUM, *Pallas*, sp.

The sounding recorded below represents a moderately shallow-water fauna, whose limit has been reached at this depth. The tests of *P. miniaceum* are here quite typical and have the characteristic rose-pink colour of specimens from less depths.

Occurrence.—Sta. 55, 507 fms.

Family NUMMULINIDÆ.

Genus NONIONINA, *Orb.*

NONIONINA DEPRESSULA, *Walker & Jacob,* sp.

It is remarkable to find this almost essentially shallow-water species so common at the great depths recorded below. The specimens are quite typical.

Occurrence.—Sta. 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 48, 2298 fms.; 109, 604 fms.; 140, 2476 fms.; 148, 2620 fms.; 149, 2550 fms.; 150, 2438 fms.

NONIONINA UMBILICATULA, *Montagu*, sp.

This form is less restricted to shallow water than *N. depressula*, and has been recorded from depths as great as 3125 fathoms.

Occurrence.—Sta. 3, 2715 fms. ; 11, 1417 fms. ; 13, 1050 fms. ; 20, 1215 fms. ; 21, 2195 fms. ; 45, 2107 fms. ; 48, 2298 fms. ; 105, 2400 fms. ; 138, 2688 fms. ; 148, 2620 fms. ; 150, 2438 fms.

NONIONINA POMPILIOIDES, *Fichtel & Moll*, sp.

The above species is more typical of deep water than even the preceding form, and it is therefore the more curious to find it comparatively rare in these deeper soundings.

Occurrence.—Sta. 20, 1215 fms. ; 21, 2195 fms. ; 138, 2688 fms.

Genus POLYSTOMELLA, *Lam.*

POLYSTOMELLA STRIATOPUNCTATA, *Fichtel & Moll*, sp.

Occurrence.—Sta. 11, 1417 fms.

POLYSTOMELLA CRISPA, *Linné*, sp.

The previously recorded depths for this species range down to 355 fathoms only.

Occurrence.—Sta. 3, 2715 fms. ; 105, 2400 fms.

Genus AMPHISTEGINA, *Orb.*

AMPHISTEGINA LESSONII, *Orb.*

Although this species has occasionally been recorded from deep-sea soundings, it had not been noticed from any greater depth than 1750 fathoms.

Occurrence.—Sta. 23, 735 fms. ; 24, 987 fms. ; 28, 1505 fms. ; 29, 475 fms. ; 31, 1158 fms. ; 55, 507 fms. ; 60, 451 fms. ; 68, 1143 fms. ; 78, 1570 fms. ; 83, 1340 fms. ; 86, 513 fms. ; 96, 1245 fms. ; 109, 604 fms. ; 141, 2741 fms.

Genus HETEROSTEGINA, *Orb.*

HETEROSTEGINA DEPRESSA, *Orb.*

Occurrence.—Sta. 55, 507 fms.

Genus CYCLOCLYPEUS, *Carpenter.*

CYCLOCLYPEUS CARPENTERI, *Brady.*

All the examples found were of the megalospheric type (= *C. guembelianus* of the ‘Challenger’ report).

Occurrence.—Sta. 55, 507 fms.

The Ostracoda of the Funafuti Deep-Sea Deposits.

Section **Podocopa.**

Family CYPRIDÆ.

Genus AGLAIA, *G. S. Brady.*

AGLAIA CLAVATA, *G. S. Brady.*

Aglaia clavata, G. S. Brady ('80), p. 34, pl. 6. figs. 4 *a–d.*

This rare form has been only once previously recorded, from Wellington Harbour, New Zealand, where a few specimens were taken from the tow-net at trawl.

Occurrence.— Sta. 13, 1050 fms. One valve.

(?) AGLAIA OBTUSATA, *G. S. Brady.*

(?) *Aglaia obtusata*, G. S. Brady ('80), p. 35, pl. 30. figs. 8 *a–d.*

"Dredged in Balfour Bay, Kerguelen Island, in a depth of 20 to 50 fathoms." (*G. S. Brady.*)

One valve of this rare form was found in the present series.

Occurrence.—Sta. 13, 1050 fms.

(?) AGLAIA *cf.* MERIDIONALIS, *G. S. Brady.*

(?) *Aglaia meridionalis*, G. S. Brady ('80), p. 34, pl. 30. figs. 7 *a–d.*

Brady's original specimen was from anchor-mud at a depth of 6 fathoms in Stanley Harbour, Falkland Islands.

One valve in the present collection, agreeing in lateral outline with Brady's figured specimen, but with a more swollen posterior extremity seen in edge view.

Occurrence.—Sta. 20, 1215 fms.

Genus PONTOCYPRIS, *G. O. Sars.*

PONTOCYPRIS TRIGONELLA, *G. O. Sars.*

Pontocypris trigonella, G. O. Sars ('65), p. 16; G. S. Brady ('68^2), p. 387, pl. 25. figs. 31–34, pl. 28. fig. 3; Brady, Crosskey, & Robertson ('74), p. 137, pl. 16. figs. 26–28; G. S. Brady ('80), p. 36, pl. 15. figs. 4 *a–d*; Brady & Norman ('89), p. 109, pl. 22. figs. 18–25, pl. 23. fig. 6; Egger ('01), p. 422, pl. 1. figs. 16, 17.

This species has a very wide geographical range, being found in Northern Europe, the Mediterranean, and the N. Atlantic. It is found fossil in the Post-tertiary deposits of Scotland. The present occurrence appears to be in exceptionally deep water for this species, as the British examples only affect depths down to 30 fathoms. In the 'Challenger' dredgings this species occurred off Bermudas at 435 fathoms. Egger records it from several localities in the S. Atlantic and the Indian Ocean.

Occurrence.—Sta. 10, 1485 fms. One typical specimen.

Pontocypris attenuata, *G. S. Brady.*

Pontocypris attenuata, G. S. Brady ('68[1]), p. 179, pl. 4. figs. 11–14; id. ('80), p. 38, pl. 15. figs. 2 *a–d*; id. ('90), p. 49, pl. 1. figs. 3, 4; Chapman ('02[2]), p. 419.

This was formerly known as a typically shallow-water species until specimens were obtained round Funafuti at 150 and 200 fathoms.

Occurrence.—Sta. 20, 1215 fms. One example, having an acuminate posterior.

Pontocypris gracilis, *G. S. Brady.*

Pontocypris gracilis, G. S. Brady ('90), p. 491, pl. 1. figs. 5, 6.

Prof. Stewardson Brady's localities for the original species are Levuka, and Rambé Island, S. Seas, between tide-marks.

The present specimens are in nearly all particulars similar to Brady's described examples.

Occurrence.—Sta. 20, 1215 fms.

Pontocypris (?) faba, *Reuss*, sp.

Bairdia faba, Reuss ('55), p. 178, pl. 10. fig. 2.
Pontocypris faba, Reuss, sp.; G. S. Brady ('78), p. 382, pl. 63. figs. 6 *a–e*.
P. (?) *faba*, Reuss, sp., id. ('80), p. 37, pl. 1. figs. 4 *a–d*.
P. faba, Reuss, sp.; Egger ('01), p. 420, pl. 4. figs. 44, 45.

Previously found by Dr. Brady only in shallow water in the Southern Ocean and the South Pacific.

Occurrence.—Sta. 13, 1050 fms. Two left valves.

Pontocypris davidiana, sp. nov. (Plate **56**. figs. 17 *a*, *b*.)

Description.—Carapace somewhat compressed, siliquose. Seen from the side, elongate, subtriangular and strongly curved; highest in front, sharply attenuated behind; dorsal margin evenly curved, ventral margin nearly straight from a little in front of the middle to the posterior angle; anterior border boldly rounded. In edge view thickest in the middle. Surface smooth. Length ·875 mm.; greatest height ·354 mm.

This is a very distinct and elegant form. It differs from *P. gracilis* in the strong curvature and broad anterior extremity, and from *P. sicula* in the gradually increasing width from point to head. I have much pleasure in naming this species in honour of Prof. David, F.R.S., who carried out the boring at Funafuti to so successful an issue.

Occurrence.—Sta. 13, 1050 fms.

Genus ARGILLŒCIA, *G. O. Sars.*

ARGILLŒCIA EBURNEA, *G. S. Brady.*

Argillœcia eburnea, G. S. Brady ('80), Rep. Chall. Zool. pt. iii. p. 40, pl. 4. figs. 1–15; Egger ('01), p. 422, pl. 4. figs. 49–51.

This species has previously occurred in the S. Atlantic and the S. Indian Oceans. It appears to be a new record for the S. Pacific.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.

ARGILLŒCIA AFFINIS, *Chapman.*

Argillœcia affinis, Chapman ('02[2]), p. 419, pl. 37. figs. 1 *a–c.*

A. affinis was described in a former paper from a single sounding of the present series, viz. Sta. 2, 1489 fathoms. It is now recorded from three other soundings, and in three out of the four it is accompanied by *A. eburnea.*

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 11, 1417 fms.; 13, 1050 fms.

ARGILLŒCIA GRACILIOR, sp. nov. (Plate **56.** figs. 18 *a*, *b*.)

Description.—Carapace elongate, compressed; seen from the side, subpyriform; height about one-third the length. Dorsal border gently arched, sometimes flattened in the middle; antero-ventral border rounded; near the middle of the ventral margin there is a well-marked sinus, followed by a wide convexity curving to meet the posterior extremity at an acute angle. In edge view the posterior extremity is seen to be much more compressed than in *A. eburnea.* Length ·7 mm.; height ·27 mm.; thickness of carapace ·27 mm.

Affinities.—Related to *A. eburnea*, but having a much larger and proportionately narrower carapace, as well as the greater posterior compression previously noticed. From *A. cylindrica*, G. O. Sars, it differs chiefly in the sharp posterior angle.

Occurrence.—Sta. 13, 1050 fms.; 20, 1215 fms. A moderately frequent species.

Genus BYTHOCYPRIS, *G. S. Brady.*

BYTHOCYPRIS ELONGATA, *G. S. Brady.*

Bythocypris elongata, G. S. Brady ('80), p. 47, pl. 6. figs. 1 *a–c*; Egger ('01), p. 424, pl. 1. figs. 48–50.

Brady's specimens were found N. of Tristan d'Acunha, at a depth of 1425 fathoms; Egger's came from near Kerguelen Island, 104 metres.

Occurrence.—Sta. 13, 1050 fms.

BYTHOCYPRIS SOLLASI, sp. nov. (Plate **56.** figs. 19 *a–c*.)

Description.—Carapace subreniform, compressed. Seen from the side the anterior extremity is broadly rounded; dorsal margin of left valve strongly arched, of the right valve nearly straight in the middle; on the right side showing a conspicuous overlapping of the left valve; the lower posterior third of the dorsal margin slopes rapidly inwards, curving to the tapering posterior angle, at which it meets the gently sinuous ventral border, giving an almost pyriform outline to the carapace. Anterior of left valve, the middle of the dorsal line, and the whole length of the ventral line showing a marked overlap. Edge view ovate, compressed, and sharp at both extremities; left valve slightly more tumid than the right. Lucid spots about ten in number, of irregular shape, forming a distinct group in the median area. Length 1·1 mm.; height ·625 mm.; thickness of carapace ·312 mm.

This species cannot be referred to *Bythocypris bosquetiana*, G. S. Brady, sp.*, on account of the remarkable attenuate extremity. In most other particulars it agrees with the form just mentioned, but another striking point of difference is the fewer lucid spots in *B. bosquetiana*. The species is named in honour of Prof. W. J. Sollas, LL.D., D.Sc., F.R.S., who inaugurated the work of boring at Funafuti.

Occurrence.—Sta. 13, 1050 fms.

(?) BYTHOCYPRIS HETERODOXA, sp. nov. (Plate 56. figs. 20 *a*, *b*.)

Description.—Left valve subovate in lateral aspect; anterior extremity broadly rounded; ventral border nearly straight; dorsal line strongly arched and sloping rapidly to meet the ventral line at a rather sharp angle. Surface faintly pitted; bearing a sharp spine in the middle of the valve close to the dorsal margin, which curves outwards and downwards. Edge view elongately subovate, compressed at the extremities.

Length ·687 mm.; height ·54 mm.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.

Genus BAIRDIA, *McCoy.*

BAIRDIA FOVEOLATA, *G. S. Brady.*

Bairdia foveolata, G. S. Brady ('80), p. 55, pl. 8. figs. 1 *a–f*, 2 *a–f*; id. ('90), p. 493; Egger ('01), p. 426, pl. 2. figs. 1–4; Chapman ('02²), p. 423.

This is one of the commonest species of *Bairdia* found round Funafuti, but mainly restricted to shallow water.

Occurrence.—Sta. 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.

* *Bairdia bosquetiana*, G. S. Brady, Trans. Zool. Soc. vol. v. 1865, p. 364, pl. 57. figs. 5 *a–c*. *Bythocypris reniformis*, G. S. Brady, 1880, Rep. Chall. Zool. pt. iii. p. 46, pl. 5. figs. 1 *a–l*. *Bythocypris bosquetiana*, G. S. Brady, sp., Brady & Norman, 1889, Trans. R. Dubl. Soc. ser. 2, vol. iv. no. ii. p. 120, pl. 14. figs. 34, 35.

Bairdia formosa, *G. S. Brady*. (Plate 56. fig. 21.)

Bairdia formosa, G. S. Brady ('68[1]), p. 221, pl. 14. figs. 5–7; id. ('80), p. 52, pl. 10. figs. 1 *a–e*.

Two valves were found in the present soundings, both of which represent young individuals. One of these is more elongate than usual, but in this it resembles the forms found by Brady in the Mediterranean; and instead of the numerous spines at the extremities, there is only one stout spine at each end. The other valve is more typical in outline, and bears a few minute spines at the posterior end along with a stronger terminal spine.

Occurrence.—Sta. 13, 1050 fms.

Bairdia milne-edwardsi, *G. S. Brady*.

Bairdia milne-edwardsi, G. S. Brady ('67), vol. i. p. 139, pl. 17. figs. 3, 4; id. ('80), p. 56, pl. 10. figs. 4 *a–g*; id. ('90), p. 494; Chapman ('02[2]), p. 422.

The examples previously recorded from Funafuti were mainly from shallow depths, with one from 200 fathoms. Dr. Brady obtained this species from only one locality, viz. off St. Vincent, Cape Verde, 1070–1150 fathoms.

Occurrence.—Sta. 13, 1050 fms.; 55, 507 fms.

Bairdia victrix, *G. S. Brady*.

Bairdia victrix, G. S. Brady ('80), p. 56, pl. 10. figs. 5 *a–d*.

Occurrence.—Sta. 13, 1059 fms. One separate valve.

Bairdia woodwardiana, *G. S. Brady*.

Bairdia woodwardiana, G. S. Brady ('80), p. 57, pl. 11. figs. 1 *a–e*; id. ('90), p. 494; Chapman ('02[2]), p. 421.

The 'Challenger' dredgings yielded this species from one locality only, viz., Tongatabu, 18 fathoms; and Dr. Brady has since found it at Taviuni, S. Seas.

Occurrence.—Sta. 2, 1489 fms.; 13, 1059 fms.; 55, 507 fms.

Bairdia crosskeiana, *G. S. Brady*.

Bairdia crosskeiana, G. S. Brady ('66), p. 366, pl. 57. figs. 10 *a–d*; id. ('80), p. 58, pl. 9. figs. 3 *a–c*; Brady & Norman ('89), p. 115, pl. 10. figs. 3, 4; Chapman ('02[2]), p. 421.

A single valve, comparable in edge view with that figured by Brady and Norman. The posterior extremity terminates in a short spine.

Occurrence.—Sta. 55, 507 fms.

Bairdia expansa, *G. S. Brady*.

Bairdia expansa, G. S. Brady ('80), p. 58, pl. 11. figs. 2 *a–e*; id. ('90), p. 495.

In edge view this species is very broad and tumid. In our specimens the anterior border is more evenly rounded. The expanded and denticulate margin is similar to Brady's specimen, found off Honolulu at 40 fathoms.

That author also records it from the South Sea Islands and from Noumea, in quite shallow water.

Occurrence.—Sta. 13, 1050 fms. ; 20, 1215 fms.

BAIRDIA MINIMA, *G. S. Brady.*

Bairdia minima, G. S. Brady ('80), p. 53, pl. 7. figs. 6 *a–g.*

Previously recorded from Port Jackson, N. S. Wales, 6 fathoms, and from the Pacific, 'Challenger' Sta. 246, 2050 fathoms.

Occurrence.—Sta. 20, 1215 fms.

Family CYTHERIDÆ.

Genus CYTHERE, *Müller.*

CYTHERE MOSELEYI, *G. S. Brady.*

Cythere moseleyi, G. S. Brady ('80), p. 64, pl. 12. figs. 5 *a–f.*

A fine carapace of a male specimen, having the approximately tapering posterior extremity, occurs in this series.

The species was originally described from examples found in shallow water off the Falkland Islands.

Occurrence.—Sta. 13, 1050 fms.

CYTHERE PARALLELOGRAMMA, *G. S. Brady.*

Cythere parallelogramma, G. S. Brady ('80), p. 82, pl. 15. figs. 1 *a–e*; Egger ('01), p. 442, pl. 6. figs. 15, 16.

Previously recorded from Prince Edward's Island.

Occurrence.—Sta. 10, 1485 fms. ; 11, 1417 fms. ; 13, 1050 fms. ; 21, 2195 fms.

CYTHERE RASTROMARGINATA, *G. S. Brady.*

Cythere rastromarginata, G. S. Brady ('80), p. 83, pl. 14. figs. 1 *a–d,* 2 *a–d*; Egger ('01), p. 442, pl. 6. figs. 5–9.

Recorded from the South Pacific and the Southern Ocean, in shallow to moderately shallow waters.

Occurrence.—Sta. 11, 1417 fms. ; 13, 1050 fms.

CYTHERE TORTICOLLIS, *G. S. Brady.*

Cythere torticollis, G. S. Brady ('90), p. 500, pl. 3. figs. 1, 2.

The original specimens of Dr. Brady's came from Noumea, New Caledonia, from shore-sand and from 2–6 fathoms.

Occurrence.—Sta. 13, 1050 fms. One left valve.

CYTHERE DASYDERMA, *G. S. Brady.*

Cythere dasyderma, G. S. Brady ('80), p. 105, pl. 17. figs. 4 *a–f.*

This species is characteristic of deep-water habitats.

Occurrence.—Sta. 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.

CYTHERE QUADRIACULEATA, *G. S. Brady.*

Cythere quadriaculeata, G. S. Brady ('80), p. 86, pl. 22. figs. 2 *a–d,* pl. 25. figs. 4 *a–d.*

The deep-water specimens found in the present series have thinner carapaces than those from shallower depths.

Brady records the species from Japan, 15 fathoms; and off the reefs at Honolulu at 40 fathoms.

Occurrence.—Sta. 13, 1050 fms.; 20, 1215 fms.

CYTHERE CURVICOSTATA, *G. S. Brady,* var. PHYLLOIDES, *Chapman.*

Cythere phylloides, Chapman ('02[2]), p. 424, pl. 37. figs. 3 *a–c.*

Further examples of this form prove it to be a sparsely costate variety of the above species, with impressed punctæ in the place of regularly defined pits arranged in rows between the riblets.

Occurrence.—Sta. 3, 2715 fms.; 20, 1215 fms.

CYTHERE CURVICOSTATA, *G. S. Brady,* var. FUNAFUTIENSIS, nov. (Plate **57**. fig. 22.)

This beautiful variety differs from the specific form as defined by Dr. Brady in the following particulars:—The anterior border is devoid of the armature of small teeth, being quite smooth. The surface sculpture is more numerously costate, and the ribs are clear and sharp.

Occurrence.—Sta. 20, 1215 fms.

CYTHERE SWEETI, sp. nov. (Plate **57**. figs. 23 *a, b.*)

Description.—Valves, seen laterally, nearly oblong, higher in front and narrowing posteriorly. Height a little more than half the length. Anterior border broad, rounded, and with a deep sulcus behind. Surface of valves rising prominently towards the middle and ventral side; the highest point in the postventral area terminating with a short, sharp spine. Dorsal margin straight, with a sudden sinuous turn to the posterior angle. Ventral margin sinuous, and curving round to meet the posterior acumination. Surface of valves finely sculptured with a polygonal network, the areolæ tending to run into straight lines parallel with the dorsal and ventral borders. Edge view subovate, compressed anteriorly. Length ·7 mm.; height ·375 mm.; thickness of carapace ·34 mm.

This species is distinct from *C. dictyon*, which it most resembles, in having a rounded ridge-swelling on the ventral margin, instead of a sharp, angulated ridge, as well as in the finer sculpturing of the valve-surface.

This species is named in honour of my friend Mr. G. Sweet, who so ably assisted Professor David in the work of boring in the Funafuti Atoll.

Occurrence.—Sta. 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.

CYTHERE VIMINEA, *G. S. Brady.*

Cythere viminea, G. S. Brady ('80), p. 94, pl. 18. figs. 3 *a–c*.

A right valve occurs in the present collection, which agrees with Brady's species in almost all essential characters, but is slightly larger, and the surface-sculpturing of polygonal fossæ is rather more minute.

The 'Challenger' specimen was found at a depth of 1375 fathoms in the Southern Ocean.

Occurrence.—Sta. 10, 1485 fms.

CYTHERE DICTYON, *G. S. Brady.*

Cythere dictyon, G. S. Brady ('80), p. 99, pl. 24. figs. 1 *a–y*; Egger ('01), p. 442, pl. 6. figs. 41–43.

This is one of the most widely distributed of the deep-sea Ostracoda. The 'Challenger' specimens were found mainly between 1000 and 2000 fathoms, the least depth recorded being 120 fathoms. The sculpture on the valves of a few of the Funafuti examples is much finer and neater than in typical specimens, and the anterior rim is more strongly defined.

Occurrence.—Sta. 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 20, 1215 fms.; 45, 2107 fms.; 105, 2400 fms.

CYTHERE VELIVOLA, *G. S. Brady.*

Cythere velivola, G. S. Brady ('80), p. 111, pl. 23. figs. 4 *a–c*.

This peculiarly ornamented little species was found in the 'Challenger' dredgings from S.W. of New Guinea, 28 fathoms.

The only example found in the present series is a right valve, which differs from the figured specimens of Dr. Brady's in its sharply pointed posterior extremity.

Occurrence.—Sta. 10, 1485 fms.

(?) CYTHERE SERRATULA, *G. S. Brady.*

(?) *Cythere serratula*, G. S. Brady ('80), p. 77, pl. 43. figs. 7 *a–d*.

Previously recorded off Culebra Isl., West Indies, 390 fathoms; off Canaries, 1125 fathoms; and N. of Tristan d'Acunha, 1425 fms.

Occurrence.—Sta. 13, 1050 fms.

Genus Krithe, *Brady, Crosskey, & Robertson.*

Krithe producta, *G. S. Brady.*

Krithe producta, G. S. Brady ('80), p. 114, pl. 27. figs. 1 *a–j*; Brady & Norman ('89) p. 180, pl. 17. figs. 5–7; Egger ('01), p. 451, pl. 4. figs. 17, 18; Chapman ('02²), p. 427.

This species has a wide distribution, ranging from the N. Atlantic to the Southern Ocean. It does not appear to have been recorded from any typical S. Pacific areas before it was noted from Funafuti (*vide supra*). Egger notes it from near Australia and Kerguelen Island. It is most at home in some of the deepest parts of the ocean.

Occurrence.—Sta. 2, 1489 fms.; 3, 2715 fms.; 10, 1485 fms.; 11, 1417 fms.; 13, 1050 fms.; 19, 1995 fms.; 20, 1215 fms.; 21, 2195 fms.; 45, 2107 fms.; 48, 2298 fms.; 68, 1143 fms.; 105, 2400 fms.

Krithe tumida, *G. S. Brady.*

Krithe tumida, G. S. Brady ('80), p. 115, pl. 27. figs. 4 *a–d*; Egger ('01), p. 451, pl. 4. figs. 19–21.

Dr. Brady records this species from one locality only, in the S. Atlantic, at a depth of 1900 fathoms. Egger obtained it in the 'Gazelle' dredgings off the W. coast of Australia at 357 metres.

A few typical valves occur in the present series.

Occurrence.—Sta. 19, 1995 fms.; 20, 1215 fms.

Krithe hyalina, *G. S. Brady.*

Krithe hyalina, G. S. Brady ('80), p. 115, pl. 27. figs. 3 *a–d*.

This species occurred in only one sample of the 'Challenger' dredgings, in the Inland Sea of Japan, 15 fathoms.

Occurrence.—Sta. 3, 2715 fms. (one valve); 20, 1215 fms. (two valves).

Krithe angusta, *Brady & Norman.*

Krithe angusta, Brady & Norman ('89), p. 181, pl. 17. figs. 10–13.
K. prælonga, Egger ('01), p. 450, pl. 4. figs. 11, 12.

It is of great interest to note the occurrence of the above species in relative abundance at Funafuti, since Canon Norman states that "It has only as yet been found in the Norwegian Seas." Dr. Egger obtained his examples of *K. prælonga*, which are without much doubt identical with the above species, off Mauritius at 411 metres.

Occurrence.—Sta. 3, 2715 fms.; 13, 1050 fms.; 20, 1215 fms.

Genus Loxoconcha, *G. O. Sars.*

Loxoconcha alata, *G. S. Brady.*

Loxoconcha alata, G. S. Brady ('68[1]), p. 223, pl. 14. figs. 8–13; id. ('80), p. 122, pl. 27. figs. 6 *a–j*.

Previously found only in shallow water at Funafuti; also at Honolulu, 40 fathoms.

Occurrence.—Sta. 68, 1143 fms.; 109, 604 fms.

Loxoconcha latissima, *G. S. Brady.*

Loxoconcha latissima, G. S. Brady ('78), p. 399, pl. 58. figs. 1 *a–h*.

This is its first occurrence as a recent form. The species was originally described by Dr. Brady from the Antwerp Crag. By the shortness of the valves and their tumidy both the present examples appear to belong to female specimens.

The carapace differs from that of *L. australis*, to which it is in some points allied, in the subparallel sides, the distinct flanging of the extremities, and the small, impressed surface-punctures.

Occurrence.—Sta. 13, 1050 fms.; 20, 1215 fms.

Genus Xestoleberis, *G. O. Sars.*

Xestoleberis margaritea, *G. S. Brady*, sp.

(?) *Cytheridea margaritea,* G. S. Brady ('66), p. 370, pl. 58. figs. 6 *a–d*.

Xestoleberis margaritea, G. S. Brady ('80), p. 127, pl. 30. figs. 2 *a–g*; Egger ('01), p. 456, pl. 3. figs. 27–30.

This is a common form in the shallower waters of Funafuti, being found in the lagoon as well as on the outer slopes of the reef. Brady's localities for this species are the Mediterranean, Booby Island, and the Mauritius. Egger obtained it in 'Gazelle' dredgings from the Australian Coast, Kerguelen Island, and Table Bay.

Occurrence.—Sta. 3, 2715 fms.

Xestoleberis variegata, *G. S. Brady.*

Xestoleberis variegata, G. S. Brady ('80), p. 129, pl. 31. figs. 8 *a–g*.

This species has already been recorded from dredgings off St. Vincent, Cape Verde, at 107–1150 fathoms; off Tongatabu, 18 fathoms; at Fiji, Samoa, and Noumea in shallow water. It was of frequent occurrence in the lagoon at Funafuti, and was often found off Funamanu at 50 fathoms.

Occurrence.—Sta. 2, 1489 fms.; a single valve.

XESTOLEBERIS ACUMINALIS, *Chapman.*

Xestoleberis acuminalis, Chapman ('02[2]), p. 429, pl. 37. figs. 4 *a–c.*

Previously found in dredgings from the lagoon at Funafuti.

Occurrence.—Sta. 13, 1050 fms. ; one valve.

Genus CYTHERURA, *G. O. Sars.*

CYTHERURA TENUICOSTA, sp. nov. (Plate **57**. figs. 24 *a, b.*)

Description.—Carapace elongate, narrow-ovate, compressed ; seen from the side, ventral and dorsal margins nearly parallel ; dorsal margin with a gentle median sinuosity and excavated posteriorly ; middle of dorsal margin straight and curving towards both extremities to meet the evenly rounded anterior border and the rather sharply pointed posterior prolongation. Carapace thickest towards the ventral border, the surface sloping convexly to the ventral, and with a transverse median depression ; surface-ornament consisting of about seven fine, sharp, parallel, longitudinal costæ, which become confluent at the extremities of the valve ; the interspaces crossed by faint striæ.

Length ·625 mm. ; height ·23 mm. ; approximate thickness of carapace ·21 mm.

Affinities.—In general shape, although more elongate, this species resembles *Cytherura clavata*, G. S. Brady *. The ornament of the valve-surface in that species, however, consists of numerous, delicate, anastomosing ridges, whilst in the present species they are parallel and extend nearly the whole length of the valve.

Occurrence.—Sta. 11, 1417 fms. ; 20, 1215 fms.

Genus CYTHEROPTERON, *G. O. Sars.*

CYTHEROPTERON WELLINGTONIENSE, *G. S. Brady.*

Cytheropteron wellingtoniense, G. S. Brady ('80), p. 36, pl. 34. figs. 4 *a–d.*

Previously described from Wellington Harbour, New Zealand. The anterior margin in our example is more evenly rounded than in the figure given by Brady.

Occurrence.—Sta. 13, 1050 fms.

CYTHEROPTERON ASSIMILE, *G. S. Brady,* var. FUNAFUTIENSIS, nov. (Plate **57**. fig. 25.)

Ref. to type form: G. S. Brady ('80), p. 138, pl. 34. figs. 3 *a–d.*

The type species was recorded from Kerguelen Island, 120 fathoms, and off Heard Island, 75 fathoms.

* G. S. Brady ('80), p. 133, pl. 29. figs. 7 *a–d.*

The valves found in the present dredgings are generally typical, but the alar beak is sharply pointed and prolonged instead of obtusely rounded as in Brady's 'Challenger' specimen.

Occurrence.—Sta. 10, 1485 fms.; 13, 1050 fms.

CYTHEROPTERON ABYSSORUM, *G. S. Brady.*

Cytheropteron abyssorum, G. S. Brady ('80), p. 138, pl. 34, figs. 3 *a–d*.

Described by Brady from one locality only, in the Southern Ocean, S.W. of Tasmania, 2600 fathoms.

Occurrence.—Sta. 11, 1417 fms.; 13, 1050 fms. Separate valves not uncommon.

Genus BYTHOCYTHERE, *G. O. Sars.*

BYTHOCYTHERE RETIOLATA, sp. nov. (Plate **57**. figs. 26 *a, b*.)

Description.—Carapace elongate; seen from the side compressed, subovate; of nearly equal width throughout, height less than one-half the length; anterior extremity strongly arched, dorsal line nearly straight and excavate posteriorly, ventral border concave in the upper third, then widely convex and curving backwards to meet the posterior prolongation; median area of valve tumid, highest towards the ventral region and posterior, sloping away to the anterior border; a deep, curved sulcus parallel with and just within the anterior margin. Median area deeply excavated by a transverse fold or sulcus, extending, a third away from the ventral, to the dorsal margin. Surface-ornament consisting of a distinct raised polygonal network. Edge view subovate, compressed at the extremities.

Length ·833 mm.; height ·312 mm.; approximate thickness of carapace ·3 mm.

Occurrence.—Sta. 13, 1050 fms.

BYTHOCYTHERE TUBERCULATA, sp. nov. (Plate **57**. figs. 27 *a, b*.).

Description.—Carapace subovate, compressed at the extremities; highest at the anterior, attenuated posteriorly. Seen from the side, elongate, subquadrangular, dorsal edge straight, and meeting the evenly rounded anterior margin at a sharp angle; antero-ventral angle rounded and widely curved along the ventral line; posterior extremity produced to a broad point. Surface of valve with a rounded prominence a little in front of the median area on the dorsal margin, behind which is a curved transverse depression; there is also a subventral ridge which carries a strong stout spine projecting outwards and downwards. Surface coarsely punctate and covered with strong prickles. Anterior margin denticulate. A narrow flange exists along the greater part of the ventral border.

Length 1·04 mm.; height ·458 mm.; thickness of carapace, including the spines, ·75 mm.

Affinities.—This species somewhat resembles *B. armata*, Chapman *, but there is no dorsal tubercle in the latter, whilst *B. armata* shows a costation of the ventral area which *B. tuberculata* does not.

Occurrence.—Sta. 20, 1215 fms.

Genus PSEUDOCYTHERE, *G. O. Sars.*

PSEUDOCYTHERE CAUDATA, *G. O. Sars.*

Pseudocythere caudata, G. O. Sars ('65), p. 88; G. S. Brady ('68[2]), p. 453, pl. 34. figs. 49–52, pl. 41. fig. 6; Brady, Crosskey, & Robertson ('74), p. 210, pl. 2. fig. 9; G. S. Brady ('80), p. 144, pl. 1. figs. 6 *a–d*; Brady & Norman ('89), p. 225; Egger ('01), p. 463, pl. 8. figs. 33, 34.

This species is very variable, as pointed out by Dr. Brady, who regards all the Northern and Southern forms as belonging to one type. The distribution is very wide, extending round the shores of the British Islands, the N. Atlantic, the Mediterranean, the S. Atlantic, and the Southern Oceans. The Funafuti examples are comparable with the 'Challenger' specimens, and are not uncommon in the deep dredgings named below. Egger obtained it off the Australian Coast at 357 metres.

Occurrence.—Sta. 13, 1050 fms.; 20, 1215 fms.

PSEUDOCYTHERE FUNAFUTIENSIS, sp. nov. (Plate 57. fig. 28.)

Description.—Carapace compressed, elongate; seen from the side, narrow, subelliptical, higher in the posterior half, height less than one-third of the length; anterior extremity pointed and truncately rounded towards the ventral angle; dorsal line slightly curved; ventral margin nearly straight in the middle, but truncated and excavated towards the posterior prolongation which lies close to the postero-dorsal angle. Surface finely lineate longitudinally over the whole length of the shell. Edge view narrow-elliptical, strongly compressed at the extremities.

Length 1·02 mm.; height ·3 mm.

Affinities.—The surface-ornament of this species is similar to that of *P. fuegiensis*, Brady †, but in the latter it is confined to the extremities of the valve. The narrow form and peculiar outline of our example show it to be distinct from that species.

Occurrence.—Sta. 13, 1050 fms.

* ('02), p. 432, pl. 37. figs. 6 *a*, *b*.
† ('80), p. 145, pl. 1. figs. 7 *a–d*.

SUMMARY OF RESULTS.

The foregoing report deals with 231 species and varieties of Foraminifera and 52 species and varieties of Ostracoda.

The following new species and varieties are herein described :—

Foraminifera.

Biloculina lucernula, Schwager, var. *striata*, nov.
Cassidulina bradii, Norman, var. *attenuata*, nov.
Lagena juddiana, sp. nov.

Ostracoda.

Pontocypris davidiana, sp. nov.
Argillœcia gracilior, sp. nov.
Bythocypris sollasi, sp. nov.
(?) ,, *heterodoxa*, sp. nov.
Cythere curvicostata, G. S. Brady, var. *funafutiensis,* nov.
,, *sweeti*, sp. nov.
Cytherura tenuicosta, sp. nov.
Cytheropteron assimile, G. S. Brady, var. *funafutiensis*, nov.
Bythocythere retiolata, sp. nov.
,, *tuberculata,* sp. nov.
Pseudocythere funafutiensis, sp. nov.

Some fossil species of Foraminifera and Ostracoda are here noted as recent for the first time. They are :—

Virgulina pertusa, Reuss (Pliocene ; Antwerp).
Lagena ventricosa, Silvestri (Miocene ; Piedmont) ; but that author compares them with Brady's recorded "*L. apiculata*."
Loxoconcha latissima, G. S. Brady (Pliocene ; Antwerp).

In relation to the question of the influence of light on the coloration of organisms in the ocean depths, it is interesting to note the occurrence of deeply coloured tests of *Polytrema miniaceum* at a depth of 507 fathoms.

A special interest attaches to some of the species found in these samples, on account of the great depth at which they were obtained. Particularly would we notice the forms occurring at depths from 2000 to 2728 fathoms, or from $2\frac{1}{4}$ to over 3 miles.

Abyssal Foraminifera (2000–2728 fms.).

Biloculina depressa, Orb.
„ „ var. *murrhyna*, Schw.
„ *tubulosa*, Costa.
Spiroloculina tenuis, Czjzek.
Miliolina oblonga, Mont., sp.
„ *bosciana*, Orb., sp.
„ *circularis*, Born, sp.
„ *tricarinata*, Orb., sp.
„ *seminulum*, Linn., sp.
„ *vulgaris*, Orb., sp.
„ *venusta*, Karrer, sp.
„ *ferussacii*, Orb., sp.
Sigmoïlina schlumbergeri, Silv.
„ *sigmoidea*, Brady, sp.
Hyperammina elongata, Brady.
„ *ramosa*, Brady.
Reophax nodulosa, Brady.
„ *dentaliniformis*, Brady.
(?) *Haplophragmium canariense*, Orb., sp.
Haplophragmium latidorsatum, Born, sp.
„ *fontinense*, Terq.
Textularia concava, Karrer, sp.
„ „ var. *heterostoma*, Forn.
„ *gramen*, Orb.
Verneuilina pygmæa, Egger.
Tritaxia lepida, Brady.
Spiroplecta americana, Ehr.
Gaudryina rugosa, Orb.
„ *pupoides*, Orb.
Bulimina pupoides, Orb.
„ *buchiana*, Orb.
„ *rostrata*, Brady.
Virgulina subsquamosa, Egger.
„ *subdepressa*, Brady.
„ *texturata*, Brady.
„ *pertusa*, Reuss.
Bolivina punctata, Orb.
„ *textilarioides*, Reuss.
„ *limbata*, Brady.
„ *lobata*, Brady.
„ *obsoleta*, Eley.
„ *robusta*, Brady.
„ *karreriana*, Brady.
„ *reticulata*, Brady.
Pleurostomella subnodosa, Reuss.
„ *alternans*, Schw.
Cassidulina lævigata, Orb.
„ *crassa*, Orb.
„ *subglobosa*, Brady.
Cassidulina oblonga, Reuss.
„ *calabra*, Seg., sp.
„ *bradii*, Norm.
„ „ var. *attenuata*, nov.
Ehrenbergina serrata, Reuss.
„ *hystrix*, Brady.
Lagena globosa, Mont., sp.
„ *stelligera*, Brady.
„ *longispina*, Brady.
„ *apiculata*, Reuss.
„ *botelliformis*, Brady.
„ *elongata*, Ehr., sp.
„ *hispida*, Reuss.
„ *aspera*, Reuss.
„ *acuticostata*, Reuss.
„ *spumosa*, Millett.
„ *lævis*, Mont., sp.
„ „ var. *distoma*, Silv.
„ *striata*, Orb., sp.
„ *sulcata*, Walker & Jacob.
„ *hexagona*, Will., sp.
„ *feildeniana*, Brady.
„ *gracilis*, Will.
„ *quinquelatera*, Brady.
„ *lævigata*, Reuss, sp.
„ „ var. *acuta*, Reuss.
„ *fasciata*, Egger, sp.
„ *quadrata*, Will.
„ *marginata*, Walker & Boys.
„ „ var. *semimarginata*, Reuss.
„ „ var. *seminiformis*, Schw.
„ *ventricosa*, Silv.
„ *staphyllearia*, Schw., sp.
„ *trigono-marginata*, Parker & Jones.
„ *wrightiana*, Brady.
„ *lagenoides*, Will., sp.
„ *quadralata*, Brady.
„ *formosa*, Schw.
„ *fimbriata*, Brady.
„ *alveolata*, Brady.
„ „ var. *substriata*, Brady.
„ *orbignyana*, Seg., sp.
„ „ var. *castrensis*, Schw.
„ „ var. *lacunosa*, Burr. & Holl.
Nodosaria calomorpha, Reuss.
„ (*Dentalina*) *communis*, Orb.
„ „ *consobrina*, Orb.

Nodosaria (*Dentalina*) *filiformis*, Orb.
„ „ *mucronata*, Neug., sp.
Rhabdogonium minutum, Reuss.
Vaginulina legumen, Linn., sp.
Cristellaria rotulata, Lam., sp.
„ *reniformis*, Orb.
„ *convergens*, Born.
„ *variabilis*, Reuss.
„ *articulata*, Reuss.
„ *tenuis*, Born, sp.
Polymorphina lactea, Walker & Jacob, sp.
„ *angusta*, Egger.
„ *lanceolata*, Reuss.
„ *sororia*, Reuss.
„ *seguenzana*, Brady.
„ *longicollis*, Brady.
Uvigerina canariensis, Orb.
„ *pygmæa*, Orb.
„ *angulosa*, Will.
„ *porrecta*, Brady.
„ *aculeata*, Orb.
„ *asperula*, Czjzek.
„ „ var. *ampullacea*, Brady.
„ *interrupta*, Brady.
Sagraina bifrons, Brady.
„ *virgula*, Brady.
„ *raphanus*, Parker & Jones.
Globigerina bulloides, Orb.
„ *triloba*, Reuss.
„ *rubra*, Orb.
„ *trochoides*, Reuss.
„ *conglobata*, Brady.
„ *æquilateralis*, Brady.
„ *dubia*, Egger.
„ *dutertrei*, Orb.
„ *subcretacea*, Chapm.
„ *sacculifera*, Brady.
„ *digitata*, Brady.
Orbulina universa, Orb.
Pullenia obliquiloculata, Parker & Jones.
Pullenia quinqueloba, Reuss.
„ *sphæroides*, Orb., sp.
Sphæroidina bulloides, Orb.
„ *dehiscens*, Parker & Jones.
Candeina nitida, Orb.
Patellina corrugata, Will.
Discorbina globularis, Orb., sp.
Truncatulina refulgens, Montf., sp.
„ *akneriana*, Orb., sp.
„ *ungeriana*, Orb., sp.
„ *wuellerstorfi*, Schw., sp.
„ *haidingeri*, Orb., sp.
„ *humilis*, Brady.
„ *tenera*, Brady.
„ *dutemplei*, Orb., sp.
„ *pygmæa*, Hantk.
„ *reticulata*, Czjzek, sp.
Anomalina grosserugosa, Gümbel, sp.
„ *polymorpha*, Costa.
Pulvinulina elegans, Orb., sp.
„ *exigua*, Brady.
„ *menardii*, Orb., sp.
„ „ var. *fimbriata*, Brady.
„ *tumida*, Brady.
„ *patagonica*, Orb., sp.
„ *canariensis*, Orb., sp.
„ *crassa*, Orb., sp.
„ *truncatulinoides*, Orb., sp.
„ *hauerii*, Orb., sp.
„ *pauperata*, Parker & Jones.
„ *favus*, Brady.
Rotalia broeckhiana, Karr.
„ *soldanii*, Orb.
„ *orbicularis*, Orb.
Nonionina depressula, Walker & Jacob, sp.
„ *umbilicatula*, Mont., sp.
„ *pompilioides*, Fichtel & Moll, sp.
Polystomella crispa, L., sp.
Amphistegina lessonii, Orb.

Abyssal Ostracoda (2000–2728 fms.).

Argillœcia affinis, Chapm.
Cythere parallelogramma, G. S. Brady.
„ *curvicostata*, G. S. Brady, var. *phylloides*, Chapm.
„ *dictyon*, G. S. Brady.
Krithe producta, G. S. Brady.
„ *hyalina*, G. S. Brady.
„ *angusta*, Brady & Norman.
Xestoleberis margaritea, G. S. Brady.

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EXPLANATION OF THE PLATES.

Plate 54.

Fig. 1. *Biloculina lucernula*, Schwager, var. *striata*, nov. Sta. 20, 1215 fms. ×40.
2. *Virgulina pertusa*, Reuss. Sta. 3, 2715 fms. ×40.
3. *Cassidulina subglobosa*, Brady. Sta. 11, 1417 fms. ×40.

Fig. 4. *Cassidulina bradii*, Norman, var. *attenuata*, nov. Sta. 105, 2400 fms. ×80.
5. *Lagena botelliformis*, Brady. Sta. 150, 2438 fms. ×80.
6. „ *spumosa*, Millett. Sta. 48, 2298 fms. ×80.
7. „ *juddiana*, sp. nov. Sta. 13, 1050 fms. ×40.
8. „ *lucida*, Williamson. Sta. 13, 1050 fms. ×40.
9. „ *ventricosa*, A. Silvestri. Sta. 11, 1417 fms. ×40.

Plate 55.

Fig. 10. *Lagena quadralata*, Brady. Sta. 3, 2715 fms. ×80.
11. „ *foveolata*, Reuss. Sta. 13, 1050 fms. ×80.
12. *Polymorphina lactea*, Walker & Jacob, sp., var. *oblonga*, Will. Sta. 20, 1215 fms. ×80.
13. *Globigerina trochoides*, Reuss. Sta. 11, 1417 fms. ×80.
14. *Discorbina globularis*, Orb., sp.: *a*, superior aspect; *b*, inferior aspect. Sta. 48, 2298 fms. ×80.
15. *Pulvinulina favus*, Brady. Sta. 3, 2715 fms. ×40.
16. *Rotalia cf. dentata*, Parker & Jones. Sta. 11, 1417 fms. ×80.

Plate 56.

Fig. 17. *Pontocypris davidiana*, sp. nov.: *a*, left valve; *b*, edge view. Sta. 13, 1050 fms. ×48.
18. *Argillœcia gracilior*, sp. nov.: *a*, left valve; *b*, edge view. Sta. 13, 1050 fms. ×48.
19. *Bythocypris sollasi*, sp. nov.: *a*, carapace seen from the right side; *b*, dorsal edge view; *c*, end view. Sta. 13, 1050 fms. ×48.
20. (?) *Bythocypris heterodoxa*, sp. nov.: *a*, left valve; *b*, edge view. Sta. 11, 1417 fms. ×48.
21. *Bairdia formosa*, G. S. Brady. Young specimen; left valve. Sta. 13, 1050 fms. ×48.

Plate 57.

Fig. 22. *Cythere curvicostata*, G. S. Brady, var. *funafutiensis*, nov. Right valve. Sta. 20, 1215 fms. ×48.
23. *Cythere sweeti*, sp. nov.: *a*, right valve; *b*, edge view. Sta. 19, 1485 fms.
24. *Cytherura tenuicosta*, sp. nov.: *a*, right valve; *b*, edge view. Sta. 11, 1417 fms. ×48.
25. *Cytheropteron assimilis*, G. S. Brady, var. *funafutiensis*, nov. Left valve. Sta. 10, 1485 fms. ×48.
26. *Bythocythere retiolata*, sp. nov.: *a*, right valve; *b*, edge view. Sta. 13, 1050 fms. ×48.
27. *Bythocythere tuberculata*, sp. nov.: *a*, right valve; *b*, edge view. Sta. 20, 1215 fms. ×48.
28. *Pseudocythere funafutiensis*, sp. nov. Left valve. Sta. 13, 1050 fms. ×48.

[N.B.—The new species and figured specimens will be placed in the Natural History Collection of the British Museum.]

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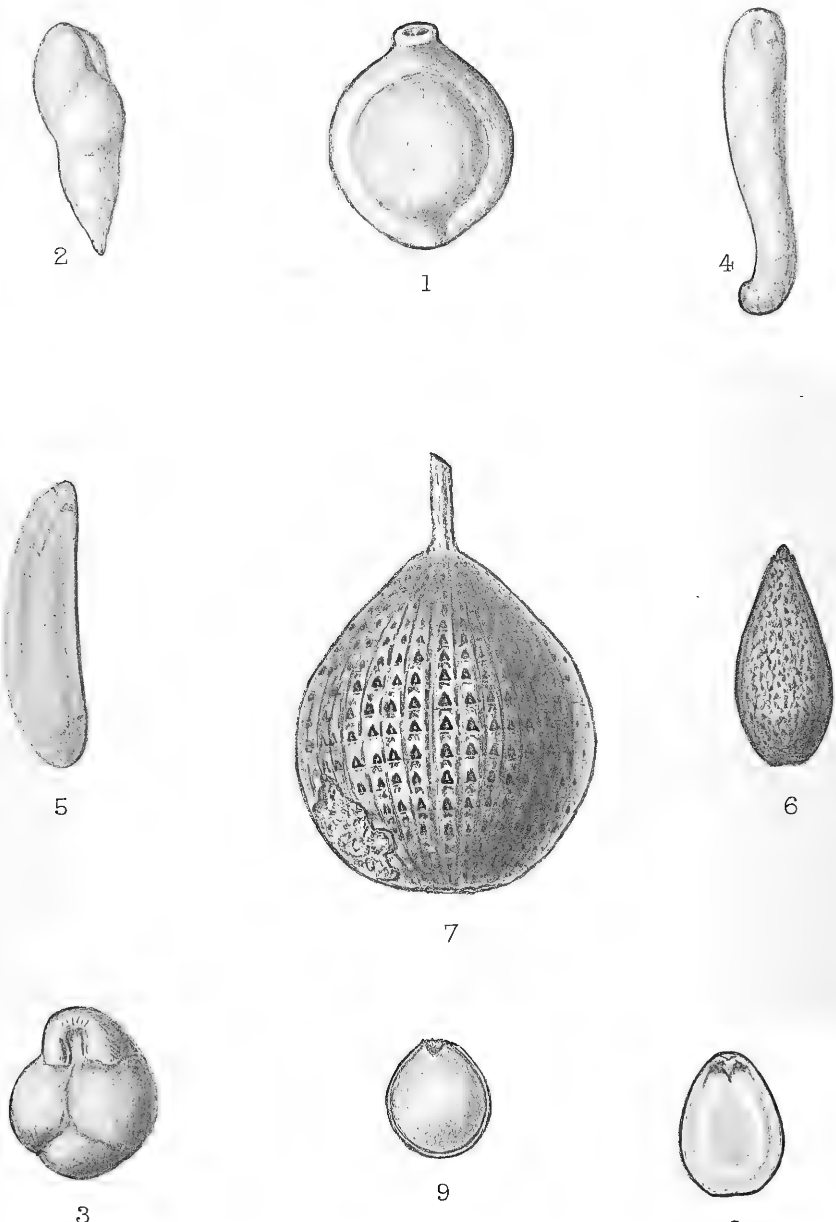
DEEP SEA FORAMINIFERA FROM FUNAFUTI.

ERRATA IN JOURNAL, ZOOLOGY, NO. 202.

(Mr. CHAPMAN'S Paper.)

Page 444, 9th line from bottom, for *assimilis* read *assimile.*

PLATE 57. The numbers 24 and 25 should be transposed.



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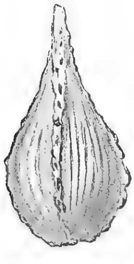

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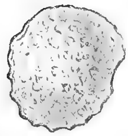

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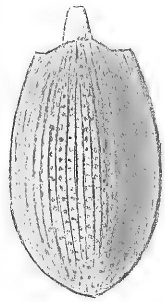

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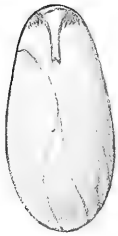

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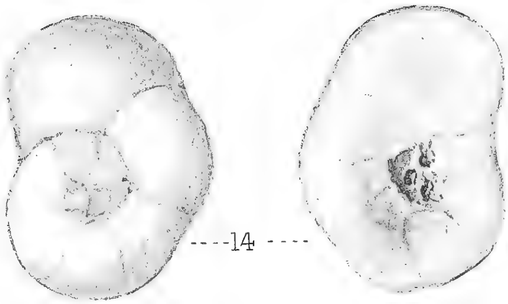
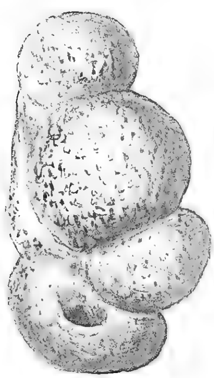


a ----14---- b



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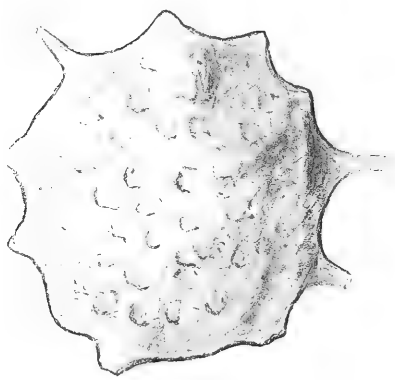

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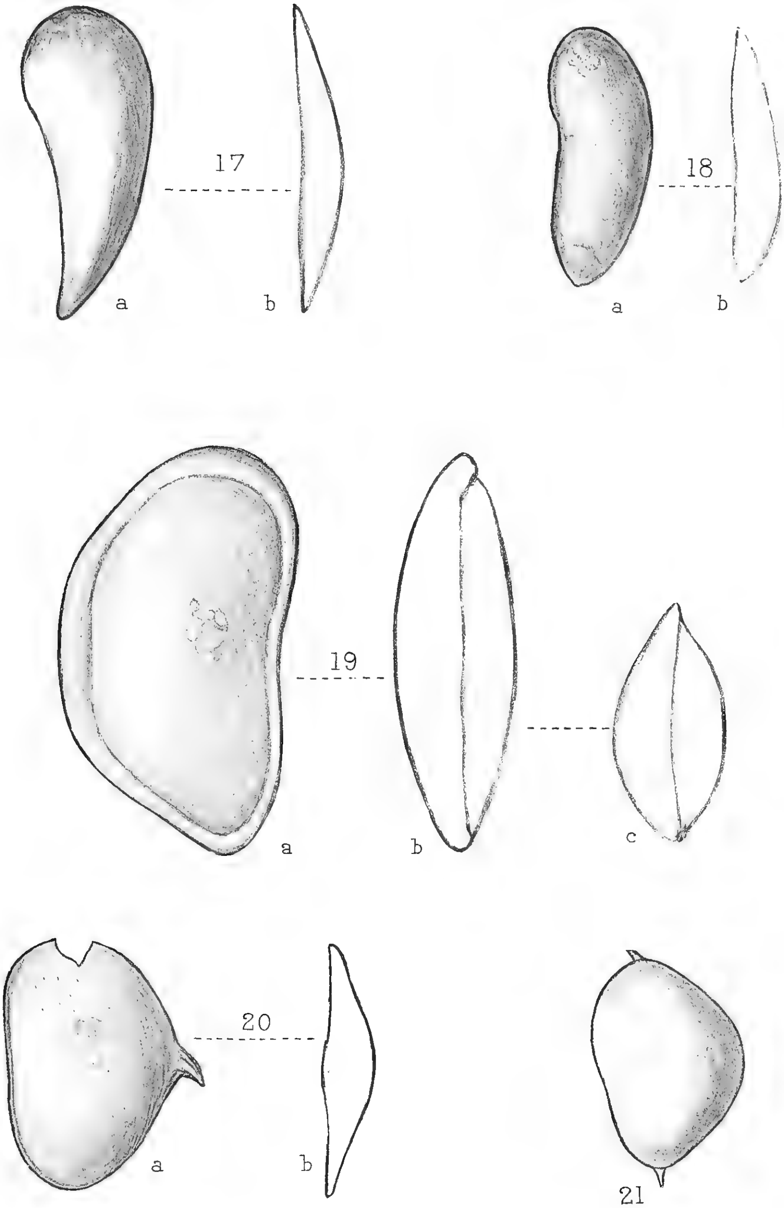

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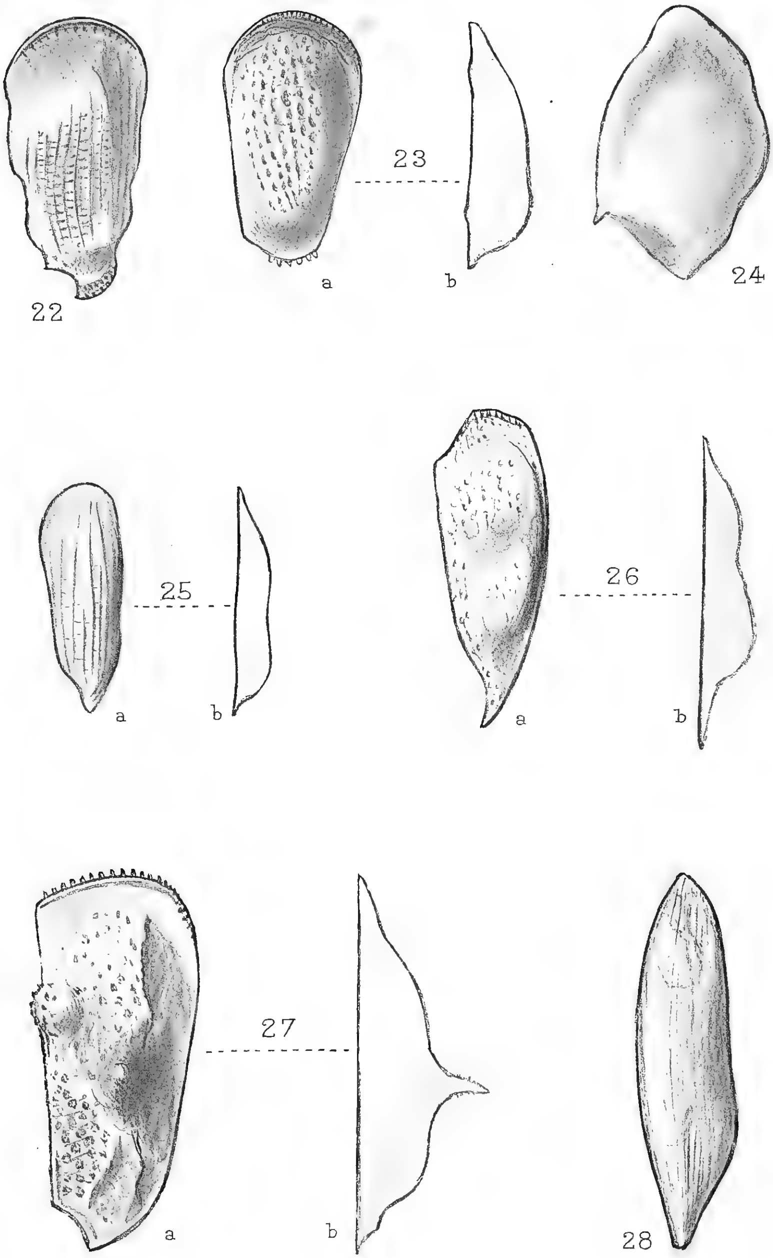

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DEEP SEA OSTRACODA FROM FUNAFUTI.

INDEX.

[Synonyms and native names are printed in *italics*. A star is added to names which appear to be used here for the first time.]

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