ECHINODERMATA.

BY

F. JEFFREY BELL.

The chief points of interest attached to the 'Alert' collection of Echinoderms may be indicated as follows:—

Though there are no new Echinoidea, there are some very precious series of some species, *Maretia planulata* being notably well represented. Similarly the series of some of the Asterids has given us evidence of a variability that would be almost incredible but for the careful registration of the localities of the species. Rare and new forms of Ophiurids and Asterids will, on inspection of the succeeding systematic list, be found to be well represented: *Ophiothrix* has a large number of forms, the exact delimitation and definition of which has been to me a matter of just as much anxiety and doubt as it has been to my predecessors; but a study of the collection has led me to a somewhat important conclusion, in that I have been compelled by the evidence to attach much less weight than some have done to the characters of the coloration *.

The question of coloration of forms has taken on almost a new aspect since the publication by Mr. Seebohm of his views as to the value of the pattern of colour in the Turdinæ (Cat. Birds B.M. v. p. viii); while, on the other hand, the recent statements of such experienced entomologists as Butler, who thinks that in time it will be impossible to decide, without rearing from the egg, whether any form is a species, a hybrid, or a variety (Trans. Ent. Soc. 1880, p. 200), and Elwes, in whose opinion (*l. c.* p. 134) climate, food, and conditions of life will more than account for the change in tint of certain representative species, seem to indicate that in the group of the Lepidoptera, where coloration has been so much attended to, those who are among the most experienced are learning to doubt its value, and to recognize, as the professed students of ichthyology (see Günther's 'Study of Fishes,' pp. 176–182) would seem to have done, that in coloration there is great variation. It would be a matter for regret if, when the views of others are advancing, the describer and systematist of Echinoderms should make a backward

* Lütken, "Le système général de coloration constitue un caractère important qu'il ne faut pas négliger dans la distinction des *Ophiothrix*" (Vid. Selsk. Skr. (5) Bd. 8, ii. p. 104); and compare the descriptions of all writers on the genus.

step. Coloration can only be safely used when the hypothesis that the genus or group is of so late an origin as not to have yet developed definite structural characters by which its species may be discriminated is not controverted by any one species; where it is, the character must be less freely used, probably to disappear more and more, not so much with the increased evolution of the genus as with our increased knowledge of it.

The succeeding pages contain an account of, or the names of, 124 species, very fairly divided among the 5 orders. Of these there are 30 new species, 15 of which belong to the Crinoids and the other 15 to the remaining orders. There is no new Echinid; but I have had to suggest a new name for the form which by some has been regarded as *Salmacis globator*.

ECHINOIDEA.

1. Phyllacanthus annulifera.

A. Agassiz, Rev. Ech. p. 387 *.

A most valuable and important series for exhibiting the variation of this species.

Thursday Island; Port Molle (14 fms.); Port Curtis; Prince of Wales Channel; Albany Island; Port Darwin.

2. Diadema setosum.

A. Agassiz, Rev. Ech. p. 274.

Port Molle; coral-reef.

3. Salmacis bicolor.

A. Agassiz, Rev. Ech. p. 471.

A good series, with spines well preserved on most from Port Molle.

4. Salmacis sulcata.

A. Agassiz, Rev. Ech. p. 476.

Port Denison (4 fms.); Port Molle (14 fms.).

5. Salmacis alexandri.

Salmacis globator, *Alex. Agassiz* (*not L. Agassiz*), *Rev. Ech.* p. 473; '*Challenger*' *Reports*, iii. p. 113.

Salmacis globator, form *a*, *Bell, P. Z. S.* 1880, p. 433, pl. xli. fig. 1.

In the third part of my "Observations on the Characters of the

* As a rule, I shall give only one bibliographical reference, and that to the 'Revision of the Echini' of Prof. Alex. Agassiz.

Echinoidea," I directed attention to the marked discrepancies which obtained between the descriptions given by Louis and Alexander Agassiz respectively of the species known as *S. globator*. I then figured and gave careful descriptions of the tests of two forms which I distinguished as form α and form β. I adopted that course in the hope that Prof. Alexander Agassiz would explain the reasons which had led him to omit any notice of the species referred to by his father. In the 'Challenger' Report the species is merely recorded, and reference made to the 'Catal. Raisonné' of Agassiz and Desor; fortunately the specimens are now in the British Museum collection, and an inspection of them is, of course, sufficient to show the characters of the form which Mr. Alex. Agassiz looks upon as being *S. globator*. I find them to be examples of what I have called form α, or, in other words, they are not representatives of L. Agassiz's species *globator*.

As the species reappears in the 'Alert' collection, it has been necessary to direct attention to the various points and to propose a name for the species. No appellation will, I think, be more suitable than that of *alexandri*; and, at the time of giving a definite name, one is also able to have the pleasure of adding a definite locality.

West Island, Prince of Wales Channel.

6. Temnopleurus toreumaticus.

A. Agassiz, Rev. Ech. p. 463.

One of the specimens (diameter 18·5 millim.) has all the spines which are preserved on it perfectly white, without any bands whatever. Smaller specimens in the British Museum collection have a number of, but not one has all, its spines thus totally white.

Port Denison (4 fms.); Prince of Wales Channel.

7. Temnopleurus granulosus.

Toreumatica granulosa, *Gray, P. Z. S.* 1855, p. 39.
Temnopleurus granulosus, *Bell, P. Z. S.* 1880, p. 425.

A good series, with the general colour of the spines dark, and not light, ringed with red as in the specimens from the Japanese seas.

Port Denison.

8. Temnopleurus bothryoides.

Pleurechinus bothryoides, *A. Agassiz, 'Challenger' Rep.* iii. p. 108.

This is one of the most important of Dr. Coppinger's finds, for with the exception of a single, though perfect, test in the collection of the British Museum, which was obtained by Sir E. Belcher off Borneo, and presented by the Admiralty in 1844, no complete example had ever been examined till the return of the 'Challenger.' The largest specimen taken by Dr. Coppinger is a little larger than

any one of the three collected by the officials of that great circumnavigating expedition.

Though the term *Pleurechinus* is due to L. Agassiz, and the specific name *bothryoides* to his incomplete comprehension of the *Cidaris bothryoides* of Klein and Leske, I have confined my "synonymy" to Alexander Agassiz's Report on the 'Challenger' specimens, as it is there only that any such definite information is given as would enable a zoologist to recognize examples of the species. The result to which my own study of the specimens and of the definitions has led me has, I think, been essentially confirmed by the investigation into the structure of the test which, at my suggestion, Prof. Martin Duncan was allowed to make *.

Looking, first of all, at the general form of the test, the observer is struck by its greater proportional height; thus we find specimens with an absolute diameter of 20, 18, or 17 millim. respectively having a proportional height of 58·5, 66·6, and 60. In no known examples of any other species of *Temnopleurus* is the proportional height more than 63·63 millim. †, and this is a rare case, which obtains with a specimen only 11 millim. wide. The examination of the dental apparatus did not show any real point of difference between this species and *T. hardwickii*. As in other species of this genus, the abactinal area is much more prominent in younger than in older specimens, while the characters of the furrows between the plates is only intermediate between the extreme condition presented by *T. torcumaticus* and that which is seen in the species just mentioned.

As to the minute construction of the test, Dr. Duncan finds that "there is a generic relation between *Temnopleurus* and *Pleurechinus*, and the only important distinction is the absence of crenulation in the last-named type." To this crenulation or its absence Dr. Duncan attaches more importance than do many naturalists who have devoted themselves to this group, and he finds in consequence that "the classificatory position assigned by A. Agassiz to *Pleurechinus* in the 'Revision' must be conceded, and it is a subgenus or section of *Temnopleurus*." Notwithstanding the weight of the authority of Agassiz and Duncan, I am bound to say that I feel still the importance of the objections long ago urged by D'Archiac and Haime‡, "Quant aux crénelures des tubercules, on sait que cette particularité n'a également qu'une valeur très-secondaire, puisqu'on la voit déjà disparaître dans une certaine portion du genre *Cidaris*, sans qu'on puisse découvrir chez les espèces à tubercules lisses aucune autre différence concomitante;" and that being so, I can find no reason which will justify the retention of a genus never very accurately defined.

The largest specimen in the 'Alert' collection has a diameter

* Journ. Linn. Soc. (Zool.) xvi. p. 447.

† P. Z. S. 1880, p. 424.

‡ Anim. foss. de l'Inde, p. 202 (1853). The student should be reminded that Prof. Martin (Notes Leyd. Mus. ii. p. 75) accepts the genus *Pleurechinus*.

of 20·5 millim. and is 12 millim. high; the abactinal area is 4·5 and the anal area is 2 millim. in diameter. The short primary spines, which, as in the other specimens, have two or three short bands of bright red on their white surface, have the neighbouring suckers of a purplish-slate colour, and these give a deeper and richer appearance than ordinary to the test. The abactinal area is not so conspicuous as in the smaller specimens, and only one of the genital plates has more than three tubercles.

Thursday Island; Prince of Wales Channel.

9. Echinus angulosus.

A. Agassiz, Rev. Ech. p. 489.

With a little hesitation I refer to this species three specimens from Thursday Island, and one from Prince of Wales Channel. The species is a wide-ranging one, and apparently presents a good deal of variation.

10. Echinus darnleyensis.

J. E. Tenison-Woods, Proc. Linn. Soc. N. S. W. ii. p. 165.

In accepting this species, I should like to do so only provisionally, as a systematic revision of the exceedingly troublesome genus to which it belongs may show it to be only part of one of the very variable species which are associated under the emended genus *Echinus*.

Thursday Island (4 fms.) and Prince of Wales Channel.

11. Tripneustes angulosus.

Hipponoe variegata, *A. Agassiz, Rev. Ech.* p. 501.
Tripneustes angulosus, *Bell, P. Z. S.* 1879, p. 657.

The coloration of this specimen is more marked than any I have yet had the opportunity of examining; the short white spines are found either on white areas, the middle of which is occupied by a black patch, or on broad black bands, rather more than half as wide as the white areas at the ambitus.

The single small specimen collected was found at Levuka, Fiji.

12. Strongylocentrotus erythrogrammus, *Val.*

Strongylocentrotus eurythrogrammus, *A. Agassiz, Rev. Ech.* p. 441.

It may perhaps be pointed out that the spelling of the specific name as here adopted is not only that which is etymologically correct, but is the very same as that which was proposed by Valenciennes ('Voy. Vénus,' Zoophyt. pl. vii. fig. 1), and adopted by Lütken and Verrill: it is true that in the 'Catal. Raisonné' of L. Agassiz and Desor (1846) we find the spelling *eurythrogrammus*,

and that the last-named naturalists were followed by Dujardin and Hupé. I am led to make these remarks from the fact that throughout the 'Revision of the Echini' the mode of spelling which is both etymologically and historically incorrect is not only adopted, but is ascribed to Valenciennes, to Lütken, and to Verrill, and is, curiously enough, carried on into the lately published Report on the Echinoidea collected by the 'Challenger' Expedition.

Port Jackson.

13. Echinometra lucunter.

A. Agassiz, Rev. Ech. p. 431.

Port Molle (beach); Levuka, Fiji.

14. Fibularia volva.

A. Agassiz, Rev. Ech. p. 509.

Prince of Wales Channel.

15. Clypeaster humilis.

A. Agassiz, Rev. Ech. p. 510.

Port Molle (4 fms.).

16. Laganum depressum.

A. Agassiz, Rev. Ech. p. 518.

Torres Straits; Prince of Wales Channel.

The British Museum contains specimens collected by H.M.S. 'Challenger' in the Arafura Sea.

17. Laganum decagonale.

Peronella decagonalis, *A. Agassiz, Rev. Ech.* p. 520.
Laganum decagonale, *Bell, Ann. & Mag. N. H.* (5) xi. p. 130.

The investigations which I have been able to make into the value of the generic and specific characters of the Laganidæ (Ann. & Mag. Nat. Hist. (5) xi. p. 130) have led me to the conclusion that no valid grounds exist for the generic or subgeneric separation of "*Peronella*" from *Laganum*.

Prince of Wales Channel; Thursday Island.

This appears to be one of those species around which misapprehensions have collected; the earlier and not ungraceful method of registration which induced De Blainville* to associate with this species the name of the naturalist to whom he owed his specimen has, no doubt in haste, been regarded by Professor Alexander Agassiz† as indicating Lesson to be the author of the species.

* Dict. Sci. Nat. vol. xlviii. p. 229; Man. d'Act. p. 215.
† Rev. Ech. p. 47, and much less accurately on p. 148.

Strangely enough, De Blainville himself is not free from error in the matter, for after Lesson's name he places the words "Voyage de l'Uranie," a voyage with which Lesson had not the close relation that he had with that of the 'Coquille,' and in the account of which no Echinoderms are described or figured.

18. Echinoneus cyclostomus.

A. Agassiz, Rev. Ech. p. 550.

A very small specimen from Prince of Wales Channel.

19. Maretia planulata.

A. Agassiz, Rev. Ech. p. 570.

A very fine series in spirit from Flinders, Clairmont, and dried specimens from Clairmont Island.

20. Lovenia elongata.

Agassiz, Rev. Ech. p. 575.

Thursday Island; Torres Straits.

21. Breynia australasiæ.

A. Agassiz, Rev. Ech. p. 578.

An excellent series from Port Denison, Thursday Island, and Prince of Wales Channel.

22. Echinocardium australe.

A. Agassiz, Rev. Ech. p. 580.

Port Jackson; Flinders, Clairmont; Port Darwin (12 fms., mud and sand).

ASTEROIDEA.

1. Asterias calamaria.

Perrier, p. 43*.

Port Jackson. The two specimens are very different in appearance: one has eleven arms, of which none are remarkably smaller than the rest; the other, which has five arms left, and appears to have had six, has one arm much longer than the others, and has three small subequal arms.

* For the majority of the Asteroidea I shall give only one reference, and that to Perrier's 'Révision des Stellérides' (Paris, 1875), following its pagination as a separate work.

2. Asterias polyplax.

Perrier, p. 63.

A small specimen with two long, two short and stout, and four shorter and more delicate arms.

Port Jackson, March 1881.

3. Echinaster purpureus.

Othilia purpurea, *Gray, Ann. & Mag. N. H.* (1) vi. p. 282.
Echinaster fallax, *Müll. & Trosch. Syst. Asterid.* p. 23; *Perrier*, p. 106.

While some have six and another five arms, not markedly differing in length, another has one very long arm, with a madreporite on either side of its base, and four shorter arms, of which one is very much shorter than the rest; it bears, however, indications of injury and subsequent repair.

Port Molle; Port Denison; Thursday Island, 4–6 fms.

4. Metrodira subulata.

Gray, Ann. & Mag. N. H. (1) vi. p. 282.

Flinders, Clairmont; Alert Island, 7 fms.

5. Linckia lævigata.

Perrier, p. 137.

A dried specimen still retains very well its blue coloration.

Clairmont Island.

6. Linckia nodosa.

Perrier, p. 153.

There is not, I think, any doubt that the four specimens from the Arafura Sea (32–36 fms.) and Prince of Wales Channel (7 fms.) are representatives of this species, of which Prof. Perrier has given an admirable description; the specimens, however, on which that description is based bore no indication of any locality.

The specimens are very much finer than those measured by M. Perrier, R being equal to 213, 118, and 104 millim., with *r* 23, 18, and 13. The disk with 18 millim. radius has apparently received some injury; but it may be that, in this species, there is a difference in the sexes, and that the specimen in question is in a different condition of generative maturity to the others; it is impossible, however, to settle the question, as the example has been dried.

7. Linckia marmorata.

Ophidiaster marmoratus, *Michelin, Mag. Zool.* 1845, *Zooph.* p. 21, pl. 10.
Linckia marmorata, *Perrier*, p. 135.

If I am correct in referring to this species a series of specimens from Port Molle and Fitzroy Island, it will be easy to understand how it is that M. Michelin's species was never again recognized till the Paris Museum came into the possession of his type; that would appear to be the only example that they possess, and, as M. Perrier points out, the "type" is obviously young. The specimens before me are clearly enough all representatives of the same species; but were any one of them described it is quite possible that from the description alone of that single specimen it would be easy to regard some others of the series as belonging to another form.

In the first place, though all the specimens are provided with the intermediate plate that connects into a pentagon the terminal one of the "rangée de plaques qui occupe la ligne médiane dorsale de chaque bras," the extent to which this is evident varies a good deal, and one would hardly think it worthy of especial note in the largest example were not attention directed to it by the better-marked characters of some of the smaller. Secondly, the smallest specimen has the dorsal plates covered with coarse granulations; of some of these, at any rate, it would be appropriate to say (again quoting Perrier) "les granules voisins de leur centre sont un peu plus gros que les autres;" on the other hand, one, two, or more granules near the centre acquire, in the larger specimens, a much greater predominance, and give a somewhat different appearance to the creature; in the largest specimen these again have disappeared, and the whole surface of the plates is more uniformly granular. Thirdly, the dorsal plates may lose the regularity of outline which is so well marked (if not exaggerated?) in Michelin's figure, and which is expressed by M. Perrier in the words "sensiblement carrée," and become narrower at the angles at which the pores are placed; this is perhaps due to the greater development in the number of pores, of which as many as seven may in some cases be found within the limits of one area. Lastly, it is only in the smallest specimens that we find a double row of tubercles fringing the adambulacral spines; in all the larger specimens the row is single, or, in other words, one row of tubercles ceases to grow proportionately, and becomes obscured in the general granulation of the actinal surface.

The only considerable point of difference between these specimens and that figured by Michelin lies in the remarkable coloration of his specimen; if, however, M. Desjardin's example from the island of Mauritius was immediately dried, it might have retained its colour: while Dr. Coppinger's specimens, which were placed in spirit, might very possibly have had part of their colouring-matter dissolved out. The largest example has *R* equal to 50 millim.

Prince of Wales Channel, 7 fms.

8. Linckia pauciforis.

Martens, Arch. f. Nat. xxxii. (1866), p. 69.

In only one example is one of the arms otherwise than perfect; but this does not seem to have been budded out in place of one cast off, but to have been bitten or broken off not far from its tip.

Three dry specimens from Bird Island, N.E. Australia; coral-reef.

9. Linckia megaloplax.

Arms five. R=67, r=9, or R=7·5 r about. Adambulacral spines flattened, one for each plate, with blunted end; externally to and alternating with these are somewhat shorter papilliform spines; the general granulation of the actinal surface of the disk extends between these latter; externally to them there is a row of larger spines, the distribution of which is extremely irregular, for while at some points they are almost as closely packed as those of the more internal row, they are at others separated from one another by the distance of three or four of the inner spines. The rest of the abactinal surface is closely covered with subequal granules of some size. The abactinal surface is traversed very regularly by six rows of poriferous spaces, which are comparatively large and markedly rectangular; the smallest spaces are found in the lowest row on either side; a short distance from the tip of each arm the spaces completely disappear, and the granulation becomes a little more prominent, and there is here, as in some allied species, a large specially modified plate with one or more large tubercles upon it. The disk itself is covered with large pore-areas, and the only noticeable character is the large and distinct, though not projecting, madreporic plate. The pore-areas are about 2 millim. wide, and the length of the madreporic plate, around which the granules are very distinct, may be 4 millim. The colour of the abactinal surface is deep brown or black, whilst that of the actinal surface is lighter.

In a specimen smaller than that which has formed the chief basis of this description the two surfaces are, towards the free end of the arm, distinguished from one another by the development of some short marginal spines. In another, dried, specimen, intermediate in size between these two, the spines at the upper and lower margins of the sides of the arm, though insignificant, are both larger and more numerous.

The idea that the younger forms would have a larger supply of spines is opposed by the fact that in a still smaller specimen these spines are altogether absent*, while the skeletal plates are stouter than in the specimens which bear the spines. The question now arises as to whether there are three stages—(*a*) one in which the ossicles are so stout that no defensive spines are needed in addition; (*b*) one in which growth has proceeded so rapidly that the bars of

* *Cf.* Ann. & Mag. N. H. (5) viii. p. 441.

the ossicles have diminished in proportional thickness while increasing in length, and so having lost their earlier stoutness, now require external aid; and (*c*) a final condition, in which equilibrium is again established, the ossicles themselves being again stouter,—or whether we have to do with two sets of variations from a common stock, due to some slight differences in the environment. But this is a complex and difficult question, which can only be satisfactorily answered by one who has at hand the living wealth of the Australian seas.

Port Curtis; Fitzroy Island; Albany Island; Port Denison, 8–12 fms.

10. Linckia, sp.

A very small specimen, from West Island, Torres Strait, presents that interesting peculiarity of three smaller and three larger arms, hinting thereby at a division of the disk instead of gemmation from a single arm; it is the smallest heteractinic *Linckia* I have seen, the longest arm measuring only 6 millim.

11. Anthenea flavescens.

Perrier, p. 276.

Port Jackson, 0–5 fms.

The Museum collection contains also specimens of this species from Fremantle, W. Australia.

12. Oreaster gracilis.

Pentaceros gracilis, *Perrier*, p. 246.
Oreaster gracilis, *Lütken, Vid. Med.* 1871, pp. 260, 261.

A selected series of five specimens, all from Port Denison (4 fms.), exhibit remarkably well the great change which occurs in this species, even after a considerable size has been attained. The smallest, which has R equal to 93·5 millim., has five tubercles, about 10 millim. high, one at the central end of each median row of tubercles: in another, with R equal to 108 millim., the tubercles, though a little stronger, are no higher and are here only to be found on three of the angles of the disk; this specimen, like another which is a little larger, has the lateral and marginal spines very well developed: two specimens, with R equal to 118 and 140 millim. respectively, have these spines less well developed, and the diminution is the more marked in the larger specimen; the smaller has one large central tubercle, and the larger has each of the whole set of five reduced to growths which are hardly larger than the other spines on the disk.

A specimen with six arms, one of which has been injured and has commenced to grow again, was collected at Port Molle.

13. Oreaster nodosus.

Asterias nodosa, *Linnæus, Syst. Nat.* ed. xii. p. 1100.
Pentaceros turritus, *Perrier*, p. 240.

Fine specimens from 4 fms., Port Denison.

14. Oreaster, sp.

A single dried specimen of a very interesting and, apparently, new form was also collected at Port Denison. Unfortunately, in the process of drying the disk has so fallen in as to completely alter what must have been a very different height in the living specimen, and, as may be supposed, the lophial line has also suffered.

15. Stellaster belcheri.

Gray, P. Z. S. 1847, p. 76.

Port Curtis.

16. Stellaster incei.

Gray, P. Z. S. 1847, p. 76.

A fine series of dried specimens was collected, and as there are some in which R was no more than 30 millim., while in others it was equal to 95 millim., we are able to see the great variability in the number and presence of the spinous tubercles, which may be very feebly or exceedingly well developed.

This is not one of those species in which we find that the smaller or younger specimens are the more richly provided with tubercles; but with this we have to correlate (1) the solidity of the skeleton, and (2) the small size and consequent slight defensive power of these tubercles, even when they are well developed.

One specimen, which, unfortunately, is very much injured, has a "greater radius" of as much as 120 millim.

Port Molle; Port Curtis (5–11 fms.); Port Denison (6 fms.); Albany Island (6 fms.); Thursday Island; and Arafura Sea.

17. Pentagonaster coppingeri.

This species belongs to the *Astrogonium* section of the genus as arranged by Prof. Perrier, for the two rows of marginal plates are richly provided with granules, and with one or two larger granules which can hardly be called spines.

Arms five. R=91, r=46. Arms 24 millim. wide at base, narrowing rather rapidly; marginal plates exceedingly well developed; pedicellariæ reduced.

The central region of the disk is a little elevated, the thickness there being about double that of the margin of the disk; the whole abactinal surface consists of a close arrangement of ossicles, the surfaces of which are coarsely granulated; the granules are a little

longer in the median line of each ray, where they form a remarkably regular series, continued on to the disk, but they become more or less ill-defined on the raised portion; the granules on the rest of the plates present no peculiarities, saving that they are a little longer on the sides of the raised portion of the disk. The respiratory pores on this surface are rather large, scattered, and simple. The supero-marginal plates are as much as 7 millim. high in the widely open angle of the arms; they are narrow, wider above than below; as these plates pass outwards they decrease in length and increase in breadth; they next decrease in size generally, and finally they are again, though much smaller, of the same general form as those of the angles of the arm; the terminal three or four touch in the middle line: of these plates there are about 23 on the side of each ray: the condition of their armature is, perhaps, best described by saying that some of the granules elongate to form small spinous tubercles. The madreporic plate is situated about one third of the radius from the centre of the disk; it is prominent, 5·5 millim. long, and has the form of an irregular elongated oval. The infero-marginal plates are likewise about 23 in number, and their form in different regions presents very much the same variations as those of the supero-marginal series; the granules, however, do not present the same tendency to become spinous, though they are all rather longer and not quite so closely packed. The adambulacral spines form a fringe of four flattened subequal spines, in addition to which two smaller outer ones may be attached to the same ossicle; beyond these there are two or three much stouter spines, and beyond these again there may be two or three spines, the tips of which may be pointed. The granulation of the intermediate plates presents very much the same characters as that of the infero-marginal plates.

This species may be distinguished from *P. singularis* or *P. miliaris* by the length of its arms, and the shape and closer packing of the plates of the abactinal surface; from the former it is also distinguished by having the adambulacral spines shorter and blunter, though they are by no means as blunt as in *P. miliaris*, where the adambulacral groove is so wide.

Colour: the specimen whose admeasurements have been given in the above description is dark slate: another, in which R=82 and $r=26$, is light stone-coloured; in it the disk is not elevated.

Port Curtis, 5–11 fms.; Prince of Wales Channel, 3–5 fms.

18. Pentagonaster validus.

This is a second new species which belongs to the *Astrogonium* division of the genus. The arms are distinct, rounded, and stout, the anus central and sometimes very distinct; the granulation of the ossicles is rather coarse, and only a few larger granules are found scattered over the abactinal surface; there are three rows of adambulacral spines.

As five specimens of this form were collected we are able to

determine to some extent its range of variation: this, as we might have expected, is most markedly presented by the characters of the spinous protuberances formed by the hypertrophy of some of the granules on the abactinal surface; the smallest specimen is without any special spines. Of three larger and subequal specimens, that which is a little the smallest has a more prominent granule developed here and there along the middle lines of the rays, and some six, still more prominent, at the centre of the disk; the other two have much more prominent spinous granules at what may be called the base of the rays, and some smaller protuberances around the centre of the disk; these latter are, in the largest specimen of all, quite inconspicuous. R is about equal to 2 r; R=72, 58; r=34, 27.

Arms 29 or 26 millim. wide at the base, narrowing hardly at all till quite near their end; marginal plates very well developed, equal in either series, and 13 or 14 in number; pedicellariæ scarce.

The central region of the disk is not distinctly elevated; with increase in size the ossicles of the abactinal surface become less closely packed than in the smaller forms; and three rows of ossicles can be quite distinctly made out; the investing granulation is not especially coarse; the intervening pores may be set singly or disposed in groups of three or four. With increase in size, likewise, the boundary line between the two sets of marginal plates becomes more distinct; from the angle of the arm outwards the supero-marginals increase in breadth till the last two or three, but they are always at least twice as long as they are broad; the terminal two or three touch in the middle line. The infero-marginals are a little stouter, but have otherwise much the same proportions as the upper series.

The intermediate plates are distinct from one another and are covered by large distinct granules. The innermost row of adambulacral spines are 6 or 7 in number, and are more delicate than the two stouter ones which are placed outside them; those of the outermost row are smaller and more irregular, and are not easily distinguished from the granules of the ventral plates.

Madreporic plate rather large, distinct, $\frac{1}{3}$ to $\frac{1}{2}$ r distant from the centre; the anus often distinguished by its periphery of eight or ten small plates.

The dried specimens are yellowish or light slate-coloured; but there is no information as to what is their colour when alive or fresh.

The species is very distinct from *P. dilatatus* of Perrier, which species has perhaps been founded on forms which were only varieties of the *Astrogonium miliare* of Gray.

Thursday Island, Torres Straits, 3–5 fms.; sand.

19. Dorigona longimana.

Pentagonaster longimanus, *Perrier*, p. 228.

Percy Island, Queensland; Prince of Wales Channel, Aug. 1881, 7 fms.

20. Asterina belcheri.

Perrier, p. 320.

With four madreporites.
Port Jackson, 0–4 fms.
This is the first locality that has been given for this species.

21. Asterina calcar.

Perrier, p. 296.

Port Jackson.

22. Asterina cepheus.

Asperiscus cepheus, *M. & Tr. Syst. Ast.* p. 41.
Asterina cephea, *Perrier*, p. 315.

I follow Prof. Perrier in using Müller and Troschel's specific name, on the ground that, though Gray's name *burtoni* has the precedence by two years, the "type" is not to be found, and the description is useless for any purposes of identification. As *cepheus* is obviously a proper name, I prefer to use it without making any alterations in its termination.
Thursday Island.

23. Asterina gunnii.

Perrier, p. 298.

A small specimen from Port Molle.

24. Asterina regularis.

Verrill, Trans. Connecticut Acad. i. p. 250.

A small specimen: Port Molle.
A good series in spirit: Port Jackson.
What seems to be a young specimen of this species was also taken at Port Jackson.

25. Asterina (Nepanthia) brevis. (Plate VIII. figs. A, A'.)

Perrier, p. 321.

As Prof. Perrier's description would appear to be based on a single small dried specimen in the British Museum, I give the measurements of two specimens preserved in spirit:—

$$R=32, 44;\ r=9, 12;\ \text{or } R=2{\cdot}7 \text{ or } 2{\cdot}8\,r,$$

and a figure of the largest specimen.
Albany Island (8 fms., sand and mud); Thursday Island (4 fms., coral).

26. Patiria crassa, *Gray*.

Perrier, p. 326.

Port Curtis.

27. Luidia, sp.

A single dried specimen of a species of this genus was taken at Port Darwin. Though it is not in a condition to be described, it is right to direct attention to it, as no species of *Luidia* is mentioned either by Prof. Perrier or by Mr. Tenison-Woods in their lists of Starfishes of the Australian seas. The example in question was greatly injured during life, and the arms, of which there are only five, differ considerably in form and length. It cannot be regarded as belonging to Gray's species *L. hardwickii* on account of the greater stoutness of the ventral plates and of the spines found on them; the tufts on the paxillæ are likewise made up of stouter spinules, and the characters of the adambulacral spines will, it is almost certain, be found to be very different when a more satisfactory specimen is obtained.

28. Astropecten coppingeri.

Dr. Coppinger has forwarded examples of a species already represented in the Museum, but of which I have never been able to find a description. The species, however, is not, I should imagine, a rare one, and it is certainly one that has not yet been recorded as from the Australian seas.

It is distinguished by the fact that it has only four spines on each series of supero-marginal plates, and these are confined to the two plates on either side of the apex of the interradial angle.

R=30·5, *r*=8. Breadth of arm at base 7·5 millim. Arms taper gradually and regularly; about twenty-five supero-marginal plates, which are higher than broad and very high in the angle of the arm, where they are narrower at their ventral ends; the plates that do not bear spines are regularly covered with a somewhat coarse granulation, which may almost become spinous; the two terminal plates are large, prominent, and smooth; the space between the arms and on the disk is regularly filled with not large paxillæ, provided generally with a central tubercle and a circlet of from eight to ten tubercles around their head. The spines of the infero-marginal plates are prominent and lie on the sides of the arms, so that they are visible from the abactinal surface. Internally to these long stoutish spines, three smaller ones are to be found on the actinal surface in the same transverse line; the intermediate space is filled up by a coarse granulation or by spinous processes. The spines bordering the ambulacral groove are closely packed; there are three or, more rarely, two on the side of each plate; these are elongated and rather delicate; beyond this internal row there is a row of stouter shorter spines, and beyond these are others which become more or less confounded with the covering of the ventral plates.

Madreporic plate not detected. The characters of the paxillæ already described do not hold for the region of the disk, where

there is a closer and more regular granulation. The coloration, which becomes blotched in the dried specimens, is found in an example sent by Dr. Coppinger to consist of an irregular darkish patch at each angle of the disk, and an irregular patch, extending on to the marginal plates, occurs twice on the length of each arm.

In a much smaller specimen (in which R=9) the spines are only developed on one plate on either side of the apex of the angle of the arm, and only two distinct spines are to be seen on the ventral plates. In a specimen in which R=16 the second spine is fairly developed on some, small on others, and absent from the rest of the plates nearest but one to the apex; on all of the ventral plates a third, and on some the fourth, spine is now to be made out.

Of several specimens collected at Alert Island one has at some of its angles three spine-bearing plates.

In addition to the specimens from Thursday Island, Alert Island, and Prince of Wales Channel (7 fms.), the British Museum contains three specimens which were collected in "Australia" by Macgillivray in 1862.

29. Astropecten polyacanthus.

M. & Tr. p. 69.

A fine series of ten specimens were taken in 0–5 fms., at Port Jackson. In the case of two examples there are three spineless ossicles succeeding the plate at the angle of the arm; in all the other cases the more ordinary condition of two such ossicles only is found to obtain. The smallest specimen has R equal to 15 millim., and the largest R equal to 36 millim. Some variability is to be noted in the tenuity of the arms.

30. Archaster typicus.

M. & Tr. p. 65.

Three dried specimens from Port Denison, 4 fms.

RETASTER.

Perrier, Nouv. Arch. du Mus. (2) i. p. 55*.

31. Retaster insignis.

Sladen, J. Linn. Soc., Zool. xvi. p. 200.

On receiving these specimens I recognized that they were representatives of a species then undescribed; since that time, however, an account of the species has been published by Mr. Sladen in his Preliminary Notice of the 'Challenger' Collection. The follow-

* I am indebted to Mr. W. Percy Sladen for this reference.

ing notes will add a little to our knowledge of this form. Not one of the three specimens collected by Dr. Coppinger (there were two in the 'Challenger' collection) distinctly presents that cruciform arrangement of fibres in the dorsal areæ which was so striking in the specimens seen by Mr. Sladen; in some of the areæ it is indistinctly marked, and in not rare cases the areæ are divided into two; the number of pores hardly exceeds fifty; the areæ may be square as well as rhomboidal, or may be triangular or have the angles rounded. There is not that difference in hue between the tissue covering the areæ and that covering the spinelets which Mr. Sladen observed; but there may be great differences in colour, specimens being ashy grey or deep brown. The minor radial axis is respectively 60, 48·9, and 44·7 millim.

Port Molle, and Thursday Island (4 fms., coral).

OPHIUROIDEA.

1. Pectinura gorgonia.

Lyman, Prel. List, p. 3*.

This is one of the species that extends as far west as Mauritius, in a dried specimen from which island all the transverse bands on the arms have disappeared, and the number of arm-spines is as many as twelve.

Port Jackson, 0–5 fms.

2. Pectinura infernalis. (Plate VIII. fig. B.)

Ophiarachna infernalis, *M. Tr.* p. 105.
Pectinura infernalis, *Lyman, Bull. M. C. Z.* iii. p. 222; and *Prel. List*, p. 3.

The three naked plates between the radial shields, which are so markedly referred to in the original description, and are so well seen in Mr. Lyman's figure, are not always so distinctly developed, as may be seen by the figure which is now given.

Port Molle; Thursday Island; Prince of Wales Channel; a young specimen from Port Darwin.

3. Pectinura megaloplax.

Very large naked radial shields; disk elsewhere covered with a coarse granulation, beneath which are largish plates, somewhat puffed; the arms wide at their insertion, slightly carinated. Large accessory mouth-shields present in all the interradii; pores between first and second ventral arm-plates only; about seven rather delicate lateral arm-spines; upper arm-plates not broken.

* The bibliographical references are here chiefly confined to Mr. Lyman's Preliminary List' (Cambridge, U. S. A., 1880).

Diameter of disk 19 millim., length of arm about 83 millim. from the edge of the disk, width of arm at disk 6 millim., height of same 5 millim. Fourteen mouth-papillæ of fair size, the outermost the largest; four stout teeth; mouth-plates with six sides, the aboral the longest and the adoral the shortest, longest hardly longer than broadest axis; accessory mouth-plates large, longer than broad, straight within, convex without; side mouth-shields distinct, inclined to be triangular, broader within than without; granulated space between mouth-papillæ and mouth-shield very small.

Lower arm-plates at first wider than long, but varying a good deal in shape; proceeding outwards the adoral edge becomes shorter and shorter as the side arm-plates encroach more and more upon the ventral middle line. The upper arm-plates at the base of the arms are very wide, about four times as wide as they are long, further out they become narrower, and towards the tip of the arm are very much encroached upon by the side plates; as a rule there are seven spines on the plates. Tentacle-scales two.

This fine form stands nearest to *P. marmorata*, from which it may be distinguished by (i.) the much larger radial shields, (ii.) the wider arm-bases, (iii.) smaller number of arm-spines, (iv.) larger accessory mouth-shield, and (v.) proportionately shorter arms.

Port Molle (14 fms.).

OPHIOPINAX, g. n.

It appears to be necessary to establish a new genus for the reception of the form hitherto known as *Pectinura stellata*, owing to the remarkable and regular arrangement of the large plates on its disk; this, which is only obscurely seen in smaller specimens, becomes very prominent in such larger examples as were obtained during the voyage of the 'Alert.'

The genus may be defined as follows:—Two elongated genital clefts; mouth-papillæ, teeth. Accessory oral shields; arm-spines delicate, attached to the outer edge of the side arm-plates. Radial shields large, separated by several radial or interradial plates from one another. All the disk, except the radial shields, is covered by granules, but there are no spines or spinous processes. Teeth (in four rows) stout, blunt. Side arm-plates extend on to both actinal and abactinal surfaces; side mouth-shields naked.

The extraordinary development of the plates between the radial shields, both of the same and of the neighbouring sets, appears to have escaped the notice of Ljungman and Grube; nor can it, I imagine, have been noticed by Mr. Lyman, as he retains *O. stellata* of Ljungman in the emended genus *Pectinura*.

At this time it appears convenient to redescribe and figure the species.

4. Ophiopinax stellatus. (Plate VIII. fig. C.)

Pectinura stellata, *Lyman, Prel. List*, p. 3.

Disk somewhat pentagonal, not puffed, with a central rosette of plates varying a good deal in the extent to which it is well defined, and occupying about half the upper surface: in some cases a central plate and two not very regular circlets of variously sized plates of irregular form can be made out. The interradial series of plates, which extend from the rosette to the edge of the disk, are stouter and more prominent than the radial series: they are composed of three or four plates varying in size and form, and sometimes paired at the margin of the disk; the larger median have smaller plates on either side. The radial series may, for its undivided portion, be formed by a single plate, but, as a more general rule, there are three; there are no smaller marginal plates. The bifurcated band which embraces the base of the arm has usually three pieces on either half. Just below the margin of the disk there is a prominent plate, which is placed interradially; in shape this is irregularly cordiform; above, on either side, it is bounded by a compressed or diamond-shaped plate; between it and the mouth-plate there is a pair of smaller plates and several still smaller plates intervening; on the side there is an elongated plate, with two smaller ones, lying along the edge of the genital slit. The radial shields are large and triangular, and fill up all the space on the disk between the radial and interradial plates which is not occupied by the rosette.

The inner mouth-shields have a straight outer edge, the sides are at first straight, and then bending inwards meet one another at a more or less acute angle; they are longer than broad; the space between them and the edges of the mouth is rather loosely granular; the outer mouth-shields are about as broad as long, and have a slightly convex outer edge; the umbo is well marked, and that shield is not divided; the side mouth-shields are well developed, and are separated from the genital slits by a small granulated patch.

Seven mouth-papillæ, the three innermost small, the innermost smallest; the next three large, increasing in size from within outwards; the outermost again small.

The arms begin to narrow immediately after leaving the disk, and become very delicate at their free ends; in a well-developed specimen, in which the disk measures 17 millim. in diameter, they are 70 millim. long, 5 millim. wide, and 4·5 millim. high at their insertion into the disk. Upper surface carinated; upper arm-plates about three times as wide as they are long, but, owing to the invasion of the side arm-plates, the aboral is longer than the adoral edge; both these edges are straight.

There is a pair of pores between the first and second lower arm-plates; the lower, like the upper, arm-plates have their aboral longer than their adoral edges, and this, as on the upper surface, is due to the encroachments of the side arm-plates, and is more strongly marked near to, than far from, the disk. None of the edges of these

plates are curved; the plates themselves are at first broader than long, but during their gradual diminution in size they have at one time their aboral edge equal to their longitudinal axis; still further out they are longer than broad. About six, short, poorly developed spines are found on each of the side arm-plates near the disk, of which the largest are median in position; they diminish in number and size as they approach the free end of the arm. Two small tentacle-scales.

Upper surface (in alcohol) dark yellow, with spots or patches of brown; the whole of the actinal surface pale flesh-colour. Although, as a rule, three consecutive segments are coloured by a darker transverse patch, there may be only two, or there may be four so ornamented, and, as irregularities, one or more than four; but the coloration always extends on to the sides of the arm, though it never passes on to the lower surface. Or the whole may be very many shades darker, and then the darkest parts are not especially remarkable; this last mode of coloration appears to be by far the most common.

Port Molle, Queensland, 14 fms., rock; and Port Denison, 3–4 fms.

In some examples, which are very much smaller, from Torres Straits the radial shields are oviform, the upper arm-plates are not nearly so wide nor so distinctly carinated; the central rosette may be only barely indicated, though the central plate is very distinct; the plates of the interradial series have no small marginal secondary plates. The side arm-plates at the base of the arm are proportionately much larger, and in consequence diminish the breadth of the lower as well as of the upper arm-plates. Striking as is the difference in effect produced by these differences in character, they are, I think, only to be ascribed to age.

5. Ophiopeza conjungens.

This species seems to strengthen the opinion, more than once expressed by Mr. Lyman, that the genera *Ophiopeza* and *Pectinura* are barely to be distinguished. Without a divided mouth-shield, it has the arms not rounded, as in *O. fallax*, but keeled above, as is so often the case in *Pectinura*.

Most closely allied to *O. fallax*, it may be distinguished by the somewhat coarser granulation of its disk, the smaller number of mouth-papillæ, and the broadened upper arm-plates.

Disk pentagonal, flattened, 17·5 millim. diam. in one example, completely covered by a delicate and regular granulation (of about twenty granules to 1 millim.), the underlying scales not large; the radial shields, in perfect specimens, only indicated by depressions. Mouth-shields not divided, wider than long, with a wide convex adoral edge, straighter sides, and a barely convex aboral margin. Side mouth-shields small; the space between the mouth-shield and the edge of the jaws is marked by a granulation, much coarser than that which obtains elsewhere on the disk. Mouth-papillæ seven,

stout, the penultimate one about twice as wide as those on either side of it.

The arms, which are not more than four times the diameter of the disk, are very delicate at their tip, strongly carinated superiorly on the proximal portion; the upper arm-plates have pretty straight oral and aboral edges, about twice and a half as wide as they are long; the lower arm-plates are encroached upon by the side plates, which extend far towards the middle line; near the disk they are wider than long and hexagonal in form; further out the two lateral angles widen out, the sides gradually become straighter, and a quadrangular replaces the hexagonal form; towards the distal end of the arm the ventral plates are longer than broad. Arm-spines, near the disk, eight, the median longer than those above or below them; quite close to the disk they may be long enough to extend to the edge of the next plate; rapidly, however, they become shorter, though they do not diminish either rapidly or notably in number. Tentacle-scales two on the most proximal joints, one beyond. A pore between the first and second arm-plates.

Colour, in alcohol, brownish, with some blackish spots on the disk; these are also found on the arms; three or four successive plates often much darker than those in front of or behind them.

Port Molle (14 fms., rock); Port Curtis; Port Denison; Thursday Island.

Specimens of this species, bearing as locality "Indian Ocean," have long been in the Museum.

Specimens of what may be the young of this species were taken in the Prince of Wales Channel.

6. Ophiolepis annulosa.

Lyman, p. 4.

Clairmont Island; Port Darwin.

7. Ophioplocus imbricatus.

Lyman, p. 4.

Port Darwin.

8. Ophiactis savignii.

Lyman, p. 14.

Port Jackson, 0–5 fms.

9. Ophionereis dubia.

Lyman, p. 25.

Thursday Island; Albany Island; Prince of Wales Channel; Torres Straits.

10. Ophiocoma brevipes.

Peters, Archiv für Natur. 1852, p. 85 ; see *Lyman*, p. 27.

Mr. Lyman (Prel. List, p. 27) gives as synonyms of this, his own *O. insularia* (about which there will, I suppose, be no dispute), the *O. ternispina* of Martens, an unnamed specimen of which, from the island of Mauritius, has been for many years in the collection of the British Museum and has for a long time been a source of much disquiet to myself (I am now persuaded that this is a specimen to which Dr. von Martens would have given the name *ternispina*), *Ophiocoma variegata* and *O. brevispinosa* of E. A. Smith, from the island of Rodriguez. I do not know that a more western locality than the island just named has ever been recorded by a zoologist ; at any rate, Dr. Haacke did not detect the species among the Ophiurids collected by Prof. Möbius in the island of Mauritius *, unless he has been, as is possible, misled by the definition of *O. squamata* given by Müller and Troschel ; the three or four lateral spines, the two tentacle-scales, and the square markings on the upper arm-plates might deceive a hasty nomenclator, but they could not, I think, mislead any one who refers to the second edition of Lamarck (vol. iii. 1840), p. 225, where he will find references to the plates of Link and O. F. Müller. Although the species there figured is regarded by the editors as distinct from *O. squamata*, the resemblance between such an Ophiurid as this *Ophiocoma* and the *Ophiothrix pentaphyllum* figured by the two just-mentioned naturalists, is so very slight that we are forbidden from supposing that the *Ophiura squamata*, Lamk. (*Ophiocoma squamata*, M. & Tr.), is a near ally of an *Ophiothrix* or *Ophiothrix*-like form.

The variations exhibited by this very widely distributed species are indeed remarkable. It seemed for a time that the larger number and smaller size of the mouth-papillæ at the inner angles of *O. variegata* and of *O. brevispinosa* would indicate a certain difference ; but a difference of quite equal extent can be detected in the mouth-organs of a single specimen. The hollow square marking on the upper arm-plates, which, when well developed, seems to give such a characteristic appearance to the arms of this species, may be replaced by a black patch, or there may be a transverse bar, or there may be only the two lines left which run parallel to the long axis of the arm ; again, there may be spots, or the coloration may be fairly uniform. The colour of the disk may be pale, spotted, or reticulated ; the mouth-shields spotted or uniform in colour.

Levuka, Fiji.

* Möbius, 'Beiträge zur Meeresfauna der Insel Mauritius' &c. (Berlin, 1880). In what follows I may seem to speak somewhat harshly of Dr. Haacke's services ; but I am bound to point out that the list of Ophiurids given on p. 50 of this work has no scientific value whatever. *O. dentata* has been for many years regarded, first by Lyman (1865) and since by others, as "only a middling-sized *O. echinata*;" the type of *O. squamata* has been lost, "and nobody can tell what it was, though it might have been *O. brevipes*." Dr. Haacke makes no reference to either of these judgments.

11. Ophiocoma scolopendrina.

Lyman, p. 26.

Port Molle.

12. Ophiarthrum elegans.

Peters, Wiegmann's Arch. 1852, p. 82.

Though the British Museum possesses several specimens of this species, the present is especially useful, as it is the first which has come to hand in which even one of the "sehr zerbrechlich" arms has been preserved entire. As the disk measures 18 millim., and this complete arm rather more than 120 millim., we find that the object now in hand presents very much the same proportions as the specimen described by Dr. Peters. In an example from Torres Straits, which has been some years in the possession of the Trustees, there is an arm which is in a sense complete, but it was obviously broken during life; and though the disk is of very much the same diameter as that just added to the collection, this arm only measures 60 millim.

Dr. Coppinger's specimen was collected at Levuka, Fiji.

OPHIOTHRIX.

In addition to the series hereafter mentioned and described, there were indications of other species, not sufficiently good to justify description, but quite well enough marked to point to the great wealth of *Ophiothrix*-forms in the seas where these dredgings were made.

13. Ophiothrix fumaria.

Lyman, p. 34.

As this is a very rare species, the following notes may be of interest:—

Radial shields naked, large, with a curve along their basal edge, each separated from its fellow by a low ridge on which granules are generally developed. Each pair of radial shields is separated by some seven rows of prominent granules; these granules occupy all but the very central portion of the disk, and form a spinous patch on the lower surface. Mouth-shields irregularly oval, pretty sharply angulated proximally and very narrow distally, so that the bridge between the genital slits is very narrow. Only the median portion of the interbrachial space is spinous.

Upper arm-plates a good deal encroached upon by the side arm-plates, so that, for the greater part of the arm, they are wider along their distal than their proximal edge; spine-ridge of side arm-plates not specially well developed; lower arm-plates rectangular, a little

broader than long. Six arm-spines, the uppermost the longest, as long as two or three arm-plates, swollen at their tip, only faintly thorny. One tentacle-scale.

Disk with a large number of blue patches and dots; arm-plates above faint reddish pink, with dots of blue at the sides, and broad transverse bands of blue at regular intervals. Colour-markings below less pronounced.

Port Jackson, 0–5 fms.

14. Ophiothrix cæspitosa.

Lyman, Chall. Rep. p. 218.

Though the 'Challenger' found but few representatives of this species, it is apparently one of the most common in the neighbourhood of Sydney.

Port Jackson, March 1881.

15. Ophiothrix martensi.

Lyman, p. 36.

If I am right in ascribing to this species examples from Thursday Island and Port Darwin, it is one which must be regarded as exhibiting very remarkable variations in coloration. The original specimens, collected by Prof. Semper in the Philippines, were described by Mr. Lyman as being in colour, "above, bright indigo, with a darker line along the arm, bounded by a lighter one on either side; below, paler indigo, with a white line along the arm." In a smaller specimen, "the blue lines along the arms were continued to the centre of the disk, but were not margined by lighter lines." In the two specimens collected on "Aug. 7, 1874" (in the neighbourhood of the Fiji Islands), by the 'Challenger,' and determined by Mr. Lyman, I observe that there is a faint indication of a white line on either side of the blue lines on the disk, and that the white line on the ventral surface is, at places, broken across by a patch of indigo.

On either side of these "typical specimens" there would appear to be a light and a dark variety. In the latter the whole creature may be deep purple, the two white lines on the arms being at regular distances invaded by purple patches of such a size as to leave only spaces of white equal to themselves; and as these patches are symmetrical on either side of the middle line, the original white lines come to be represented by nothing more than paired patches of white; similarly the white line below disappears, or rather is forced out to the sides, and appears only as a thin marginal line. The light variety is no less interesting; with the exception of the radiating lines, the disk above is altogether white, and even these lines may

become less conspicuous and much reduced; the white lines along the arm are broken into by blue patches, much less extensively developed than in the dark form; on the lower surface of the arm the blue lines may be present as continuous tracts, or they may here and there be interrupted by white.

Port Curtis; Thursday Island; Port Darwin.

16. Ophiothrix striolata.

Lyman, p. 36.

Thursday Island.

17. Ophiothrix galateæ.

Lyman, p. 36.

Port Darwin.

18. Ophiothrix ciliaris.

Lyman, p. 35.

Port Jackson, 0–5 fms.; Port Molle.

19. Ophiothrix rotata.

Martens, Arch. f. Nat. 1870, p. 258.

A single specimen, without doubt referred to this species, differs in one or two points from that described by Dr. von Martens. In the Berlin-Museum specimen the diameter of the disk is 7 millim., and the length of the arms 35 millim. In our specimen the arms must have been nearly 150 millim. long, while the diameter of the disk is 12 millim. The upper spines are not more than twice the width of the arm, instead of four times. The original describer makes two statements with regard to the colour of the oral shields:—"Unterseite der Scheibe mit den Mundschildern und die Armstacheln blass"; and "Das der Madreporenplatte zugehörige Mundschild ist merklich grösser, an den Seiten nicht eingebuchtet und weiss, nicht wie die andern violett." In the specimen now under examination there is some violet marking on each one of the mouth-shields.

Thursday Island, 3–4 fms.

So far as the present collection allows me to form any ideas with regard to the range of variation within the limits of a "species," and the value of the colour-markings on which previous investigators have laid, and, as it seemed, justifiably, very considerable stress, I am inclined to the view that the variation is very much greater than was supposed, and that, after all, colour-marking, though an important aid in the discrimination of the species, can hardly be said to have the value which has been attached to it. The doubts first raised by a study of *O. martensi* (*vide suprà*) are not a little strengthened by the three specimens now lying before me, which, I have little

doubt, will be seen, when a large series is to hand, to be nothing more than varieties of *O. rotata*. As none of the arms are complete, the measurements I could give might only be deceptive; in them the upper arm-spines are proportionately larger than in the specimen already spoken of; the bands separating the plates, the character of which has given rise to the specific name, may vary in breadth on one and the same disk; and the granules may be in narrow or broad bands, and may be so greatly elongated that they may more correctly be spoken of as spines; the marking would by some be spoken of as exceedingly characteristic, for there extend from the disk on to the arms two lines of dots of blue; at every fourth plate, when regular, the two dots of either side fuse, and the spot enlarges into a blue patch; an exactly similar marking is to be seen on the lower surface. In the specimen unhesitatingly placed with *O. rotata* there is not this definite arrangement of the dots.

I have thought it right to direct attention to these peculiarities, but a full and satisfactory discussion of the subject must be based on a much larger series of specimens.

These examples were also from Thursday Island.

20. Ophiothrix punctolimbata.

Martens, Arch. f. Nat. 1870, p. 257.

Port Curtis: Port Molle; Thursday Island, 3–4 fms.; Prince of Wales Channel; Warrior Reef.

The specimen from Port Curtis, which is smaller than the others, has the lateral spines proportionately longer, more echinulated, and much more glossy.

21. Ophiothrix longipeda.

Lyman, p. 35.

Port Curtis; Port Molle.

22. Ophiothrix microplax.

Disk large, covered with short spines, less thick on the radial shields; ends of the not-thorny arm-spines faintly clavate. Proportion of arms to disk about 6 to 1.

The disk is rather large (20 millim. in diameter) and is covered with very short spines, which may almost be described as spinous granules; these are not so closely packed on the radial shields or on the actinal surface as on the rest of the disk. The radial shields are small, elongated, triangular, the straight base of the one faces that of the other; the plates of each pair are separated by several elongated scales, which carry a few longer spines. There is some imbrication of the scales on the actinal surface of the disk.

Arms at least six times the diameter of the disk, not diminished in width for some distance out. Just beyond the disk there are three large upper and four much shorter spines: the lowest, which is the smallest, is very small; gradually this disappears, and then the following one gets smaller and smaller till it disappears. The upper spines are faintly echinulated near their tip; the uppermost but one is generally rather the longest, but is never more than equal to about the length of two of the upper arm-plates.

The edge of the genital slit is fringed by some elongated plates; the bridge is pretty wide; the mouth-shields are large and stout, rather longer than broad, and have a notch in the middle of their inner edge.

The lower arm-plates have pretty even sides and are of about the same length as breadth; the tentacle-scale is only distinct at the proximal end of the arm. The upper arm-plates are twice as broad as long, broader along their distal than their proximal edge.

General colour of disk yellowish grey, the radial shields violet, the upper arm-plates washed with slate-grey and having a faint white line along their middle; the spines light-coloured, but darker towards their tip; the actinal surface lighter; the mouth-shields prominent by their whiteness.

Port Darwin.

23. Ophiothrix darwini.

Disk somewhat pentagonal, with delicate spines on its upper surface, but the radial shields naked. Colour light pink, green, or lemon in places, with a few dark spots.

Length of arms perhaps not more than six or seven times the diameter of the disk.

The large radial shields form right-angled triangles, the perpendicular side being separated from that of its fellow by a very narrow line and by only a single row of rare spines; a slight notch separates the plates at the periphery of the disk. The interradial spaces are about as broad as the base of the radial shields, and are richly covered with delicate spinules, these extend on to the actinal surface, but leave a bare band bordering the genital slits; the bridge between the slits is narrow; mouth-shields broader than long, somewhat irregularly lozenge-shaped in form. The lower arm-plates are very regularly arranged, and are only slightly oblong, many being almost completely square. The upper arm-plates are broader than long, the aboral edge three-sided, the adoral sides long, and the consequent form that of a not very regular hexagon. Four or five arm-spines, the lowest not peculiarly short, and the uppermost equal to five upper arm-plates in length, echinulated at their free end. There appear to be two very small tentacle-scales.

The larger of the two specimens presents the following markings:—There are three black dots on each of the mouth-shields; some of the lower arm-plates are light green, the adoral edges of others are marked by a black spot, and this is rendered the more conspicuous

by the fact that two successive plates are so marked, and that then there is an interval of two or more not so distinguished. Three or four blackish dots are to be found on the radial shields, along the line of the vertical side; by pairs or threes the upper arm-plates are faint pink or light green, and the pink ones are distinguished by each having a black dot.

I have taken advantage of the locality of this well-marked and really beautiful species to associate with it a name honoured by us all.

Port Darwin, 7–12 fms., mud and sand.

24. Ophiothrix melanogramma.

Disk pentagonal in appearance, completely covered with fine spinules, which are a good deal longer and rarer on the actinal surface. Arms 4–5 times the diameter of the disk, tapering very delicately; the upper surface marked by a black line, which extends a good way on to, but does not reach, the centre of the disk.

The radial shields are almost completely obscured by the spinulation, which is very delicate; mouth-shields broader than long, the inner sides meeting at an acute angle, the outer edge rather evenly rounded, the bridge between the genital slits very narrow; seven or eight arm-spines, the two lowest very small, the upper one as long as five or six upper arm-plates, but the uppermost of all is not the longest; the upper spines are richly and delicately echinulated, and, owing to the great encroachment of the side arm-plates on the upper surface of the arm, the spines of either side come to lie very close to one another, and soon obscure the arm itself. One small tentacle-scale. The lower arm-plates have a concave notch on their adoral edge, have a short side passing into the short lateral edge, and are three-sided on their aboral face, so that they form an irregular hexagon which is broader than long. Owing to the size of the side arm-plates, the upper arm-plates are lozenge-shaped.

This species has a most elegant appearance, the black band already spoken of relieving the whiteness of all the other parts, while a kind of feathery appearance is given to the arms by the delicate plates and long glassy spines.

Prince of Wales Channel.

25. Ophiomaza cacaotica.

Lyman, p. 37.

The coloration of these specimens is very far from the chocolate of Mr. Lyman's type; but three specimens collected in one locality (Gulf of Suez) are—one chocolate-coloured, one quite light, and one intermediate. A discussion, however, of the characters of the variations of this species will be more profitable when our series is larger.

Port Molle; Prince of Wales Channel.

26. Euryale aspera, *Lamk.*

Lyman, p. 43.

(*a*) One specimen, Port Molle, 12 fms.; bottom, rock and sand: of a dark black colour.

(*b*) Several specimens, Port Curtis: all lighter in colour.

HOLOTHUROIDEA.

A considerable number of specimens belonging to less than twenty species were collected, *Colochirus tuberculosus* being extremely well represented; in the case of rarer or less well-known species, unfortunately, a single representative was often all that was obtained, so that in some cases conclusions have been arrived at which cannot be regarded as any thing more than provisional. Where a number of specimens were collected, or where the species was already represented in the British Museum, evidence was frequently obtained as to the wide extent of variation within the limits of apparent species; and this has especially made the work of discrimination an anxious and difficult one. Other difficulties were presented by the extreme density of the integument of some of the species and our slight knowledge of the characters of the group. On the other hand, the work of bibliographical research has been but slight, the three more important workers at the group (Professors Semper, Selenka, and Ludwig*), having published works of remarkable exactness and care.

The arrangement followed is that of Prof. Semper.

1. Synapta grisea.

Semper, Hol. p. 11.

The condition of the single specimen did not admit of an anatomical investigation, so that the characters of the calcareous ring were not discovered; the form of the anchoring-plates is, however, exactly that of the species described by Semper under this name. That the species has a wide distribution would seem to be shown by its presence in this collection, and by its being represented by a specimen from the Indian Ocean in the Leyden Museum †.

Fitzroy Island, Queensland.

2. Cucumaria maculata.

Semper, Hol. p. 47.

From the external characters of the single specimen one would hardly be led to associate it with this species; but in the case of

* Dr. Théel's work does not seem to touch the present collection.

† See Ludwig, Notes Leyd. Mus. iv. p. 128.

Holothurians it is especially necessary to remember the words of Fabricius, "In spiritu vini mire deformatur, ita ut non pro eadem habeatur"*. The remarkable spicules are, however, an exact copy of those figured by Semper; and there seems to be no good reason for erecting on it a new species.

Port Jackson, 0–5 fms.

3. Cucumaria semperi. (Plate IX. fig. A.)

Body elongated, 5-sided; suckers regularly arranged in two rows, except at the two ends of the body; the suckers darker than the other parts, being almost black; the rest of the body of a mulatto tint (in spirit), or slate-grey, or whitish. Body widest in the middle. Length 36, 25 millim.; greatest breadth 10, 8·5 millim.

Retractors inserted at a little more than one third of the whole length from the anterior end; Polian vesicle large; calcareous ring long, and composed of a number of pieces, as in *C. conjungens* or *C. citrea*. Genital tubes delicate, about 6 millim. long, attached to the mesentery at about the middle of the body.

The supporting-rods in the suckers are not unlike folding eye-glasses in form, and are somewhat similar to those of *Ocnus pygmæus*; the plates in the integument are spherical, the framework very delicate and consisting, as seen in a surface view, of a central bar connected at either end with the peripheral encircling piece by two bars making an acute angle with one another. They are present in great numbers.

Port Denison; Torres Straits.

4. Ocnus, sp.

A single specimen of what is apparently an undescribed species is in the collection; but its form is so characteristic that I have not thought it right to injure it in any way. It is distinguished externally by the soft interspaces in the integument, the greyish-white colour, and the elongated narrow form of the body.

Port Darwin, 12 fms.

5. Colochirus tuberculosus. (Plate IX. fig. B.)

Colochirus anceps, *Semper, Hol.* pp. 57, 239, *ibique citata.*

There is a very large series of this species, and the specimens differ very considerably among themselves, not only in appearance but in the extent to which the colouring-matter has been dissolved out; only one retains any indication of the red pigment. The variations exhibited by the specimens as they have come to the Museum (some being quite white, others slate-grey, and others

* Fauna Groenl. p. 354.

almost black), the differences in the extent to which the papillæ are developed, and the comparatively much greater firmness of the integument of the younger specimens help us to understand how it is that several different names have been given to this widely distributed species. On the other hand, it is well to still bear in mind that our knowledge of Holothurian organization is not yet so complete as to justify us in definitely asserting that fresh differential marks do not yet remain to be discovered; if there are such, the series now regarded as single may be shown to contain representatives of more than one form.

As the only illustration of the spicules appears to be that which has been given by Prof. Semper, I have had views made of them from the side to show the characters of the free projecting processes, and from below showing the inside of the hemisphere.

Port Molle: Port Denison; Torres Straits; Alert Island (Torres Straits), 17 fms., sand.

6. Colochirus australis.

Ludwig, Semper's Arbeiten, ii. p. 88.

This species, which is represented by only one specimen from Port Molle (14 fms.), was more richly so in a collection forwarded some three years ago from Port Jackson by Mr. J. Brazier. I do not, however, find that the suckers are in them brown in colour, while the tentacles are rather black and white than brown and yellow. Neither of these are, however, points of any real importance. I find, from Mr. Ramsay's collections, that this species is very abundant in Port Jackson.

7. Actinocucumis difficilis. (Plate IX. fig. C.)

I have had the greatest difficulty in assuring myself of the specific distinctness of this form from the *A. typica* of Ludwig, the variations exhibited in the present collection impressing one with the necessity of the greatest care in the delimitation of species.

The species may perhaps be most conveniently described by pointing out the several characters by which it is to be distinguished from *A. typica*. The ambulacral papillæ on the dorsal surface are rare, and the suckers are not in more than four rows for each ray; the differences in the form of the spicules will be best seen by comparing the figures now given with those drawn by Professor Ludwig. The retractors are inserted rather further back, being found at 24 millim. from the anterior end in a specimen 65 millim. long, and at 22 millim. in one 70 millim. long; the genital tubes are shorter than in *A. typica*, being not more than 15 millim. long in any specimen examined. The Polian vesicle would also appear to be shorter, being only 7·5 millim. long in a specimen of 65 millim. length. It may be added that the loop of the intestine is exceedingly short; that the tentacles, which are not always 20, sometimes seem to

belong to an outer, and at others to an inner circle on the disk; and that the colour which in some cases is light brown, in others is purplish grey.

Albany Island; Torres Straits.

Quite recently an example of this species has been received from Kurrachee.

8. Thyone mirabilis (?).

Thyone mirabilis, *Ludwig*, *Semper's Arbeiten*, ii. p. 93.

The form of the spicules would perhaps allow us to place the single specimen here with doubt referred to this species either with it or with *Holothuria dietrichii* of Ludwig, the supporting-rods in the suckers of the latter not being figured. Though our specimen has much more the form and colour, so far as one may judge from the description, of the Holothurian, the eight large arborescent and two small tentacles, the scattered sucker-feet, and the unarmed anal orific exactly determine its generic affinities.

Port Denison.

9. Thyone sacellus *.

Stolus sacellus, *Selenka, Zeit. f. wiss. Zool.* xvii. p. 355.
Thyone rigida, *Semper*, *Holothurien*, p. 66.
Thyone sacella, *von Marenzeller*, *Verh. z.-bot. Ges. Wien*, 1881, p. 134.

Torres Straits.

10. Thyone okeni. (Plate IX. fig. D.)

The two specimens of this species are in remarkably good condition for examination, as one died with its tentacles fully expanded and the other was laid open by the collector.

With the exception of the terminal plate in the suckers I have not been able to detect any calcareous bodies either in the suckers or the integument; and if any such are present they must be exceedingly small and very rare. This characteristic brings this species into proximity to the *T. villosa* of Semper, where, as in this, the suckers are very closely packed.

Elongated in form, very dark brown in colour (in spirit), tentacles of about the same shade; suckers closely packed and distributed over the whole body, their radial arrangement in the region of the anus very obscurely indicated. Anus without teeth. Retractors inserted very nearly as far back as the middle of the body. Calcareous ring of ten pieces, the radial similar to the interradial, elongated, and wider below than above (fig. D). Calcareous plating extends some way along the enteric tract (fig. D). Genital tubes numerous, very slender and long, inserted behind the middle point of the length of

* Prof. Selenka has been kind enough to inform me that *sacellus*, as used by him, is a diminutive form of *saccus*, not of *sacer*.

the body. Polian vesicle? Length 85, 62 millim.; greatest breadth 17·5, 17·5 millim.

Port Jackson.

Save in the complete absence of spicules this species would not appear to have any resemblance to the *T. inermis* of Heller, the shorter body of which, attenuated at both ends, is said to have a very thin integument and to be of a yellowish-grey colour.

11. Thyonidium schmeltzii.

Ludwig, Semper's Arbeiten, ii. p. 94.

As there is only one specimen of this species, I have been obliged to content myself with an examination of the integuments, where the "morgensternähnliche Gebilde" were found in abundance in the outer layer.

Warrior Reef, Torres Straits.

12. Orcula cucumiformis.

Semper, Hol. p. 244.

Port Molle.

13. Phyllophorus proteus. (Plate IX. figs. F, F′.)

Body varying greatly in form, being saccular, swollen, or elongated; in the last case it is narrower behind than in front, and pretty regularly convex above. The integument, which is rather thick, may be black, and the colour rendered more marked by the lightness of the suckers, as there may be merely dark longitudinal bands, or the whole body may be greyish, and the only black spots the tips of the suckers. The suckers themselves always have a wrinkled appearance, but no definite statement can be made as to their arrangement on the body.

The retractors are triangular in form and considerably enlarged at their origin; the buccal ring is well developed, the radial pieces being very large, and the interradial dagger-shaped; both are rather deeply excavated above (fig. F′). The spicules in the suckers present an appearance not unlike that seen in the zoogloea-stage of *Bacterium termo*; the spicules of the integument are more or less four-sided, four-chambered bodies, made up of somewhat delicate bars, forming a trellis-work.

Port Molle; Clairmont and Thursday Islands; Alert Island (7 fms., sand).

14. Stereoderma validum. (Plate IX. figs. E, *a–f*.)

Body elongated, tapering more at its posterior than at its anterior end; the ventral surface a little convex, the dorsal concave. A

specimen measuring 46 millim. in length has a greatest width of 20 and a greatest depth of 15 millim. The dorsal surface slopes gradually to the two sides, which are marked off from the ventral surface by the development along the lateral line of from three to six short, conical, sharp denticle-like processes. From the median dorsal line to this line the scattered suckers increase in number; they are, however, much more numerous on the ventral surface, and more regularity of distribution is to be observed along the ventral median line than in any other part. The suckers are provided with stout plates, but no special terminal plate was detected. The calcareous plates in the skin are on the general plan of those in *S. unisemita*; but the bars do not appear to be so stout, and there may be at least seven pores. The ten pieces of the calcareous ring are all equal, and the retractor muscles are not especially strongly developed. As in *S. unisemita* there is, comparatively, a feeble development of the digestive and respiratory organs; but these characters, as well as the stiffness of the tentacles, are rather points of generic importance.

A more complete generic diagnosis will be made when the two species have been carefully compared.

Two young specimens have the integument much thinner.

Port Jackson, 0–5 fms., where it is, as other collections show, exceedingly common. Also from North Dunbar Island, China seas, and from between Ball's Head and Goat Island (*coll. Brazier*); and two dried specimens, purchased in 1848 of Mr. Cuming, from Brisbane Water, N. S. W.

In the definition of the genus given by Prof. Selenka there occur the words "Körper mit einfachen Füsschen bedeckt, die in der rechten (oder linken) Flanke in einer Doppelreihe stehen;" and the presence of this more distinct set of suckers is implied in the specific term of the American species, *unisemita*. In the present species, of which there is a good supply of specimens, I observe that the double row occupies the middle of the trivium, but that it varies considerably in the extent to which it is distinctly developed. Some modification of the generic diagnosis must therefore be made, and the suckers be spoken of as scattered over the body, but having a tendency to form a regular double row in some part of the trivium *.

15. Stichopus variegatus.

Semper, Hol. p. 73.

A single, rather small specimen from Port Molle.

* Since working out this species I have had the opportunity of examining another member of the genus from Kurrachee; for *S. murrayi* see Proc. Zool. Soc. 1883, p. 61.

Mr. Ramsay tells me that the naturalists of Sydney have been in the habit of regarding *S. validum* as the *Holothuria spinosa* of Quoy and Gaimard: this determination cannot, I think, be accepted.

16. Holothuria lineata.

Ludwig, Semper's Arbeiten, ii. p. 103.

One specimen from Thursday Island; skin very thick.

17. Holothuria peregrina.

Ludwig, Semper's Arbeiten, ii. p. 105.

With considerable doubt I refer to this species a single specimen from Thursday Island.

18. Holothuria modesta (?).

Holothuria modesta, *Semper's Arbeiten*, ii. p. 106.

Professor Ludwig described his species from a single specimen, and, curiously enough, there is only one specimen in the 'Alert' collection. The characters of the supporting rods in the suckers leads me to believe that the two are forms of the same species; but a full examination is not possible with a single representative.

Torres Straits.

19. Holothuria macleari. (Plate IX. fig. G.)

As will be seen by the figures, the spicules of this species present a considerable resemblance to those of *H. tigris*, with which, as it would seem, it must be closely allied.

As there is but a single specimen, presenting well-marked external characters, I think it right to limit myself to an account of these. Body elongated, trivium flat, bivium convex, anus round, unarmed, without (perhaps having lost) any distinct indications of pentamerous marking; ambulacral papillæ on the convex back, three rows of not very regularly arranged suckers on the trivium. An appearance of ringing both above and below is produced by the white colours and transverse setting of the papillæ and suckers respectively; as the former are less numerous than the latter, there are only about thirty bivial rings, while on the trivium two or three rings are here and there confluent and present a kind of longitudinal marking.

The single specimen is 49 millim. long and 10 millim. wide.

"Clairmont and Bird Islands," N.E. Australia.

A specimen from the island of Rodriguez, in the possession of the British Museum, apparently belongs to this species.

CRINOIDEA.

In the preparation of this portion of my Report I have had the very considerable advantage of the kindness of Mr. P. Herbert Carpenter, whose work on this group is so well known to, and so highly appreciated by, his fellow-workers. Mr. Carpenter has not only been good enough to favour me with his opinion on many of the species and specimens in the present collection, but, at what must have been considerable trouble to himself, he copied out for me the notes that he had been able to make at various times and places on the "type specimens" of the species named by the illustrious founder of the system of this group; thanks to this act of kindness, I have probably escaped from some of the numerous pitfalls which, with the advance of our knowledge, now surround the student who applies himself to Johannes Müller's descriptions of the different species. As Mr. Carpenter will, in the progress of time, publish his studies on these Müllerian types, I have thought it proper on this occasion to do little more than merely note the presence of such forms in this collection.

The proportion of undescribed to described species is no doubt appalling: but on making a careful estimate I do not find it to be practically greater than in the case of my predecessors. In a Note which I communicated to the Zoological Society in May 1882 I gave a list of all the described species, which was very nearly complete: therein were enumerated 37 *Antedons* and 21 *Actinometræ*. Of these, 7 *Antedons* and 4 *Actinometræ* were first described in 1881, from the collection of the Leyden Museum, by Mr. Carpenter. In that paper the percentages of new to all the known species were respectively 23 and 23: the percentages to new species in the collection respectively 70 and 40.

As there are here described 12 new species of *Antedon*, my percentage to the 37 described forms is 32·5, to all the species mentioned in this Report it is 75; on the other hand, there are some 5 new species of *Actinometra*, giving a percentage of 23·5 to all the described forms, and of 38 to those enumerated in the accompanying list.

Against this higher proportion we must, however, set off the fact that five of the earlier species had been described by Müller from the specimens in the Leyden Museum.

But the whole story has not yet been told: without, of course, wanting in any way to tie Mr. Carpenter down to details, I may add that his examination of the 'Alert' collection was made after he had examined the collection of Crinoids brought together by the officers of H.M.S. 'Challenger,' and entrusted to him for description. Only a single form among the "new species" in the present collection has been detected by Mr. Carpenter to be one of the treasures which he has described, but whose description he has not yet published:

the interesting *A. jukesi*, of which Mr. Carpenter has already indicated the more essential characters, is indeed represented in this collection, as it is probably in any fair collection of the marine fauna of the Australian coast.

Yet, again, in a paper which will be shortly published in the 'Journal of the Linnean Society'*, Mr. Carpenter describes eight out of the nine specimens of *Antedon* from the Hamburg Museum as new, and he speaks in the introduction as estimating the species of Comatulids at something like 400.

Further, it is of great significance to observe that many of the species here enumerated or described were collected at one station only.

Lastly, we note that the number of *Antedons* is larger than might have been expected; for in the Moluccas "*Antedon* seems to be comparatively rare"†, while of the 29 species here enumerated, 16 belong to that genus. From such material as has passed through my hands, I am inclined to think that on the northern and eastern coasts of Australia we shall find *Antedon* to be rather more abundantly represented in species than *Actinometra*; the time, however, for any generalization is still far off.

In entering into the detailed enumeration of the proportion of new to old species, I had not in view the purpose of apologizing for the presence of so many new forms in this collection, but rather the desire of directing attention to facts which can only be within the knowledge of a limited number of special students; those who know how few species of *Comatulæ* have been described, and how rich in novelties not only new collections but old museums are, will not think that there is any suspicious wealth of new species in the very valuable and important collection by which Dr. Coppinger has more than doubled the number of specimens and species in the possession of the British Museum ‡.

So large a number of new species should be presented in some kind of arrangement, either in the form of a phylogenetic table or of a "key." The former being an impossibility at present, on account of our unsatisfactory knowledge of the ancestry of the Comatulidæ, and keys being, of all things, the most unscientific, I propose to give formulæ for all the species of Comatulids here described, basing those formulæ on the method I proposed to the Zoological Society§, as improved by the suggestions of Mr. Carpenter ‖.

* Journ. Linn. Soc. xvi. p, 487.

† Notes Leyd. Mus. iii. p. 191.

‡ [The above is allowed to stand, though written some eighteen months ago, as it puts more forcibly than a briefer and colder statement could, the present tenuity of our knowledge of Crinoid species and the wide area that is opening up to us.—Dec. 4, 1883.]

§ P. Z. S. 1882, p. 530.

‖ P. Z. S. 1882, p. 731. I retain A' as the sign for *Actinometra*, as *a* is used in the formulæ of the cirri; and I propose to use *br* for the brachials, as *b* is likewise used in the formulæ of the cirri. Similarly I omit the 10, as A 10 followed by A 3 (in such a list as the following) is very apt to mislead.

Antedon.

adeonæ .... A. $\frac{b}{b}$.

milberti .... A. $\frac{b}{b}$.

pinniformis .... A. $\frac{a}{b}$.

carpenteri .... A. $\frac{a}{a}$.

pumila .... A. $\frac{b}{a}$.

bidens .... A. $\frac{b}{a}$.

loveni .... A. $\frac{b}{\times}$.

decipiens .... A. $(3)\frac{b}{b}$.

reginæ .... A. $2.(2)\frac{b}{b}$.

articulata .... A. $2.2\frac{c}{b}$.

irregularis .... A. $3.(2)\frac{b}{b}$.

elegans .... A. $3.\frac{(2)\,b}{(3)\,c}$.

gyges .... A. $2.2.\frac{c}{b}$.

briareus * .... A. $3.2.(2)\frac{b}{a}$.

microdiscus .... A. $3.3.(3)\frac{c}{c}$.

Actinometra.

solaris .... $A'R\frac{br}{2}\cdot\frac{a}{a}$.

intermedia .... $A'R\frac{br}{2}\cdot\frac{b}{a}$.

robusta .... $A'R\frac{br}{2}\cdot\frac{b}{b}$.

cumingi .... $A'\frac{a}{a}$.

coppingeri .... $A'\frac{b}{a}$.

jukesi .... $A'R\frac{d.br}{2}\cdot\frac{0}{0}$.

parvicirra .... $A'3.3.\frac{(ab)}{a}$.

alternans .... $A'3.2.3.2.\frac{0}{0}$.

paucicirra .... $A'R\frac{d.br}{2}\cdot\frac{a}{a}$.

multifida .... $A'3.2.2.\frac{b}{a}$.

variabilis .... $A'3.2.\frac{a}{a}$. / $A'3.3.\frac{a}{a}$. / $A'3.(2).(2)\frac{a}{a}$.

From the table of *Antedon* formulæ some facts become at once apparent :—

(α) There are six examples among the more than ten-rayed forms in which the arms are not a regular multiple of ten—that is, not 20, 40, or 80 ; this is clear from the sign for the palmar or post-palmar being in these cases placed within brackets.

(β) In all cases cirri are developed, and these are rarely very numerous or very long.

(γ) In no case is the radial axillary a syzygy.

A moment's inspection of the table of formulæ for the *Actinometræ* will reveal to the student a number of interesting facts :—

(α) Three species have the same structural characters, and only

* A study of this species is sufficient to show the advantage of Mr. Carpenter's proposal to register the number of joints in each division over my proposal to register rather the syzygies first of all, as *A. briareus* has no syzygies on the palmars or succeeding joints where the arms divide again.

differ in comparatively unimportant details, of a kind which are probably *adaptive*.

(β) There is a marked tendency to the development of a small number of short cirri *.

(γ) And ten species have lost the cirri altogether.

(δ) Of the eleven species the formula of no two is exactly the same.

1. Antedon adeonæ.

Comatula adeonæ, *J. Müller*, *Gattung Comatula*, p. 15 †.

A white line, which extends along the middle of the radials, the rest of which is of a reddish purple, is continued for a short though varying distance along each of the arms.

There is a curious error in connexion with this species which does not seem to have been noticed. Lamarck described it as "*C. radiis pinnatis denis* &c.:" de Blainville, while quoting Lamarck, refers also to his own figures in his 'Atlas' (pl. xxvi.); in this reference he is followed by J. Müller and by the editors of the second edition of Lamarck. The figures, however, when referred to are seen to be those of a species with twenty arms and with cirri nearer thirty than twenty. It is not perhaps necessary at this distance of time to waste time in inquiring what species it is that de Blainville has there figured.

Port Curtis and Port Denison.

2. Antedon milberti.

Comatula (Alecto) milberti, *J. Müller*, p. 19.

The rich supply of this species in the present collection ‡ amply justifies the doubts which Mr. Carpenter has expressed to me as to the exactness of the locality (North America) ascribed by Müller to this species.

Port Molle; Port Denison; Prince of Wales Channel; Torres Straits.

3. Antedon pinniformis.

P. H. Carpenter, *Notes Leyd. Mus.* iii. p. 180.

Dundas Strait, N.W. Australia.

* So far as we know at present, *c* rarely appears in the formula of an *Actinometra*; in words, the cirri are rarely very numerous (more than 30) or very long (with more than 40 joints).

† The essay on *Comatula*, the pagination of which is here quoted from its separate copy, was published in 1849 in the 'Abhandl.' of the Academy of Berlin for 1847, where it occupies pp. 237–265.

‡ It is also well represented in a collection of Mr. E. P. Ramsay's, of the Australian Museum, Sydney.

4. Antedon carpenteri. (Plate X. figs. A, *a–c*.)

Centrodorsal a flattened disk; about 12 marginal cirri, of almost 20 short joints, of which the lowest are almost twice as broad as they are long; it is not till we reach the penultimate one that we see a distinct spine, though the dorsal surface of most of them is produced into a minute protuberance.

First radials not visible; the second do not or do only slightly touch, united to the third by ligament. Ten arms. First brachials touch, they are nearly oblong and more than twice as wide as long; the second are a little wider on their outer than their inner side; the third with a syzygy; fourth to sixth oblong, seventh wider on inner than outer side, eighth wider on their outer than inner, and so on alternately; twelfth and thirteenth serrated at their distal edge; the fourteenth syzygial. Thence from four to seven joints between each syzygy. 130–180 joints in the arm.

The second pinnules on the fourth brachial are very stout, with extraordinarily wide joints, which are armed on either side by spinous projections; the first pinnule is a little longer than the third.

Colour white, with purple bands or patches, not always developed at the syzygies. The middle line of the arm often white.

Arm about 40 millim. long, disk 6 millim. in diameter, cirri less than 9 millim. long.

This species has some considerable resemblances to *A. serripinna*, from which, however, the pinnules alone would, as Mr. Carpenter assures me, be sufficient to distinguish it.

Port Curtis.

5. Antedon pumila. (Plate X. figs. B, *a–b*.)

Centrodorsal rather wide, rounded; with about 25 cirri, in three rows, very delicate, of about 12 joints, which, from the fourth onward, are a good deal longer than broad, hourglass-shaped, but a little wider at their distal than at their proximal ends; some are also produced into a small spinous ventral process; no dorsal spine developed till the penultimate, and that is small.

First radials just visible, second not in contact; axillaries triangular in shape, sloping backwards in the middle line. Ten arms. First brachial longer without than within, the second within than without and projecting backwards in the middle line; the third a syzygy wider within than without. The succeeding joints may be incised, so as to leave a lozenge-shaped space between every two; when this disappears, the joints which have projected strongly forwards on either side alternately become more evenly oblong.

Syzygies 3, 8, 12, 15; then a little rarer.

Pinnules delicate, the second longer than the first, with elongated joints which are a little wider at their distal than at their proximal end and are produced into a minute spine.

Arm about 30 millim. long, cirri 7 millim., diameter of disk 3·5 millim.

Colour creamy white, in spirit.

Port Jackson, 0–5 fms.

The above description was originally drawn up from the single specimen received from the 'Alert,' which in spirit had a creamy-white colour and appeared to be hardly mature. Since its arrival the Museum has acquired specimens from Nelson's Bay, which are no larger and are a little darker or grey in colour: these specimens, of which I have been able to examine a number, bear witness to their maturity by the presence of a large number of ova attached to the pinnules.

6. **Antedon bidens.** (Plate XI. figs. A, *a–c*.)

Centrodorsal prominent; about 20 cirri, with about 20 joints, a number of which have two minute processes on their dorsal side; the penultimate spine is small; none of the joints are distinctly longer than broad, but a number of them have a shallow lateral excavation along their distal edge.

First radials just visible; second very wide, in contact; third almost triangular, not quite twice as long as the second, and forming a convex protuberance with it. Ten arms. First brachials in contact, a little wider on their outer than their inner side, as are also the second brachials, which form with the first a convex protuberance; the third brachials, which are syzygies, have a sharp distal edge, as have the succeeding joints; these soon become wedge-shaped, and form a strong overlap on either side alternately; after some time this diminishes, and the more terminal joints of the arm form rather bead-like swellings on either side.

Syzygies 3, 9, 14; 4–6 joints between the succeeding syzygies.

The first pinnule is very stiff and long, with the most proximal joint the longest; it is placed on the second brachial, has some 12 joints, of which the more basal are much longer than broad, and which are also stouter than those on the sixth brachial, which, again, are a little stouter than those on the fourth. The pinnules then gradually diminish in size, and then again increase further out.

The arms are stiff, and somewhat compressed from side to side: they are about 45 millim. long; diameter of disk 5 millim., of centrodorsal 3·3; length of cirri about 8 millim.

The original colour was probably purple.

Torres Straits.

7. **Antedon loveni.** (Plate X. figs. A, *a–e*.)

Centrodorsal large, as large as the disk, excavated in the centre, with about 20 cirrus-sockets (cirri lost).

First radials just visible, second oblong with a convex median protuberance along their distal edge; axillary pentagonal, not a

syzygy. Ten arms. First brachials wider without than within, in contact, with a convex median protuberance along their distal edge; the second with sides a little more regular; the third almost square, a syzygy. The fourth to seventh joints a little wider than long; eighth or ninth a syzygy. The succeeding joints wedge-shaped, with their free margins a little overlapping and slightly toothed. About 5–8 joints between the succeeding syzygies.

The earlier pinnules are extraordinarily stiff; the first, which is on the second brachial, is much shorter than the second or third, which are of about the same length and made up of rather less than 20 joints, most of which are longer than wide, and have their distal edge enlarged and slightly denticulated. There are 10 or 12 stiff pinnules: the succeeding ones are shorter, and then again longer.

Arms more than 120 millim. long; disk not more than 7 millim. in diameter. The radials and the earlier brachials have their infero-lateral edge produced into a kind of ledge. The more proximal joints have the appearance of being tuberculated, and there is a faint median dorsal ridge; at the sides they are compressed.

Colour dark slate.

The stiff pinnules, the long arms, and the small disk are very striking characters in this species.

Port Denison.

The large *Myzostomum* found on it has been named *M. coriaceum* by Dr. Graff.

8. **Antedon decipiens.** (Plate XI. figs. B, *a*.)

Centrodorsal small; cirri on three levels, about 20 in number, with 25 joints, of which the fourth to tenth are longer than wide; the rest, which gradually become shorter, are provided with a well-marked spine; these decrease towards the end, but the penultimate one is larger again.

First radials quite distinct; the second oblong, three times as long as wide, partly in contact; the third almost triangular. The arms may or may not divide, so that there are from about 14 to 18. The first brachials or first distichals are always wide, and touch; where the arms divide there are three distichals, and the axillary may be a syzygy. The first brachials, which have sharp overlapping distal edges, are pretty regularly oblong; at about the seventh they become alternately wider on either side, to again become more regular later on.

Syzygies 3, 12–15, 22–25; then from 10–12 joints between each syzygy.

First pinnule on second distichal (when present), that and the one on the third brachial short; those on fifth to ninth much longer, the basal joints very stout, the free ends very delicate, and their outer side produced into a well-marked conical process. The succeeding pinnules are shorter, and these again increase in length; they are not composed of a large number of joints.

Disk small. Arms about 70 millim. long, cirri about 16 millim.

Colour white; pinnules sometimes banded with darker.

This species presents some resemblances to *A. pinniformis* of Carpenter.

Arafura Sea (32–36 fms.); Dundas Strait; Prince of Wales Channel.

I provisionally associate with this, as a variety, two specimens from St. 144, in which the cirri are rather more numerous and more jointed, in which the whole animal appears to be more slender and delicate, and the colour ashy grey.

9. Antedon reginæ. (Plate XII. fig. A, *a*.)

Centrodorsal hidden by the cirri; cirri about 30, with 30 stout and laterally compressed joints, about 20 of which are provided with a well-marked spine.

First radials not visible, second broader than long, in contact; third short, with a very slight backward projection in the middle line. Two broad distichals. Thirty-five arms; if the arms divide a second time there are two palmars, and the third brachial is a syzygy; if the arm does not divide a second time, the fifth brachial is a syzygy. At first the joints are fairly regular, though much shorter than wide; later on they become more or less, though never very strikingly, wedge-shaped.

Syzygies on the ninth joint; then from 9–14 between each.

The first pinnule is shorter than the second, which is of some length, and the third than the fourth; most of the pinnules are very short.

Length of arms about 70 millim., cirri about 24 millim. Disk deeply incised, 10 millim. in diameter.

Colour, flesh-coloured.

Port Molle.

10. Antedon articulata.

Comatula (Alecto) articulata, *Müll. Gat. Comat.* p. 27.

Port Molle.

11. Antedon gyges. (Plate XII. figs. B, *a*, *b*.)

Centrodorsal flattened, rounded, with cirri in three rows, rather more than 40, with rather more than 30 joints, the fifth to the tenth longer than broad, the succeeding joints shorter, and provided, first of all, with a convex dorsal edge; this narrows into a wide spinous protuberance, which becomes more and more spiny till the fairly well-marked penultimate spine is reached.

The single specimen has 41 arms.

First radials completely, second largely obscured; the third triangular, not a syzygy; a slight median conical protuberance in the

line of junction of the second and third. Distichals 2; palmars 2: in neither case is the axillary a syzygy, and in both cases there is a slight conical protuberance where the two joints meet, and in both cases also the more proximal of the two joints is in close lateral contact with its fellow. First brachials a little wider along their outer than their inner side; along the latter they are again in close contact with their fellow; as the second brachial is also wider without than within, there is a feebly-marked diamond-space interval. The third brachial is nearly oblong, and, being syzygial, has somewhat the appearance of a dice-box. For the next three or four joints there is no wedge-shaped arrangement; at first feebly indicated, it rapidly becomes more marked; further out it diminishes, and the terminal joints are nearly oblong. As in *A. flagellata* (see Carpenter, Notes Leyd. Mus. iii. p. 183), the earlier brachials are flattened on their outer side.

The first syzygy is on the third brachial, the next about the fifteenth, and there are then intervals of 9–10 joints between the syzygies.

The species is at once to be distinguished from *A. flagellata* by the fact that the third is shorter than the first pinnule; of the first three the second is the longest. The first is on the second brachial, and is but little shorter than the second; the first three pinnules all have broad basal and elongated distal joints, but though longer than the next succeeding they are by no means remarkable in their length.

Colour: brownish flesh-coloured arms; the peristome very much darker; the cirri much darker on their ventral than their dorsal aspect.

Disk incised, with a diameter of 7·5 millim.; arms about 80 millim. long; cirri 21 millim. long.

Thursday Island.

12. Antedon irregularis. (Plate XIII. figs. A, *a–c*.)

Centrodorsal flattened, small; cirri marginal, in two rows, about 25 in number (but there may be not more than 15), with 30–35 joints, the lowermost short, fourth to ninth longer than wide, then again shortening; no spine, except on the penultimate joint, and that exceedingly small.

First radials not (or barely) visible; second wide, in contact, with a median convex protuberance; the third almost perfectly triangular.

Arms 11–22. Three joints in the first division, the axillaries syzygies; when there is a second division there are two joints, the axillaries not syzygies. The earlier joints of the arm have a well-rounded convex dorsal surface and are broader than long; soon, however, they become very markedly wedge-shaped and form a prominent projection alternately on either side. Towards the end of the arms these disappear.

Syzygies 3 : 10 : 19, or 3 : 11 : 21, or 3 : 13 : 21, or 3 : 14 : 21, or 3 : 15 : 22 ; then from 6–10 joints between each.

First pinnules very short; third and fourth the stoutest and longest, quite stiff, with well-developed broad lower joints, each of which has a marked protuberance on either side; the succeeding ones shorter, and then again longer.

Arms about 85 millim. long, the longest cirri 24 millim. ; diameter of disk 6 millim.

Colour : pale flesh, occasionally with a dark band here and there, especially at the syzygies ; sometimes there is a good deal of brown. The cirri are typically banded purple and white.

Prince of Wales Channel ; Torres Straits.

This species has some resemblance to *A. decipiens* ; but it may be distinguished from it by (α) the absence of spines from the joints of the cirri, (β) the broader lower pinnules, and (γ) the greater length of the more distal pinnules.

13. Antedon elegans. (Plate XIII. fig. B, a.)

Centrodorsal small and flattened ; cirri marginal, in two rows, 25–30, with 40 joints, the fifth to tenth rather longer than broad ; the succeeding ones with a short conical spine, which diminishes in the more distal ones, but enlarges again somewhat as a penultimate spine.

First radials just visible ; second wide, barely in contact ; the third comparatively short. Thirty arms. The three distichals pretty long ; the axillary a syzygy. If the arms divide again there are generally two joints, when the axillary is not a syzygy ; but there may be three joints, and then the axillary is a syzygy. The earlier brachials have even sides ; they then become wedge-shaped, but do not overlap. Still further out, they become shorter and project a little at the sides ; towards the free end of the arm the upper face of each joint is sharply convex.

Syzygies 3 : 11 : 22 ; then 9–13 joints between each.

The first two pinnules are stiff and long, longer and stouter than the third and fourth ; none of the following are long, but the rather more distal are the longer.

The disk is deeply incised, and the margins of the rays provided with a well-developed and characteristic calcareous plating.

Arms delicate, 95 millim. long, cirri 30 millim. ; disk (owing to the incisions) only 8 millim. in diameter.

Arms pinkish flesh-colour above, much darker below ; the cirri ringed purplish and white. In a younger specimen there are purplish spots on the arms above.

Port Molle.

A disk from Thursday Island probably belongs to this species.

14. Antedon briareus. (Plate XIV.)

Centrodorsal flattened; 15–20 marginal delicate cirri, formed of a few short joints.

Arms more than 70.

First radials obscured; second in contact, at least three times as long as they are broad; third widely triangular. Three distichals, the axillary a syzygy; two palmars. If there is another division there are again two joints: no syzygy. The first five or six brachials have nearly even edges; the succeeding ones are markedly wedge-shaped. A syzygy on the third brachial; succeeding syzygies rare.

Second pinnules longer than first, very delicate, made up of a number of small joints; the succeeding pinnules stouter and more fleshy.

This is one of the species in which there is a very considerable difference in the length of the arms; here some of the arms may be as much as 110 millim. long, while others are only 75 millim. There is an interradial plating, extending as far as the distichal axillary.

The colour (in spirit) is dark brown.

Port Denison.

15. Antedon microdiscus. (Plate XV.)

Centrodorsal rather large and prominent; the cirri marginal, in two or three rows, from 30–50 in number, with from 50–70 joints, none of which are markedly longer than broad; as a rule, the distal two thirds have an inconspicuous dorsal spine, and in the larger specimen the penultimate spine is hardly more conspicuous.

The first radials visible; all very short and wide, the second not in contact. Three distichals, the axillary a syzygy. Three palmars, the axillary normally a syzygy. The arms may divide again, and of the three joints the axillary may or may not be a syzygy. Probably as many as 90 arms in an adult. The earlier brachials have fairly even edges, are well rounded above and flattened at their sides; the next succeeding are faintly wedge-shaped, the distal edge of each projecting alternately on either side into a slight protuberance; further out, the wedge-form disappears. The arms generally, though slender, are very firm and stiff and are set very close to one another.

Syzygies 3, 22–25, 40–41; then from 10–12 joints between each.

The earlier pinnules exceedingly long in the adult, with very stout slightly keeled basal joints; the second, which is a good deal longer than the first, has as many as 50 joints and is quite fine at its free end; the more distal joints are provided with a spine or tuft of spines.

The stiff straight arms are about 150 millim. long; the cirri measure nearly 50 millim.; the disk, with rounded incisions, has a diameter of about 12 millim.

The disk and the arms, as far as their last division, are largely

washed with purple; the middle line of the arms is lighter, but patches or spots of purple are to be found at the sides; the lower surface is a little lighter on the disk than on the arms, where it is almost black.

Port Molle, 12 fms.

Three smaller specimens already in the collection of the British Museum, from Nicol Bay, N.W. Australia, must, I think, be referred to this species. The smallest of these has not more than 30 cirri, nor have they more than 40 joints; their spines, and especially the penultimate one, are better developed. There are only about 50 arms, and in some cases there are only two palmars (when the axillary is not a syzygy). The ground-colour is purplish, marked with yellow bands.

16. Actinometra solaris.

P. H. Carpenter, Notes Leyd. Mus. iii. p. 192; *Journ. Linn. Soc., Zool.* xvi. p. 514.

Two specimens of different sizes do, I think, undoubtedly belong to this species, to which specimens have not unfrequently been assigned that are to be distinguished by what are apparently good specific characters.

Prince of Wales Channel.

The greatest difficulties attend the exact delimitation of the specific characters of this species; and the question whether they vary within wide limits or are, rather, sharply defined cannot yet be answered. For the purposes of exact knowledge it seems to be at present the better course to try and recognize points of difference between allied forms; we must by experiment and experience discover which of the characters of a Comatulid afford trustworthy criteria in the discrimination of species; so few forms have, as yet, been described, and so little criticism has been brought to bear on what work has been done, that our knowledge of how species are to be defined and delimited is as yet in a very elementary condition.

The only consolation is to be found in the reflection that what may seem, with wider knowledge, to be a "bad species" is justifiably regarded now as a "good one," and that wary specific discrimination is often a considerable aid to the exact and accurate knowledge of the characters of complex and elaborate forms.

The two specimens here ascribed to *A. solaris* present the following characters:—

There are 12 cirri, and there may be only 18 joints in a cirrus; the more proximal joints of the arms of the smaller specimen are more "knobby" than the correspondingly placed joints in the larger. In both cases the arms are at their widest a little distance from the disk; the keels on the basal joints of the second pinnule are well marked in the smaller specimen; but in neither case are there any very prominent keels on the basal joints of the third pinnules.

Arm of the larger specimen about 120, of the smaller about 85 millim. long; in the former the first pinnule is about 20 and the cirri 16 millim. long.

Both of the specimens are white and without any dorsal median line; dark spots or marks prominently developed on the pinnules.

For the present, at least, I associate with *A. solaris* a specimen from Warrior Reef, in which the characteristic keel to the pinnule is developed and in which the cirri do not seem to have been more than twelve in number, but in which the number of cirrus-joints would appear to be less than fifteen.

There are also specimens from Port Curtis and Torres Straits which, though still small, hardly promise to ever have the stout arms which are so characteristic of the adult; further experience will, I think, shew them to be "dwarfs."

From the Arafura Sea we have received a comparatively small specimen, which is chiefly remarkable for the smaller number of its cirrus-joints.

In Dundas Strait there were dredged some small specimens which approach in character *A. pectinata* and *A. purpurea*, but give us, with our present scanty information, but little aid in determining the character or limits of these species.

From Thursday Island we obtained a somewhat injured and large specimen belonging to the "type" of *A. solaris*, but which completely eludes my attempts to understand it.

Under the name of *A. albonotata* I was inclined to separate a specimen from Albany Island, which is to be distinguished from the form to which the name *A. solaris* is ordinarily restricted by the larger number (20–25) of cirri, and the less prominent keels on the basal joints of the second pinnules. The general facies, however, of the specimen is distinctly that of *A. solaris*, with the exception of the rather remarkable coloration, which has led to the proposal of a distinctive name. When, however, we make a careful comparison between the pattern of this coloration and that of the two specimens first described and unhesitatingly referred to *A. solaris*, we see that there is really a striking resemblance between the two, and we are again led to the reflection that great circumspection is to be exercised whensoever we are tempted to make use of difference in colour as a distinguishing mark. I have already stated that there are black patches or spots on the pinnules of the first-described pair of specimens; what we find in the one now under consideration is that these spots having greatly increased in number, and become more extensive than the white, have caused the white ground to assume the appearance of spots on a dark ground. The extreme limit of the species seems, however, to be reached by this form; and as the cirri are more numerous than usual, and the basal joints of the second pinnule less strongly keeled, I propose to speak of it as *A. solaris*, var. *albonotata*.

We must not be tempted by the difficulties of specific discrimination to make use of mere coloration: there are in the collection two specimens of *A. solaris* from Thursday Island, one of which is uni-

formly purple, while the other has the purple relieved by a white median dorsal line and by some white pinnules.

I trust that with an increase in our knowledge and with a larger series of specimens the preceding discussion will be found, long as it must have seemed, to be of some aid in the determination of the characters and limits of the species; with such scanty information as we possess at present it would be to the last degree rash to venture on any kind of prophesy. Were I to make one, however, I should say that many of the variations, which at present there is a tendency to regard as of specific importance, will be found to present less constancy of arrangement when large series are brought together for examination. In the work of enlarging our knowledge of the species of Crinoids the British Museum may well look to those English colonists who live on such sea-boards as that of the Australian coasts, and who have opportunity to do some dredging in their waters.

The student will believe that it was not without much study that I instituted the species now succeeding; since I did so I have had the opportunity, thanks to the kindness of Mr. E. P. Ramsay, of examining a collection of Australian Echinoderms; and it was with a certain amount of satisfaction that I obtained from it specimens which exhibited a close resemblance to *A. intermedia*, and led me to think that I was justified in regarding its differential characters as constant and definite.

Standing midway between *A. solaris* and *A. robusta* it may be distinguished as

17. Actinometra intermedia.

As Mr. Carpenter has pointed out, it appears to be possible, in part at any rate, to distinguish *A. solaris* from *A. robusta* by the character of the keels, which, in the former, are so strikingly developed on the basal joints of the second pinnule. Basing myself on the theory that the keel is constantly present on the basal joints of the second pinnule of *A. solaris* (Plate XVI. fig. A, *a*), and that it is never found on those of *A. robusta* (fig. A, *b*), I venture to think that, in the case of *A. intermedia*, we have to do with a form in which constantly the keels are never as well developed as in *A. solaris*, and never so slightly as in *A. robusta*, while at the same time there are considerable differences in the extent of the development of the keel, not only within the limits of the species but even of the individual (*cf.* figs. A, *c*, *d*).

The following appear to be the more characteristic marks of the species:—A general resemblance to *A. solaris*; but there are about 18 cirri, with from 18–20 joints; first pinnules not specially long, of rather more than 40 joints; basal joints of second pinnules with a not conspicuous keel, and with one which varies in the extent to which it is developed. Arms widest a slight distance from the disk.

A specimen with an arm 120 millim. long has the cirri 15·5 millim. long, the first pinnule 20 millim. long, and the arms 3 millim. at their widest; in other words, these measurements are very much the same as those of the specimens of *A. solaris* lately referred to. The faint white line which is so often seen along the middle of the dorsal surface of the arms is to be seen in some specimens; and in some cases we may observe the black spots on the pinnules, to which attention has already been directed.

It will be clear enough to the student that the specimens now under discussion present several points of considerable difficulty; but, though they have the general facies of *A. solaris* and on the other hand a larger number of cirri and a feebler keel, thereby approaching *A. robusta*, they, at the same time, present sufficient constancy in the retention of their differential characters to prevent our believing that the differences that we observe have not passed within the influence of the laws of heredity.

Albany Island.

18. Actinometra robusta.

Actinometra robusta (*Lütken, MSS.*), *P. H. Carpenter, Journ. Linn. Soc., Zool.* xvi. p. 517.

In specimens of this comparatively well-marked form from "St. 144," * which were somewhat smaller than those described by Mr. Carpenter, I noted that the basal joints of the arm were not so distinctly knobbed, and that there was a faint carination to the basal joints of the second pinnule. On the other hand, in a larger specimen from Port Curtis, which appeared to be particularly well developed, the knobs were very prominent.

With regard to the specimens from St. 144, Dr. Coppinger notes that they were "originally of a purple colour."

19. Actinometra strota.

Among the present collection of Crinoids Mr. Carpenter recognized a single specimen of a species which he has distinguished as *A. strota*, n. sp., and of which he will give a full account in his forthcoming Report on the Comatulæ of the 'Challenger' Expedition.

Port Molle.

20. Actinometra cumingii.

Comatula cumingii, *J. Müller*, p. 19.

A delicate specimen with 10 cirri, the cirri having about 12 joints and no penultimate spine, and most of the joints being a

* Probably Thursday Island.

little longer than broad, is referred to this species. Two of the arms which have undergone injury are now giving rise to four and three arms respectively.

Port Molle.

21. Actinometra coppingeri. (Plate XVI. fig. B.)

Centrodorsal small; 17–20 cirri in two rows, with from 17–20 joints, the fourth to sixth longer than broad, the rest shorter; the spines, including the penultimate one, obscure.

First radials hardly visible, the second three times as wide as long, partly in contact; the axillary almost triangular, not a syzygy. The specimen under examination has 12 arms, but the normal number is probably 10. First and second brachials wider on their outer than their inner side, the first in contact, the third a syzygy; it and the next two oblong; the succeeding ones wedge-shaped and the distal edges slightly dentated; further out the joints more regularly oblong.

Syzygies on the third and tenth, and then at about every fifth joint.

First pinnules on the third brachials longer than the second, and the second a little longer than the third; the fourth again rather longer. The succeeding ones of a fair length.

Length of arms about 70 millim., of cirri 7·5 millim.; diameter of disk 4·5 millim.

Colour creamy white.

Flinders, Clairmont.

22. Actinometra jukesi.

P. H. Carpenter, P. R. S. 1879, p. 390.

A technical description of this species will be given by Mr. P. Herbert Carpenter in his Report on the Comatulidæ of the 'Challenger' Collection. It is evidently a common form.

Albany Island; Prince of Wales Channel.

23. Actinometra parvicirra.

Actinometra parvicirra (*Müller*), *P. H. Carpenter, Notes Leyd. Mus.* iii. p. 204, *ibique citata.*

A small specimen, from Warrior Reef, was determined for me by Mr. Carpenter; another from Port Molle has less than 20 arms, as in some of the specimens in the Paris Museum. It is of interest to note that this appears to be, like *A. carinata*, a species of exceedingly wide range, for Mr. Carpenter found two specimens of it from Peru in the collection of the Hamburg Museum.

24. Actinometra alternans.

P. H. Carpenter, Notes Leyd. Mus. iii. p. 208.

An example of this interesting species was determined for me by Mr. P. H. Carpenter; the stumps of two cirri are still present.

Port Molle.

25. Actinometra paucicirra. (Plate XVII. fig. A, *a*.)

Centrodorsal small, low, rounded, with 5 or 6 marginal cirri of 15–18 joints, a number of which are longer than broad; the penultimate spine exceedingly small.

First radials visible, second radials very wide, not in contact, united with the third by a syzygy. Twenty arms; two joints in the distichals united by a syzygy, the more prominent joints in contact. First and second brachials united by a syzygy; third and fourth pretty regularly oblong; the fifth faintly wedge-shaped; after this the wedge-shaped form becomes more marked, but the edges do not overlap.

Syzygies on the eighth and twelfth, then from 3–5 joints between each. First pinnules longer than the second, and the third than the fourth; the first alone of any considerable size: its joints produced into very prominent edges. The succeeding pinnules small; later out they enlarge somewhat, but are never at all long.

Arms about 70 millim. long, cirri 8 millim., disk 7 millim. in diameter. A slight development of calcareous deposit between the bases of the arms.

Colour creamy white above, rather darker below.

Prince of Wales Channel; Thursday Island.

26. Actinometra multifida.

Comatula multifida, *J. Müll.* p. 26.

Percy Island, Queensland; Albany Island; Prince of Wales Channel.

27. Actinometra variabilis. (Plate XVII. fig. B, *a*.)

Centrodorsal of moderate size, concave in the middle, with 10 marginal cirri, of about 15 joints; very faint indications of spines on the most distal only.

First radials visible, second exceedingly wide in proportion to their length, in contact; the third almost perfectly triangular, not a syzygy; there are normally three distichals, and the axillary is a syzygy; there are two palmars and no syzygy, or three palmars and a syzygy. If there is another division there are two joints, and the axillary is not a syzygy. Arms from 60–90.

The first four or five brachials have the sides pretty even, the succeeding are very distinctly wedge-shaped, and the distal edge becomes faintly denticulated. Further out the wedge becomes wider, and the denticulation disappears.

Syzygies 3, 10, 14; then about three joints between each. The pinnules generally are delicate and short, the first rather the longest.

Arms not very long, thin; cirri about 10 mm. long; disk as much as 30 mm. in diameter, owing to the extensive development of the interradial plating which extends to the distichal axillaries.

Colour yellowish green with darker spots, patches, or lines; the ends of the arms and the lower surface darker, or the upper surface may be of a pale flesh-colour.

Thursday Island.

28. Actinometra, sp. juv.

It is very possible that a young specimen from Dundas Strait belongs to a species, *A. purpurea*, of which a single example is alone known; and that, as Mr. Carpenter informs me, is in rather bad condition. It is to be hoped that further exploration will result in the discovery of more representatives of this incompletely known form.

General Remarks on Distribution.

After concluding the survey of the Echinoderms collected in the Australian seas by Dr. Coppinger, I arrived at certain results, which it is unnecessary now to state; for my views have since been profoundly modified by what I have since learnt from a closer study of the marine fauna of Port Jackson than was possible with the comparatively scanty material that was in my hands two years ago, when the body of this Report was being framed.

I have learnt since, thanks to the opportunities afforded me by arrangements made with Mr. E. P. Ramsay, the Curator of the Australian Museum, Sydney, what are the characters of the Port-Jackson fauna, and what is the extent of its resemblance to that of Port Molle and Torres Straits.

I have, in the first place, learnt that no view can be more erroneous than one which speaks of an Australian (marine) fauna without some sort of qualification; Cape York and Port Molle are as much part of Australia as Port Jackson, but between the two faunæ the resemblance is as slight as is in the nature of things possible.

This statement is abundantly proved by the first two tables of distribution which I now give, and which are based on the 27 Echinids and 16 Ophiurids from the collection of the Sydney Museum.

TABLE I.—Echinoidea of Australian Museum, Sydney.

		South of the tropics.	Inter-tropical species.
1.	Phyllacanthus parvispinus	*	
2.	Goniocidaris tubaria	*	
3.	—— geranoides	*	
4.	Diadema setosum	.....	*
5.	Centrostephanus rodgersi	*[1]	
6.	Echinothrix calamaria	.....	*
7.	Salmacis alexandri	*	A
8.	—— bicolor	.....	*
9.	—— sulcata	.....	*
10.	—— dussumieri	.....	*
11.	Amblypneustes ovum	*	
12.	—— sp.	*	
13.	Strongylocentrotus erythrogrammus	*	A
14.	—— tuberculatus	○	
15.	Sphærechinus australiæ	*[2]	
16.	Echinostrephus molare	○	
17.	Echinometra lucunter	○	A
18.	Heterocentrotus mammillatus	.....	*
19.	Echinanthus testudinarius	*	*
20.	Laganum decagonale	.....	*
21.	—— peronii	*[3]	
22.	Arachnoides placenta	.....	*
23.	Maretia planulata	*	A
24.	Lovenia elongata	*	A
25.	Breynia australasiæ	○	A
26.	Echinocardium australe	*	A
27.	Hemiaster apicatus	*	

TABLE II.—Ophiuroidea of Australian Museum, Sydney.

1.	Pectinura stellata	.....	*
2.	—— gorgonia	*	A
3.	Ophioplocus imbricatus	.....	*
4.	Ophioglypha multispina	*	
5.	Ophiactis resiliens	*	
6.	Amphiura constricta	*	
7.	Ophionereis schayeri	*	
8.	Ophiocoma scolopendrina	.....	*
9.	—— erinaceus	.....	*
10.	Ophiarthrum elegans	.....	*
11.	Ophiothrix longipeda	.....	*
12.	—— cæspitosa	*	
13.	—— fumaria	*	
14.	—— sp.	*	
15.	—— sp.	*	
16.	Euryale aspera	.....	*

○ means that the species is, in this collection, known only from Lord Howe's Island; A, that the 'Alert' found the species within the tropics.

[1] Reported by Agassiz from New Caledonia; [2] from the Mauritius; [3] from the Philippines.

It will be seen, then, that of the Echinids 19 were found south of the tropical line, and 11, or 57·5 per cent., were not found either by the 'Alert' or 'Australian Museum' collectors within the tropics. Of the Ophiurids 9 were found south of the line, and only one also within it, so that of this class 88·8 per cent. were found only to the south of the tropics.

When we turn to the lists of the 'Alert' collections in the 'Australian' seas and in the western part of the Indian Ocean, we find a very different story.

Echinids.—Of the 28 species collected within the tropical seas of Australia, four only, or 14·2 per cent., were found also at Port Jackson, while no less than 23, or 72 per cent., were found also in the tropical parts of the western Indian Ocean.

Table III.—List of Echinoidea collected by the 'Alert' (to which is added a statement of such as are found also north of the equator, but within the tropics).

		South of the tropics.	Inter-tropical. 'Australia.'	South Japanese Seas.	Western Indian Ocean.
1.	Cidaris metularia	.....	*	.....	*
2.	Phyllacanthus annulifera	.....	*		
3.	—— baculosa	.....	.....	.....	*
4.	Diadema setosum	.....	*	.....	*
5.	Astropyga radiata	.....	*	.....	*
6.	Salmacis alexandri	*	*		
7.	—— bicolor	.....	*	.....	*
8.	—— sulcata	.....	*	*	*
9.	Temnopleurus toreumaticus	.....	*	*	*
10.	—— granulosus	.....	*	*	
11.	—— bothryoides	.....	*	*	
12.	Echinus angulosus	*	*	.....	*
13.	—— darnleyensis	.....	*		
14.	Toxopneustes pileolus	.....	*	*	*
15.	Tripneustes angulosus	.....	*	.....	*
16.	Strongylocentrotus erythrogrammus	*	*		
17.	Echinometra lucunter	.....	*	*	*
18.	Fibularia volva	.....	*	.....	*
19.	Clypeaster humilis	.....	*	.....	*
20.	—— scutiformis	.....	*	.....	*
21.	Laganum depressum	.....	*	.....	*
22.	—— decagonale	.....	*	*	*
23.	Echinoneus cyclostomus	.....	*	.....	*
24.	Maretia planulata	.....	*	.....	*
25.	Lovenia elongata	.....	*	.....	*
26.	Breynia australasiæ	.....	*	*	*
27.	Echinocardium australe	*	*	*	*
28.	Brissus unicolor	.....	*	.....	*
29.	Metalia sternalis	.....	*	.....	*

The Asterids tell a not dissimilar story: of the 26 species found in the intertropical Australian seas, 3 only, or 11·5 per cent., were found also at Port Jackson, while 8, or 30 per cent., were found also in the western seas.

Ophiuroidea.—Twenty-nine species were found in the intertropical Australian seas; and of these 3, or 10 per cent., were found also at Port Jackson, while 16, or more than 50 per cent., were found in the western parts of the Indian Ocean.

It is useless, in the present condition of our knowledge, to appeal to the Holothuroidea or the Crinoidea.

TABLE IV.—List of Asteroidea collected by the 'Alert.'

		South of the tropics.	Intertropical. 'Australia.'	South Japanese Seas.	Western Indian Ocean.
1.	Asterias calamaria	*			
2.	—— polyplax	*			
3.	Echinaster purpureus	.....	*	.....	*
4.	Metrodira subulata	.....	*		
5.	Linckia lævigata	.....	*	.....	*
6.	—— nodosa	.....	*		
7.	—— marmorata	.....	*	.....	*
8.	—— multiforis	.....	*	.....	*
9.	—— pauciforis	.....	*		
10.	—— diplax	.....	.....	.....	*
11.	—— megaloplax	.....	*		
12.	Scytaster variolatus	.....	.....	.....	*
13.	Anthenea flavescens	*			
14.	Oreaster gracilis	.....	*		
15.	—— nodosus	.....	*		
16.	—— lincki	.....	.....	.....	*
17.	Stellaster belcheri	.....	*	*	
18.	—— incei	.....	*		
19.	Pentagonaster coppingeri	.....	*		
20.	—— validus	.....	*		
21.	Dorigona longimana	.....	*		
22.	Culcita schmideliana	.....	*	.....	*
23.	Gymnasterias carinifera	.....	*	.....	*
24.	Asterina belcheri	*			
25.	—— calcar	*			
26.	—— cepheus	.....	*	.....	*
27.	—— gunnii	*	*		
28.	—— regularis	*	*		
29.	—— brevis	.....	*		
30.	Patiria crassa	.....	*		
31.	Astropecten coppingeri	.....	*		
32.	—— polyacanthus	*	*	*	*
33.	Archaster typicus	.....	*	*	*
34.	Retaster insignis	.....	*		

TABLE V.—List of Ophiuroidea collected by the 'Alert.'

		South of the tropics.	Inter-tropical. 'Australia.'	South Japanese Seas.	Western Indian Ocean.
1.	Pectinura gorgonia	*	*	.....	*
2.	—— infernalis	.....	*	.....	*
3.	—— megaloplax	.....	*		
4.	—— stellata	.....	*		
5.	Ophiopeza conjungens	.....	*	.....	*
6.	Ophiolepis annulosa	.....	*	.....	*
7.	Ophioplocus imbricatus	.....	*	.....	*
8.	Ophiactis savignii	*	*	*	*
9.	Ophionereis dubia	.....	*	* (var.)	*
10.	Ophiocoma brevipes	.....	*	.....	*
11.	—— scolopendrina	.....	*	.....	*
12.	—— erinaceus	.....	*	.....	*
13.	—— pica	.....	*	.....	*
14.	Ophiarthrum elegans	.....	*	.....	*
15.	Ophiarachna incrassata	.....	*	.....	*
16.	Ophiothrix trilineata	.....	*	.....	*
17.	—— propinqua	.....	*	.....	*
18.	—— longipeda	.....	*	.....	*
19.	—— cæspitosa	*			
20.	—— martensi	.....	*		
21.	—— striolata	.....	*		
22.	—— galateæ	.....	*		
23.	—— ciliaris	*	*		
24.	—— rotata	.....	*		
25.	—— fumaria	*			
26.	—— punctolimbata	.....	*		
27.	—— microplax	.....	*		
28.	—— darwini	.....	*		
29.	—— melanogramma	.....	*		
30.	Ophiomaza cacaotica	.....	*		
31.	Euryale aspera	.....	*		

The collections of the 'Alert' afford us, then, another justification for the view of the existence in the Indo-Pacific of a widely distributed common fauna.

It must, however, be carefully borne in mind that *the greater part of this common fauna is restricted to the inter-tropical zone;* what little we know of the fauna of the Southern Japanese seas leads us to think that the common forms are to be found there also.

The majority of extra-Australian naturalists have as yet failed a little in recognizing the lesson which these collections bring so prominently forward—a lesson already being learnt by those who have the best opportunities of examining the characters of the Australian fauna; the term *Australian*, without definition or limitation, affords no exact information†. It is greatly to be regretted that in his tables of the distribution of the species collected

† As is well known, Dr. Günther has long since recognized this as regards Fishes, and has instituted a South-Australian District (Introd. Study of Fishes, p. 283).

by the 'Challenger,' Mr. Alexander Agassiz should have devoted one to the species of "West, South, and North-East Australia—New Zealand;" nor can we wonder when we find one who, ten years ago (Rev. Ech. p. 230), spoke of the Australian as the "most typical of all the districts," saying in 1881 that the "whole of the Australian field seems to be cut out of the Indo-Pacific realm." It is clear that these statements oppose each other, and that a more accurate representation of the facts would be made in terms like the following:—The species found on the northern and north-eastern shores of Australia have a wide range eastward and westward, but gradually disappear as we pass southwards.

In fine, an Australian Echinoderm-fauna, as conterminous with the Australian shores, does not exist.

It may be convenient for the student if I sum up the points in which Dr. Coppinger's collections have most advanced our knowledge.

Asteroidea.—Two faunal lists of the Australian Asteroidea have been published during the last few years; one by our great authority on this subject, Professor Perrier*, of the Jardin des Plantes, the other, which, as I imagine, was partly based on it, by the Rev. J. E. Tenison-Woods †. It has been difficult so to marshal the facts contained in these essays as to be able to render easily intelligible the advances now made in our knowledge; this is chiefly due to the fact that while M. Perrier (justified, no doubt, by the evidence in his hands) distinguished between the fauna of the northern and of the other coasts of Australia, Mr. Woods was preparing a list which should be of use to the Australian student generally. Further than this, the present collection is from the northern and the eastern coasts of Australia.

It is not necessary to give all the steps by which I have worked out the question of how far our knowledge of the distribution of the Asteroidea is increased by the present collection. Put shortly, we find that while Mr. Woods's compilation was of value as giving us certain information as to the localities of *Tosia ornata*, which was described by Müller and Troschel from an unknown habitat, and of the *Patiria ocellifera* of Gray, the locality of which could only be guessed at from the fact of its having been described in the Appendix to the Voyage of the 'Fly,' Mr. Coppinger's collection enables us to fix one locality at least for *Anthenea flavescens* and *Nepanthia belcheri*, extends the range of *Linckia marmorata* from Mauritius to Australia, gives more southern stations for *Archaster typicus* and *Stellaster belcheri*, extends *St. incei* westward from Cape York to the Arafura Sea, and puts in Port Denison as intermediate between Cape York and South Australia.

It may be, perhaps, useful if I point out that definite information is still wanting as to the exact habitats of *Asterias fungifera*, *Anthenea acuta*, *Nectria ocellifera*, *Oreaster australis*, *O. franklini*, *O. nodulosus*‡, *Tosia astrologorum*, and *T. aurata*. It is hardly

* Nouv. Arch. du Mus. (2) i.

† Philos. Soc. Adelaide, 1878–9, p. 89.

‡ Since this was written the Trustees have purchased two specimens of *O. nodulosus* from N.W. Australia.

sufficient to say "Mers australes," New Holland, or Australia in dealing with a continent which extends over 30 degrees of latitude and 40 of longitude, howsoever wide the distribution of the dwellers on its shores may be; nor could it be permitted by one who would study a collection of Port-Jackson specimens, and then take up the corresponding forms from Port Molle or Torres Straits (*cf.* Tables I.–V. of Distribution).

Ophiuroidea.—*Ophiopinax stellatus*, described from Singapore, and found by the 'Challenger' at lat. 11° 37′ N., long. 123° 32′ E., has now been found at Port Molle, Port Denison, and Torres Straits. If *Ophiothrix fumaria* has been correctly identified, this is apparently the first time that a definite locality has been ascribed to it; *O. martensi* has been shown to be very common in the Australian seas; *O. galateæ* (from the Nicobars) and *O. punctolimbata* (Java) have their distribution extended eastwards; *O. rotata* has been extended from Mindanao to Thursday Island; and *O. ciliaris*, known from the "Indian Ocean," has been seen to appear at Port Jackson.

If we might with justice attempt any generalization from such facts as these, we should be led to a belief in the significance of the free-swimming larva as affecting the extent of the distribution of not-stalked Echinoderms.

With regard generally to the Echinoidea, it may be said that in seven cases we have the area of distribution increased: *Diadema setosum*, *Salmacis bicolor*, *Temnopleurus toreumaticus**, *T. granulosus* have never yet been found on the eastern coast of Australia; *Clypeaster humilis* and *Marctia planulata* have been reported from New Caledonia, but not from such a locality as Port Molle or Clairmont†. *Temnopleurus bothryoides*, found by the 'Challenger' in the Arafura Sea and Kobi, Japan, is now known from an intermediate locality. The members of this class bear ample witness to the now well-known fact that Indian-Ocean and Pacific specimens invade largely the Australian seas.

A question which presented itself to me, but on which I can throw but little light by way of answer, might perhaps be formulated thus: What differences are there between the forms of the eastern and northern and the western coasts of Australia? ‡

To the south of the East-Indian islands there lies an area of deep sea almost free from islands, and having sweeping across it, in obedience to the laws of motion, a current with a south-westerly direction from the equator; this current sweeps, as we know, round the Cape of Good Hope, and there comes into contact with the southern con-

* Mr. Tenison-Woods reports it from "all the coasts of Australia, but rare outside the tropics."

† But *M. planulata* was taken at Port Jackson by the 'Challenger;' the presence of this species in the Australian seas is additionally interesting from the fact that a form allied thereto, *M. anomala*, has been described by Prof. Martin Duncan (Q. J. Geol. Soc. xxxiii. p. 52).

‡ For Echinoderms, as for Fishes (see Günther, 'Introd. Study of Fishes,' p. 284), the western half of the south coast of Australia is still almost a *terra incognita*. It is earnestly to be hoped that the investigation of this area may be soon undertaken.

necting or southern Australian currents, which form probably the northern boundary of the Antarctic circle, and along the lines of which some species are now satisfactorily known to be extensively distributed*. This south-westerly current leaves on its east the western shores of Australia, and it seemed to be interesting to make a definite examination of this question: Have the species in extending westward along the northern shores of Australia, and thence southward, become specially modified in their journey?

Interesting as such a discovery would have been, it must be said that the view that there might be a fauna special and peculiar to the western coast of Australia cannot be in any way sustained either by a consideration of the Echinoidea of the present collection or by a general review of the distribution of the Order.

The voyage of the 'Gazelle' resulted in the discovery at Naturalist Channel, or Mermaid Straits, of four of the species noted in our list —*Salmacis sulcata*, *Echinometra lucunter*, *Lovenia elongata*, and *Breynia australasiæ*; *Salmacis alexandri* (*globator*) is known from the west coast; and all the following species would appear to be found on the westerly as well as the easterly coasts of the continent: —*Goniocidaris geranoides*, *G. tubaria*, *Centrostephanus rodgersi*, *Amblypneustes griseus*, *A. pallidus*, *Microcyphus zigzag*, *Sphærechinus australasiæ*, and *Echinocardium australe*; or about 25 per cent. of the Echinoidea found on other parts of the Australian coast have already been found on the western shores, and no species are known to be peculiar to them.

It is, no doubt, reasonable to suppose that the species which are widely distributed in the Indo-Pacific will be found on the western coast of Australia, and that the more southerly forms will be represented by the species of *Amblypneustes*, *Microcyphus*, or *Holopneustes*, which we are in the habit of regarding as truly "Australian."

A somewhat similar story is told by the Ophiuroids.

Till lately fourteen species of Asteroids were known only from Western or South-western Australia; but Mr. Woods reports *Culcita pentangularis* from N.E. Australia, *Pentagonaster dubeni* from S. Australia, and *Tosia australis* from S. Australia and Tasmania; while the present collection enlarges the range of *Patiria crassa*.

Although there appeared at one time to be good reason for disagreeing with Martin†, the present amount and weight of evidence in our hands goes to point to the existence of a tropical oceanic fauna; to-day, as in those Tertiary times when a wider sea separated the Australian from the Asiatic continent, there are forms whose breadth of range is coincident rather with isothermal lines than topographical boundaries.

For the elucidation of the details of this tropical fauna, we may look with almost more than confidence to the information afforded by the species of Crinoids: here, however, the cabinet naturalist can as yet only appeal to the collector.

* Evidence as to this was given by the earlier collections of the 'Alert' in the Straits of Magellan (see P. Z. S. 1881, pp. 1-141).

† Notes Leyd. Mus. ii. p. 73 *et seq.*