

PRELIMINARY NOTICE OF A COLLECTION OF RECENT CRINOIDS FROM THE PHILIPPINE ISLANDS

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The first consignment of crinoids received from the United States Fisheries steamer *Albatross*, now engaged in work among the Philippine Islands, proves to be a collection of more than usual interest. Not only does it contain a remarkably large number of new and interesting forms, but many species, heretofore known only from single more or less imperfect specimens, are represented.

The littoral comatulids of the Indo-Pacific region have already received more attention than any other group of recent crinoids; Seba, Linck, and Petiver described and figured species, upon which species Linnæus bestowed binomial names; Lamarck diagnosed a number of additional species in 1816, and Müller several more in 1841 and 1846. Since then Carpenter and Bell have made great additions to our knowledge, the former, especially, in his magnificent *Challenger* monograph; in 1893 Hartlaub made the East Indian littoral forms the subject of a most excellent memoir; and in 1895 and 1898 Kœhler and Döderlein published important papers dealing with them. In view of all this previous work, it is with no little surprise that I find in the present, mainly littoral, collection the new forms outnumbering those already known, if we except only the family Comasteridæ.

Some time ago, while discussing the distribution of the recent crinoids, I mentioned that the entire Australian coast, southern as well as northern, was inhabited by purely tropical species, and belonged in my "Indo-Pacific—Japanese" region. I did this with considerable hesitation; for the genus *Ptilometra*, characteristic of southern Australia, had never been taken elsewhere, though all the other genera range at least to Singapore, and most of them as far as Japan. It is, therefore, with peculiar satisfaction that I am now enabled to announce the discovery of *Ptilometra* north of the equator, and to reaffirm, without the possibility of contradiction, the identity of the southern Australian crinoid fauna with that of the tropical East Indies.

Family PENTACRINITIDÆ

Genus METACRINUS P. H. Carpenter

METACRINUS ZONATUS, new species

Stem rather slender, rounded-pentagonal, the lateral grooves slightly marked; internodals 7 to 9 (usually 8), the edges scarcely crenulated, encircled by very prominent ridges, more strongly marked on alternate joints, high and thin, their bases not occupying more than the median third of the joints, and of uniform height all around the stem, passing unchanged over the broadly rounded angles; nodal joints moderately hollowed by the cirrus sockets, and with uniform high thin ridges connecting the bases of the cirri; cirrus sockets scarcely affecting the supra- and infra-nodal joints. Cirri in length about ten times the diameter of the stem, rather stout basally, composed of 55 to 57 joints, the first five short, then about half again as long as broad, gradually becoming broader than long in the distal half; cirrus joints with rather prominent and finely serrate distal ends, giving them a characteristic feeling and appearance.

Basals broad and of nearly uniform height, slightly convex exteriorly, forming a very even basal ring, abruptly cut off distally and not produced into a point; "radials"¹ in all instances 8 (2 + 3; 5 + 6) (*i. e.*, "six, the second and fourth syzygies"); arms dividing three times both exteriorly and interiorly; distal edges of the arm joints prominent, making the dorsal surface of the skeleton very rough, especially proximal to the last axillary; pinnules resembling those of *Metacrinus moseleyi*.

Measurements.—Stem 195 mm. long, with thirty-six internodes; cirri 45 mm. long; arms (from the "primary" radials) 80 mm. long, the terminal 15 mm., with only rudimentary pinnules.

Another specimen has a stem 190 mm. long, with thirty internodes, and cirri 35 mm. long; the stems of both are freshly broken below.

Color (in spirits).—Purple; stem, calyx, and arms to the second axillary greenish yellow; two other specimens are entirely light yellow.

Type.—Cat. No. 25435, U. S. N. M., from *Albatross* Station No. 5167; off Simonor, Tawi Tawi group; 110 fathoms.

¹ I use Dr. Carpenter's terminology to facilitate comparison with the species described in the *Challenger* report, in the Linnæan Society's Transactions, and by Dr. Döderlein in the *Siboga* report.

Also found at Station No. 5168; off Simonor, Tawi Tawi group; 80 fathoms.

The large number and regularity of the "radials" place this species with *Metacrinus wyvillii*, *M. costatus*, *M. nodosus*, and *M. interruptus*, from all of which, however, it is readily distinguishable by the prominent girdle on the internodals and the very broadly rounded angles of the stem. Its closest affinities appear to be with *M. moseleyi*, in which, however, the "radials" are irregular, the girdle on the internodals low and broad, arising from their whole surface, the angles of the stem more marked, and the cirri with fewer joints.

Family COMASTERIDÆ

Genus COMASTER L. Agassiz

COMASTER SENTOSA (P. H. Carpenter)

Station No. 5139; between Jolo (Sulu) and Pangasinan Island; 20 fathoms.

Station No. 5141; between Bubyán and Pangasinan Islands; 29 fathoms.

Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

COMASTER FIMBRIATA (Lamarck)

Station No. 5136; off the town of Jolo; 22 fathoms.

Station No. 5137; off the town of Jolo; 20 fathoms.

Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

Station No. 5141; between Bubyán and Pangasinan Islands; 29 fathoms.

Station No. 5142; north of Jolo (town); 21 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Station No. 5163; south of San Gasanga Island (Tataan group); 28 fathoms.

Station No. 5165; south of San Gasanga Island (Tataan group); 9 fathoms.

Station No. 5205; Janabatas Channel, between Leyte and Samar; 6 fathoms.

There are also some specimens with no definite locality given.

COMASTER COPPINGERI (Bell)

Station No. 5153; east of Port Dos Amigos, Tawi Tawi; 49 fathoms.

Two of the specimens have only ten arms.

Genus COMATULA Lamarck

COMATULA PECTINATA (Linnæus)

Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

Station No. 5142; north of the town of Jolo; 21 fathoms.

There are some additional specimens without data as to exact locality.

This species is at first sight very much like the ten-armed *Comanthus cumingii*, first described by Professor Müller from Malacca—so much so, indeed, that I was at first forced to dissect apart the costals of each specimen to be sure of the identification, though I later learned to recognize the species from external characters. In *Comanthus cumingii* the cirri are proximally rounded with elongate joints, and distally flattened with short joints; this gives the cirri when viewed laterally the appearance of expanding distally; in *Comatula pectinata* the cirri are uniform throughout, the joints all subequal, usually not quite so long as broad. As a comparison, it may be said that while the cirri of *C. cumingii* resemble those of *C. rotalaria*, those of *C. pectinata* resemble those of *C. solaris*. In *C. cumingii* the lower pinnules are much elongated, and decrease gradually in length from the first outward; in *C. pectinata* only the first pinnule is elongated, the second and following being subequal and short; in the latter, moreover, the first two pinnules, and sometimes the third also, are very strongly carinate basally, a feature never found in *C. cumingii*. In *C. pectinata* the costals have a shallow and rounded, though distinct, median furrow, which is quite lacking in *C. cumingii*, while in the latter the proximal third or half of the arms is disproportionately large and swollen, this region not being enlarged in *C. pectinata*.

I have compared the Philippine specimens with one from Java, identified by Dr. Carpenter, and find them identical. Indeed, Carpenter himself mentions the similarity between this specimen and some from Bohol collected by Professor Semper.

Genus PHANOGENIA Lovén

PHANOGENIA TYPICA Lovén

Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

Dissection shows that the costals in this species, in *P. multibrachiata*, in *P. nova-guinea*, and in *P. gracilis* of Hartlaub are united by synarthry and not by syzygy, the dorso-ventral ridge across the joint face being always plainly visible, at least near the central canal. The distichals are ordinarily 4 (3 + 4); but all the succeeding division-series are 2 (1 + 2); the distichals are rarely 2. In *Comatula pectinata* the division series, when present, are 2 (1 + 2), as in *C. paucicirra*, and the costals are also united by syzygy. In *Phanogenia typica* the syzygies in the division series sometimes have traces of the synarthrial ridge which would seem to show that the syzygies were in the process of encroaching upon the synarthries of the division series, but had not yet succeeded in replacing the two first.

Phanogenia typica, *P. multibrachiata*, *P. nova-guinea*, and *P. gracilis*,¹ therefore, occupy an intermediate position between *Comatula* and the group of species of "*Actinometra*" typified by the *Alecto parvicirra* of Müller, having the costals and distichals of the latter, but the remaining division series of the former; they further differ from both in the great differentiation of the comb on the lower pinnules; this comb, moreover, is not confined to the proximal pinnules, as in other forms, but reappears at intervals all along the arm. There is a sixth, undescribed, species from the East Indies allied to *P. typica* and *P. gracilis*, and presenting the same peculiarities; in view of the sharp differentiation between these and the other species of the Comasteridæ, it would give a more correct idea of the systematic value of their characters to restrict the genus *Phanogenia* to them, and to consider the species with distichals 4 (3 + 4) or 2, subsequent division series 4 (3 + 4) or 2 as constituting the genus *Comanthus*, typified by the *Alecto parvicirra* of Johannes Müller (= *Comatula rotalaria* Lamarck).

These two genera may be differentiated as follows:

a¹.—First articulation of the free arm a syzygy; all division series except the first 2 (1+2); terminal comb short, with long curved teeth, and set at an angle to the axis of the pinnules, not confined to the proximal pinnules, but occurring at intervals throughout the arm. *Phanogenia*

¹ To which must be added *P. distincta*.

a^2 .—First articulation of the free arm a synarthry; all division series 4 (3+1) or 2; terminal comb long, with short teeth, continuing in the same direction as the basal portion of the pinnule, and confined to the pinnules in the proximal part of the arm.....*Comanthus*

Comatula is readily distinguished from both of these genera by the syzygy between the costals, and *Comaster* by the presence of a pinnule on the first brachial of all arms not arising from costal axillaries.

PHANOGENIA NOVÆ-GUINEÆ (J. Muller)

Station No. 5136; off the town of Jolo; 22 fathoms.

Station No. 5137; off the town of Jolo; 20 fathoms.

Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Station No. 5142; north of Jolo town; 21 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Station No. 5153; east of Port Dos Amigos, Tawi Tawi; 49 fathoms.

Station No. 5174; off Jolo town; 20 fathoms.

Station No. 5179; between Tablas and Romblon; 37 fathoms.

The cirri are usually less than ten in number, with 12 or 13 joints, the proximal much elongated, the distal short. The arms are 75 mm. to 90 mm. long, composed of joints with overlapping and spinous distal ends; the pinnule joints are more or less spinous.

PHANOGENIA MULTIBRACHIATA (P. H. Carpenter)

Station No. 5141; between Bubyán and Pangasinan Islands; 29 fathoms.

Station No. 5142; north of Jolo town; 21 fathoms.

Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Genus COMANTHUS A. H. Clark

COMANTHUS NOBILIS (P. H. Carpenter)

Santa Cruz, Marinduque.

Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Station No. 5163; south of San Gasanga (Tataan group); 28 fathoms.

Station No. 5165; south of San Gasanga (Tataan group); 9 fathoms.

COMANTHUS DUPLEX (P. H. Carpenter)

Station No. 5145; off the town of Jolo; 23 fathoms.

COMANTHUS DIVARICATA (P. H. Carpenter)

Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Station No. 5147; off Balinpongpong Island; 21 fathoms.

There are also other specimens with no definite data.

COMANTHUS ROTALARIA (Lamarck)

Alecto parvicirra 1841. J. MÜLLER, Archiv für Naturgesch., 1841, 1, p. 145.¹

Station No. 5142; north of Jolo town; 21 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Station No. 5159; west of Sunalac Island (Tataan group); 18 fathoms.

Station No. 5163; south of San Gasanga (Tataan group); 28 fathoms.

Station No. 5205; Janabatas Channel, between Leyte and Samar; 6 fathoms.

Pangasinan Island; shore.

Tataan Islands; shore.

There are also other specimens with no definite data in regard to locality.

There can be no doubt that the species commonly known as *parvicirra* is in reality the same as the previously described *rotalaria*. The only recognized difference between the two is the possession by the latter of distichal series of 2 followed by palmar series of 4 (3 + 4), while in the former all the division series are 4 (3 + 4); but both Carpenter and Hartlaub, who have each treated of the species "*parvicirra*" at considerable length, admits the more or less common occurrence of distichal series of 2 in specimens they unhesitatingly refer to it. Dr. Hartlaub, under his "Type B" of *parvicirra*, says that this type has distichal series of 2, and 4 (3 + 4).

¹ For additional synonyms see Carpenter, *Challenger Reports*, xxvi, Zoölogy, p. 338.

with a strong tendency toward the former condition; three of his specimens had five of each type, two six of 2, and the remainder (not more than four) 4 (3 + 4) one eight of 2, and two all of 2. Carpenter in his description of *rotalaria* says "two distichals, the second axillary without a syzygy;" later he says "tridistichate series occur abnormally in both examples [he had only two];" his figure shows nine distichal series, three of 4 (3 + 4), and six of 2. Overlooking the difference in the number of the distichals, Carpenter's description of *rotalaria* is included in every character in his more exhaustive one of *parvicirra*; since Hartlaub has shown the number of distichals to be valueless, we are forced to the conclusion that *rotalaria* and *parvicirra* are identical.

Carpenter records from the same station in the Philippines (Samboangan, 10 fathoms) seven specimens of *parvicirra*¹ and two of *rotalaria*, the latter, however, both with one or more distichal series of 4 (3 + 4). The present Philippine collection may safely be considered to include specimens identical with Carpenter's Philippine examples. I find in it all variations; the majority of the specimens have the distichals mainly 4 (3 + 4); many have them all 4 (3 + 4); but one (Tataan) has them all 2, thus being even more typical than Carpenter's specimens, which he refers without question to *rotalaria*. But there is not the slightest doubt that all the specimens before me are specifically identical; and therefore, assuming my "tridistichate" specimens to be comparable to Carpenter's Philippine *parvicirra* (they are certainly identical with the two *Challenger* specimens in the National Museum), and my "bidistichate" specimens to be the same as his *rotalaria*, from the unquestionable specific identity of mine I am led to infer the specific identity of his.

Some question might, of course, arise in regard to the correctness of Carpenter's conception of *rotalaria*; but he personally examined minutely the collection at Paris, and so careful was he in regard to specific discrimination that I believe we are safe in assuming the identity of the Paris specimens and those dredged by the *Challenger* at Zamboanga.

COMANTHUS ALTERNANS (P. H. Carpenter)

Station No. 5142; north of Jolo town; 21 fathoms.

¹ I have at hand two of these.

COMANTHUS CUMINGII (J. Muller)

Station No. 5137; off Jolo town; 20 fathoms.

Station No. 5142; north of Jolo town; 21 fathoms.

This very distinct species has about ten cirri with thirteen joints. It is hardly necessary to call attention to the fact that none of Professor Bell's records of "*Actinometra cumingi*" refer to this form.

COMATELLA new genus

The type of arm structure found in "*Actinometra*" *pulchella* (*i. e.*, *alata*), *maculata*, *stelligera*, and *nigra* differs from that found in any other group. The division series are all 2, but the first two brachials of the free arm are united by syzygy. In ten-armed specimens belonging to one of these species, or in arms springing direct from the costal in others, the first syzygy is between the third and fourth brachials. Assuming the type of arm division to be extraneous, and Z_1 and Z_2 to be the distichals, this would be at once explained; for a splitting of the arm just before the first syzygial pair would, of course, result in a doubling of the syzygial pair, these two resultants resting upon Z_2 as an axillary; thus we would get distichals 2, and a syzygy between the first two brachials. This is the condition found in *maculata* and in the majority of specimens of *alata*; but in some specimens of the latter, and in *stelligera* and *nigra*, from one to five additional axillaries occur. Now the manner of occurrence of these additional division series is unique; in *nigra*, starting from the distichal axillary, they are only found exteriorly, so that from each distichal axillary there spring two main trunks giving off interiorly at every two joints an undivided arm, after the last axillary ending in undivided arms themselves. In *stelligera* and in *alata*, when palmars are developed, the costal axillary instead of the distichal is the starting point. The first two joints of the undivided arms and of the terminal arms at the end of the branching trunks always have a syzygy between the first two brachials; but in *alata* and in *stelligera*, in arms springing from the costal axillary the first syzygy is between the third and fourth brachials. The natural inference is an extraneous division, as in *Comaster*, but just before, instead of just after, the first syzygial pair. When exterior palmar series are developed in *alata* and in *stelligera*, we get a peculiar state of affairs; for internally the distichals represent the first two brachials of a free arm followed by the third and fourth (a syzygial pair) as usual; but externally they represent an

interpolated division series, the two palmars representing Z_1 and Z_2 , or the first two brachials of the two exterior arms. In *nigra* the costals and distichals appear both to be interpolated, instead of only the costals, as in the other species; the proof of this would be found in an arm arising undivided from a distichal axillary (a condition I have not been able to observe, as all the specimens before me have the full complement of palmar series), where, if this interpretation were correct, the first syzygy would be between the third and fourth brachials. This condition, in which a single division series represents internally Z_1 and Z_2 , and externally an interpolated series, I propose to distinguish as *compound* arm division; and it seems worth while to recognize the species possessing this compound type of arm division as constituting a distinct genus, which may be designated *Comatella*, the genotype to be *Actinometra nigra* P. H. Carpenter. The presence of a syzygy between the first two brachials of the free arm (this being the first syzygy), combined with the exclusive occurrence of division series of 2, distinguishes the species at sight from those of the remaining genera.

COMATELLA NIGRA (P. H. Carpenter)

Station No. 5136; off the town of Jolo; 22 fathoms.

Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

Station No. 5142; north of Jolo town; 21 fathoms.

Station No. 5145; off Jolo town; 23 fathoms.

Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

The cirri are about xx, 30, the distal joints with small dorsal tubercles; there are three to five post costal axillaries; the first costals are entirely, and the radials partially, visible; the rays and division series are widely separated. The arms are 150 mm. in length, and the cirri, which are rather stout, 30 mm.

Family ZYGOMETRIDÆ

Genus CATOPTOMETRA A. H. Clark

CATOPTOMETRA MAGNIFICA, new species

Centro-dorsal large, discoidal, with a moderately concave, broad polar area 5 mm. to 10 mm. in diameter, having a deep rounded pit in the center.

Cirri marginal, arranged in two closely crowded, irregular, but more or less alternating rows XXX-XL, 18-25¹ (usually 20-24), 30 mm. to 35 mm. long; first joint about twice as broad as long, second not quite so long as broad, third squarish or very slightly longer than broad, fourth slightly longer, fifth slightly longer still, about half as long again as its median diameter; next three joints similar, the following then gradually decreasing in length, the terminal six or seven being squarish; opposing spine, though prominent, small, terminally situated, rarely reaching in height more than one-third the diameter of the penultimate joint; terminal claw large; longer than the penultimate joint (usually half as long again, sometimes even longer), stout, and moderately curved.

The cirrus joints are deeply concave dorsally and laterally, though nearly straight ventrally; this makes the articulations stand out prominently and gives the cirri a characteristic knobby appearance like those of *C. rubroflava*; this character becomes less and less marked as the joints decrease in length distally.

Disk more or less plated along the ambulacra.

Radials, and usually the first costals also, concealed by the centro-dorsal; first costals, when visible, very short, united in their anterior half, but widely separated distally; costals united by syzygy; costal axillaries short, triangular, in the smaller specimens about three times as broad as long, in the larger four or five times as broad as long; distichals, palmars, and post-palmars 2; first joints of each division series inwardly united for their proximal half, but their inner edges diverging in their distal half almost in a straight line from the point of union, so that the arms and division series are well separated. Arms 40 to 80 in number; first brachial usually rather large, sometimes nearly as long exteriorly as broad, inwardly united in the proximal half, diverging in almost a straight line in the distal; there is considerable diversity in the size of the first brachials, some being very short, while most of them are about twice as broad as long exteriorly; second brachial nearly oblong, about twice as broad as long; third and fourth (syzygial pair) oblong, somewhat less than twice as broad as long; following six or seven brachials oblong, about twice as broad as long, then becoming wedge-shaped, then almost triangular, about twice as broad as long, gradually becoming less and less obliquely wedge-shaped, and very gradually increasing in length, so that the terminal joints are wedge-shaped, about as long as broad, or rather longer, with rather prominent articulations.

¹The number of the cirri are given in Roman numerals, and the number of their component joints in Arabic.

Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth to seventeenth and eighteenth (rarely an additional one between the ninth and tenth), and distally at intervals of three to thirteen (usually six or eight) oblique muscular articulations. The second and following brachials have projecting and finely spinous distal edges, making the arm characteristically rough.

Proximal pinnules very slender and flagellate; first pinnule 15 mm. to 20 mm. long, very delicate, with about 60 joints, the first five of which are broad and are provided with a dorsal carinate process, the remainder squarish; second pinnule longer, about 22 mm. in length, with the same number of joints, but slightly stouter; first five joints modified as in the first pinnule, the remainder squarish; third pinnule similar to the second and about the same length; following pinnules decreasing gradually in length, in basal stoutness, and in the number of component joints, the sixth being 12 mm. long with 30 joints, of which those in the proximal third are similar to the corresponding joints of the second and third pinnules, those in the distal portion being longer than broad, becoming terminally about twice as long as broad; twelfth pinnule 8 mm. long, with about 20 joints, the first two not quite so long as broad, the third and fourth squarish, the remainder becoming progressively elongated, and about twice as long and broad distally; distal pinnules very slender, 9 mm. long, with about 30 joints, the first wedge-shaped, not so long as broad, the second trapezoidal, about as long as its greater diameter, the third longer than broad, the remainder about twice as long as broad. The pinnule joints have slightly projecting and very finely spinous distal ends.

Measurements.—Arms 140 mm., cirri 30 mm. to 35 mm. in length.

Color (in spirits).—Red brown, the cirri yellow brown; in life apparently bright yellow with regular bands of bright red on the arms, like *C. rubroflava*.

Type.—Cat. No. 25436, U. S. N. M., from *Albatross* Station No. 5137; off the town of Jolo; 20 fathoms.

This species was also found at Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

This fine species resembles *C. rubroflava* in the knobby character of the cirri and the roughness of the arms; but the cirri are very much longer than in that species, while the arms are from forty to eighty in number as compared with a maximum of thirteen in *C. rubroflava*; moreover, the distichal series in *C. rubroflava*, as in all of the recent Zygometridæ previously known, are 4 (3 + 4), while in the present species they are 2.

Genus EUDIOCRINUS P. H. Carpenter

EUDIOCRINUS SERRIPINNA, new species

Centro-dorsal discoidal, the rather broad dorsal area flat.

Cirri XIX, 12-14, 5 mm. to 7 mm. long, arranged in a partially double marginal row; first joint short, second squarish, third, fourth, and fifth about half as long again as broad basally, the terminal five or six squarish; second and following with expanded distal ends, this character dying away distally; cirri rounded basally, but becoming compressed distally, the distal portion consequently appearing broader in lateral view; opposing spine prominent, central in position, not reaching half the diameter of the penultimate joint in height; terminal claw longer than the penultimate joint, abruptly curved basally.

The arms are as in the other species of the genus, except that the brachials are rather more strongly overlapping, the carination, which is very slight, is single instead of double, and the syzygies occur at intervals of three oblique muscular articulations; the surface of the joints is finely granulated, as in *E. granulatus*.

The proportions of the pinnules are as in the other species, but the lower pinnules, and especially those which are enlarged, have the distal ends on the dorsal side very strongly produced, giving them a strongly serrate profile.

The strongly serrate condition of the lower pinnules distinguish this species at once from the other three species of the genus; the single carination of the dorsal surface of the arms is also unique, while the small number of the cirrus joints differentiate it sharply from *E. indivisus* and *E. granulatus*.

In Professor Bell's description of *E. granulatus*, he uses "first" and "second" pinnule in the sense of the two first pinnules on the same side of the arm, while Professor Semper uses the same terms strictly, taking the pinnules alternately in order of sequence; hence Professor Bell finds a great difference between the "first" and "second" pinnules of his *E. granulatus*, and those of *E. indivisus*, which, in reality, is non-existent.

Measurements.—Arms about 40 mm., cirri 5 mm. to 7 mm. long.

Color (in spirits).—Yellowish brown, the cirri lighter, the perisome darker.

Type.—Cat. No. 25437, U. S. N. M.; from Albatross Station No. 5136; off Jolo town; 22 fathoms.

Genus ZYGOMETRA A. H. Clark

ZYGOMETRA ELEGANS (Bell)

This species was found at Station No. 5137; off Jolo town; 20 fathoms; and at Station No. 5138; between Jolo and Pangasinan Island; 19 fathoms.

Family HIMEROMETRIDÆ

Genus PONTIOMETRA A. H. Clark

PONTIOMETRA ANDERSONI (P. H. Carpenter)

One magnificent specimen was secured at Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Genus HIMEROMETRA A. H. Clark

HIMEROMETRA BARTSCHI, new species

Centro-dorsal thick, discoidal, with a rather strongly concave polar area; cirri arranged in two and a partial third crowded, more or less alternating, rows.

Cirri xxx, 41-43, long, rather more than one-third the length of the arms, moderately stout; first five joints about twice as broad as long, the following gradually increasing in length to the ninth or tenth, which is squarish; after about the sixteenth they gradually decrease in length, the terminal joints being about twice as broad as long; after the seventeenth joint small but prominent dorsal spines are developed; opposing spine centrally situated, rather slender, reaching about half the diameter of the penultimate joint in height; terminal claw considerably longer than the penultimate joint, slender, moderately curved.

Radials approximately even with the edge of the centro-dorsal; first costals short, united for their entire length; division series and brachials as in *H. crassipinna*.

Distichal and palmar pinnules 25 mm. long, very stout basally, but tapering gradually to a slender and delicate tip, with about 40 squarish joints; first brachial pinnule 15 mm. to 17 mm. long, proportionately more slender than those preceding, with about 32 joints, slightly longer than broad, the first two of which are slightly carinate; second brachial pinnule smaller and more slender, 13 mm. long, with 30 joints, the first short, the next three or four squarish,

the remainder slightly longer than broad; the second, third, and fourth joints are somewhat carinate; third brachial pinnule 8 mm. long, small and weak, with about 20 joints, those in the proximal half squarish, those in the distal slightly longer than broad, the second to the sixth rather strongly carinate; succeeding pinnules decreasing rapidly in length, the fifth and following being 5 mm. long, then slowly increasing again and reaching a length of 9 mm. distally.

Measurements.—Arms, 120 mm., cirri 45 mm. in length.

Color (in spirits).—Brown.

Type.—Cat. No. 25438, U. S. N. M., from *Albatross* Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

Another similar specimen was obtained at Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

This species agrees with *H. crassipinna* in the general scheme of its arm division and in the shortness and strong overlapping of the projecting distal ends of the brachials; the distichals are 4 (3 + 4), the palmars 4 (3 + 4) externally, 2 internally; the post-palmars, which are developed on the inner side of the inner palmar series of each distichium only are 4 (3 + 4); each distichium divides once externally and twice internally, which would make fifty arms in all; the type specimen has fifty-one. The comparatively slender lower pinnules, which become delicate and flagellate distally preclude any possibility of confusion with *H. crassipinna*.

HIMEROMETRA ROBUSTIPINNA, new species

This new form agrees in its general appearance and in its arm structure with *H. crassipinna*, but the cirri, while containing the same number of joints, are without dorsal spines, though the last three joints may have small central tubercles (in *H. crassipinna* strong dorsal spines are developed in the outer third or even half of the cirri), and the lower pinnules, though with the same number of component joints, are much stouter, with most of the joints broader than long, and smooth, without the prominent projecting spinous distal ends characteristic of the joints of the proximal pinnules of *H. crassipinna*.

The type has 37 arms 100 mm. long, and 18 cirri 35 mm. long; the distichal pinnule is 15 mm. long.

Color (in spirits).—Dull violet.

Type.—Cat. No. 25439, U. S. N. M., from *Albatross* Station No. 5165; south of San Gasanga (Tataan group); 9 fathoms.

HIMEROMETRA MAGNIPINNA, new species

The absence of prominent dorsal spines on the cirri of this species separate it at once from *H. crassipinna* and *H. bartschi*, and give the cirri a certain resemblance to those of *H. robustipinna*; but they are smaller than those of that species measuring only one-quarter of the arm length instead of rather over one-third, and are correspondingly delicate.

The proximal pinnules, however, are different from those of any other form; they are very stout, but also very long, and taper evenly from the base to the tip; the distal ends of their component joints are slightly swollen, but are not spinous and overlapping as in *H. crassipinna*; the taper is much more gradual than in that species, while the pinnules have 28 or 29 joints instead of 20.

The arm structure and arrangement is as in *H. crassipinna*, *H. bartschi*, and *H. robustipinna*.

The type specimen has 62 arms 120 mm. long, and 25 cirri 30 mm. long, with 28 to 32 (usually 28 to 30) joints.

Color (in spirits).—Dull violet.

Type.—Cat. No. 25440, U. S. N. M., from *Albatross* Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

This species was also found at Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

HIMEROMETRA PERSICA A. H. Clark

Station No. 5163; south of San Gasanga (Tataan group); 28 fathoms.

Another specimen has no definite data as to locality.

HIMEROMETRA BENGALENSIS (Hartlaub)

Station No. 5146; west of Tapul Island (south of Jolo); 24 fathoms.

HIMEROMETRA QUINDUPLICAVA (P. H. Carpenter)

Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

Another specimen has no definite data in regard to locality.

HIMEROMETRA ANCEPS (P. H. Carpenter)

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Other specimens have no definite locality given.

HIMEROMETRA MILBERTI (J. Müller)

Station No. 5100; off Corregidor Island (entrance to Manila Bay); 35 fathoms.

HIMEROMETRA DISCOIDEA, new species

Centro-dorsal large, hemispherical or somewhat columnar, with a large convex polar area; cirrus sockets marginal, in two crowded alternating rows.

Cirri XVII, 37-45 (usually about 40), 30 mm. long; the cirri decrease very gradually in diameter for the first eight or ten joints, then remain uniform; first cirrus joint short, about twice as broad as long, or rather shorter, the following gradually increasing in length, becoming squarish after about the twelfth or sixteenth, and becoming about one-third broader than long in the terminal portion; from about the eighteenth onward prominent, though small, dorsal spines are developed, subterminal in position, becoming terminal in the last two or three joints; opposing spine small, median in position, not rising to more than one-third the diameter of the penultimate joint; terminal claw somewhat longer than the penultimate joint, moderately curved.

Radials projecting slightly beyond the centro-dorsal, their dorsal surface parallel to the dorso-ventral axis of the animal; first costals short, oblong, about three times as broad as long; costal axillaries rhombic, about twice as broad as long, rising to a low conical tubercle with the first costals. Ten arms about 130 mm. long; first brachial wedge-shaped, about twice and one-half as broad as its exterior length, almost entirely united interiorly; second brachial irregularly quadrate, rather larger than the first; third and fourth brachials (syzygial pair) oblong, twice and one-half as broad as long; following brachials to the tenth slightly wedge-shaped, about three times as broad as long; the following brachials become more obliquely wedge-shaped, somewhat over twice as broad as their greatest length, then gradually become shorter and less and less obliquely wedge-shaped and very short and discoidal after about the proximal third of the arm.

First pinnule small and comparatively slender, 7 mm. long, with fifteen joints, all somewhat longer than broad, the first two and the terminal three or four being not quite so long as the others; second pinnule 11 mm. long, with seventeen joints, stouter than the first; first two joints squarish, the remainder slightly longer than broad;

third pinnule 10 mm. long, with fifteen joints, resembling the second; fourth and following pinnules 7 mm. long, with fourteen joints, the fifth and following being about as stout as the first; distal pinnules 10 mm. long.

In the specimen from the Philippine Islands, all the lower pinnules have squarish joints; the first is 9 mm. long with 19 joints, the second 10 mm. with 17, the third 8 mm. with 15, and the fourth and following 6 mm. with 14; the distal pinnules are 10 mm. long.

Color (in spirits).—Flesh color, the perisome brown.

Type.—Cat. No. 25453, U. S. N. M., from Port Denison, near Bowen, Queensland.

A specimen was dredged at *Albatross Station* No. 5138, between Jolo and Pangasinan Islands; 19 fathoms.

This is probably the species which has been recorded from Port Denison as "*Antedon milberti*," but the relatively slender cirri with comparatively long joints contrast sharply with the very stout cirri of *milberti*, which have exceedingly short joints.

HIMEROMETRA VARIIPINNA (P. H. Carpenter)

Station No. 5157; west of Sunalac Island (Tataan group); 18 fathoms.

HIMEROMETRA UNICORNIS, new species

Centro-dorsal thick-discoidal, the small polar area deeply concave.

Cirri xx, 30-32, stout, arranged in two closely crowded, more or less alternating rows; cirrus joints remarkably uniform, all about twice as broad as long, with very prominent dorsal distal ends, giving the cirri a strongly serrate profile dorsally; after the tenth the joints bear paired dorsal tubercles.

Radials barely visible, separated somewhat distally; first costals oblong, short, about three times as broad as long, rounded, widely separated, with a strong rounded-triangular ventro-lateral process supporting the disk; costal axillaries broadly pentagonal, rather over twice as broad as long, with a somewhat larger ventro-lateral projection than the first costals; distichals and palmars 2, the latter developed only on the outer side of the rays; joints of the division series and first brachials with stout ventro-lateral processes; about 30 arms; first eight brachials oblong, about twice as broad as long, then becoming slightly wedge-shaped about twice as broad as long, gradually becoming less and less wedge-shaped and practically oblong again, about twice as broad as long in the outer half of the arm. The brachials, except the discoidal proximal series, have

everted and finely spinous distal ends, giving the arm a characteristic rough feeling, much as in *Catoptometra*. Syzygies occur between the third and fourth brachials, again between the fourteenth and fifteenth to forty-second and forty-third (usually in the vicinity of the thirtieth) and distally at intervals of six to twelve (usually seven to nine) oblique muscular articulations.

First pinnule very slender, 12 mm. long, with 28 joints, the first two about twice as broad as long, then increasing in length to the fifth, which is squarish, the remainder being slightly longer than wide, increasing to about half again as long as broad distally; second pinnule 15 mm. long, very stout and stiff, with 20 to 23 joints, the first two nearly twice as broad as long, the third squarish, the remainder slightly longer than broad; the fourth or fifth and following joints have prominently everted and spinous distal edges dorsally and laterally, though ventrally the joint ends are unmodified; third pinnule smooth, 6 mm. long (or one-half the length of the first), small, but rather stiff, tapering evenly from the base to a slender tip, with 13 joints, of which the distal are about half again as long as broad; fourth pinnule similar, but only 5 mm. long; following pinnules similar, but very gradually increasing in length; distal pinnules 10 mm. long, with 20 or 21 joints, the first nearly twice as broad as long, the second trapezoidal, nearly as long as its greater diameter, the remainder about half again as long as broad. All the pinnules are somewhat stiffened.

Measurements.—Arms 140 mm., cirri 20 mm. to 25 mm. long.

Color (in spirits).—Reddish brown, the large second pinnule lighter, or yellow, the remaining pinnules nearly black in their proximal, white in their distal half; or, light blue-gray, with numerous small red-brown spots; cirri red-brown.

Type.—Cat. No. 25441, U. S. N. M., from *Albatross Station* No. 5160; off Nusa Takbu Channel (Tataan group); 12 fathoms.

Other specimens were obtained at Station No. 5141; between Bubyán and Pangasinan Islands; 29 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms; and Station No. 5163; south of San Gasanga (Tataan group); 28 fathoms.

The short, stout cirri of this species, combined with the greatly enlarged second pinnule, distinguish it at a glance from all the "bidistichate" species of *Himcrometra*. It is most nearly related to *H. bella* and *H. abbotti*.

HIMEROMETRA ECHINUS, new species

Centro-dorsal discoidal, the moderately large polar area slightly concave; cirri arranged in two closely crowded, more or less alternating rows.

Cirri XXIV, 26-30; first four joints about twice as broad as long, sixth squarish, seventh to tenth or eleventh about one-third longer than broad, then becoming squarish again, and, in the terminal twelve or fourteen, broader than long; tenth and following joints with large dorsal spines; opposing spine terminally situated, erect, about half as long as the diameter of the penultimate joint; terminal claw rather longer than the penultimate joint, slender, and moderately curved.

Radials projecting slightly beyond the centro-dorsal; first costals trapezoidal, proximally about four times, distally about three times as broad as long, united in their basal third, but diverging very rapidly from their point of union, so that the free lateral border of two adjacent first costals forms a moderately curved even line; costal axillaries broadly pentagonal, nearly twice as broad as long, with large and broad ventro-lateral projections; distichals, palmars, and post-palmars 2, bearing on the outer side of the rays, in common with the first brachials, large and broad ventro-lateral processes. Forty arms in the type (one interior palmar series being absent, but its loss compensated by the development of an external post-palmar series on the same distichium); first nine or ten brachials discoidal, or very slightly-wedge-shaped, about twice as broad as long, then becoming short-triangular, rather more than twice as broad as long, and short-wedge-shaped in the distal portion of the arms. Syzygies occur between the twenty-second and twenty-third to thirty-second and thirty-third (most commonly in the vicinity of the twenty-third) brachials, and distally at intervals of 9 to 24 (usually 9 to 13) oblique muscular articulating.

First pinnule 15 mm. long, large, stiff, and spine-like, resembling the second, with 15 joints, the first two nearly twice as broad as long, the third squarish, then increasing in length, the seventh and following being from once and one-half times to nearly twice as long as wide; second pinnule 16 mm. long, with 12 or 13 joints, of which the distal are rather longer than those of the first; third pinnule 15 mm. long, resembling the second; fourth, 12 mm. long, with 11 joints, resembling the third; following pinnules decreasing in length and also slightly in stoutness, the seventh being 7 mm. long, with 10 joints, then gradually losing their peculiar stiffness, and

later gradually increasing in length; distal pinnules 10 mm. long, with about 20 joints, the first two not so long as broad, the third squarish, the remainder about one-third longer than broad, becoming half again as long as broad distally.

Measurements.—Arms 110 mm., cirri 25 mm. in length.

Color (in spirits).—Dull yellowish, the division-series and arms thickly covered with small dull red spots and blotches; perisome brown.

Type.—Cat. No. 25442, U. S. N. M., from *Albatross* Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

The length of the second pinnule, which has comparatively few joints, and the similarity of the first to the second, place this species near *H. tenuipinna*; but the greater number of joints in the lower pinnules, and the fact that the first eight or nine instead of only the first three are similar in character, distinguish it at once.

HIMEROMETRA GRACILIPES, new species

Centro-dorsal a thick disk with a small flat polar area, the cirri arranged in two, and a partial third, more or less alternating crowded irregular rows.

Cirri XIX, 41-52 (usually about 50); first joint about twice as broad as long, following increasing in length to the fifth or sixth, which is squarish, then remaining the same (or becoming slightly longer than broad) to about the twenty-sixth, then gradually becoming shorter, about half again as broad as long; after the twentieth to the twenty-second dorsal spines gradually begin to develop, which, however, never become very large; opposing spine terminal, erect, about half as long as the diameter of the penultimate joint; terminal claw longer than the penultimate joint, slender, moderately curved.

Radials very prominent, their external dorsal surface parallel with the dorso-ventral axis of the animal, about twice as broad as long; each radial bears a low rounded postero-lateral tubercle on each side; first costals trapezoidal, about three times as broad as long proximally and twice as broad as long distally; they are basally united, but diverge very rapidly distally; costal axillaries pentagonal, about one and one-half times as broad as long; distichals, palmars, and post-palmars 2, widely separated, the last developed only on the outer side of the distichal series. Forty-four arms in the type; first ten brachials oblong, not quite twice as broad as long, then wedge-shaped, almost triangular, about twice as broad as long, becoming proportionately longer in the distal part of the arms.

Syzygies occur between the third and fourth brachials, again between the forty-fourth and forty-fifth to the fifty-sixth and fifty-seventh (usually nearer the latter), and distally at intervals of 6-11 (usually 7-9) oblique muscular articulations.

First pinnule 10 mm. long, slender but somewhat stiffened, tapering evenly from the base to the delicate tip, with 22 joints, the first about twice as broad as long, the fourth squarish, then gradually increasing in length, the seventh and following being about half again as long as broad; second pinnule usually slightly longer, with 17 joints, those in the distal part being more elongated than the corresponding joints in the first; third pinnule 5.5 mm. long, of the same character as the two preceding, with 12 joints; following pinnules small, short, and delicate, 4 mm. long, with 12 joints, the first three squarish, the remainder longer than broad, becoming about twice as long as broad distally; distal pinnules 7 mm. long, with 20 joints, the first short, the second squarish, the third about half again as long as broad, the remainder about twice as long as broad, or rather longer.

Measurements.—Arms 90 mm., cirri 35 mm. to 40 mm. in length.

Color (in spirits).—Brownish gray.

Type.—Cat. No. 25455, U. S. N. M., from *Albatross Station* No. 5163; south of San Gasanga (Tataan group); 28 fathoms.

HIMEROMETRA PROTECTUS (Lutken)

Simonor, Tataan Islands.

Pangasinan Island; also a specimen with no definite locality given.

HIMEROMETRA MONACANTHA (Hartlaub)

Station No. 5109; Simo Banks, southwest of Manila Bay, Luzon; 6 fathoms.

Station No. 5147; off Balinpongpong Island (south of Jolo); 21 fathoms.

Genus CYLLOMETRA A. H. Clark

CYLLOMETRA SUAVIS, new species

This species is allied to *C. perspinosa*, with which it agrees in its general structure; but it entirely lacks the prominent spinous overlapping of the pinnule and cirrus joints characteristic of that species, and the lower pinnules, while stiffened as in *C. perspinosa*, are subequal in length and not elongated, and are much more slender than

in that species. The cirri, while containing 35-40 joints, as in *C. perspinosa*, differ strikingly from those of that species in having the dorsal spines in the distal portion single and median in position instead of paired. The general appearance of the whole animal is much more delicate than in *C. perspinosa*; the costals are more elongated, the arms, cirri, and lower pinnules more slender.

Measurements.—Arms about 100 mm., cirri 25 mm. to 30 mm. in length.

Color (in spirits).—Purple, the costals and discoidal lower brachials with a median line of white; arms, pinnules, and cirri purple, with very numerous narrow bands of white.

Type.—Cat. No. 25443, U. S. N. M., from *Albatross* Station No. 5137; off Jolo town; 20 fathoms.

Fragments of another specimen were dredged at Station No. 5145; off Jolo town; 23 fathoms.

CYLLOMETRA MANCA (P. H. Carpenter)

Station No. 5213; east of central Masbate; 80 fathoms.

Genus OLIGOMETRA A. H. Clark

OLIGOMETRA GRACILICIRRA, new species

Centro-dorsal thick-discoidal, the rather large polar area thickly covered with small blunt spines.

Cirri in a single marginal row, xv, 28-30; first joint very short, the following gradually increasing in length to the fourth, which is squarish, then becoming very slightly broader than long after the tenth; from the seventh joint onward long and sharp dorsal spines are developed; opposing spine as long as the diameter of the penultimate joint, arising from the entire surface of that joint; terminal claw rather stout, about as long as the penultimate joint, moderately curved.

Radials visible, but short, bearing a small median tubercle on the distal border; first costals oblong, nearly three times as broad as long, with straight lateral edges which are just in apposition; costal axillaries broadly pentagonal, about once and one-half times as broad as long. Ten arms; first two brachials wedge-shaped, the shorter side in, the first interiorly united for one-half or two-thirds of their length, and both slightly flattened exteriorly; third and fourth brachials (syzygial pair) nearly twice as broad as long, rather longer interiorly than exteriorly; following brachials to the ninth oblong, about twice as broad as long, after which they become

obliquely wedge-shaped, about as long as broad, and gradually less and less obliquely wedge-shaped distally; costals and lower brachials with a faintly indicated rounded median keel; brachials after about the eleventh developing slightly overlapping and spinous distal edges. Syzygies occur ordinarily between the third and fourth, ninth and tenth, and fourteenth and fifteen brachials, and distally at intervals of seven to eleven (usually nine) oblique muscular articulations.

First pinnule moderately stout, with 7 or 8 squarish joints, about 2 mm. long; second pinnule about 3 mm. long, considerably stouter than the first, with 9 or 10 joints, the first two not quite so long as broad, the third squarish, the remainder slightly longer than broad; third and following joints with strongly overlapping and spinous distal edges; third pinnule similar, but smaller; fourth pinnule, while similar to the third, is about the size of the first; after the twelfth or thirteenth the pinnules increase in length, reaching about 4.5 mm. distally.

Measurements.—Arms 55 mm., cirri 12 mm. in length.

Color (in spirits).—Costals while, with a broad median line of purple; arms purple, with a median line of white in their proximal third; cirri white, with a narrow band of purple about the middle of each joint.

Type.—Cat. No. 25444, U. S. N. M., from *Albatross* Station No. 5153; east of Port Dos Amigos, Tawi Tawi; 49 fathoms.

The slender and spiny cirri with comparatively numerous joints, as well as the delicate build of the whole animal and the shortness and stoutness of the lower pinnules, distinguish this species at once from all the others of the genus.

OLIGOMETRA PULCHELLA A. H. Clark

One specimen from Station No. 5139; between Jolo and Pangasinan Island; 20 fathoms.

This species was previously only known from Singapore.

Family TROPIOMETRIDÆ

Genus CALOMETRA A. H. Clark

CALOMETRA CARDUUM, new species

This species is a member of that division of the genus *Calometra* in which the rays, through lateral processes, are more or less in contact, and comes nearest to *C. flavopurpurea*, of Japan.

Centro-dorsal hemispherical or thick discoidal, a large convex polar area bare, the cirri marginal, arranged in two closely crowded rows.

Cirri x-xv, 26-40 (usually 34-36); first joint short, the following becoming progressively longer to the fourth or fifth, which is squarish, then remaining similar to about the end of the proximal third of the cirrus, after which the length gradually decreases; from the twelfth or fourteenth onward prominent blunt dorsal spines are developed; opposing spine rather small, the apex opposite the end of the penultimate joint, the spine arising from the entire dorsal surface of that joint.

Radials usually concealed by the centro-dorsal, but sometimes partially visible in the interradi al angles; first costals short and band-like, in lateral apposition, the dorsal surface coarsely rugose, the edges crenulate or more or less dentate; costal axillary triangular, about twice as broad as long, the dorsal surface rugose, the edges finely crenulate; distichals 2, resembling the costals, and, like them, in close lateral apposition. Fifteen to twenty arms; first brachial wedge-shaped, longer outwardly than inwardly, in close apposition interiorly, the edges sharply crenulate or dentate; second brachial similar; third and fourth brachials (syzygial pair) roughly oblong, not quite twice as broad as long; next three brachials oblong, rather more than twice as broad as long, then becoming more and more wedge-shaped, after about the twelfth becoming triangular, broader than long, then very gradually becoming wedge-shaped again and increasing in length, though even distally the joints are never quite so long as broad; arm terminating very abruptly with three or four minute joints, beyond which the terminal pinnules extend for about 3 mm. Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth to seventeenth and eighteenth (in undivided arms usually also between the ninth and tenth), and distally at intervals of four oblique muscular articulations.

The pinnules are essentially like those of *C. flavopurpurea*.

Measurements.—Arms 60 mm., cirri 20 mm. to 25 mm. in length.

Color (in spirits).—Bright yellow, the calyx, division series, and cirri white. One specimen has a narrow dull purple band crossing the arms at the first syzygy, and another has indistinct dull purplish blotches on the pinnules.

Type.—Cat. No. 25445, U. S. N. M., from *Albatross* Station No. 5167; off Simonor Island (Tawi Tawi group); 110 fathoms.

This species is readily distinguishable from *C. flavopurpurea* by the absence of the sharp median keel on the costals, and the strongly dentate or sharply crenulate edges of those joints.

CALOMETRA ACANTHASTER, new species

This new form comes nearest to *C. multicolor*, of Japan, but it differs from that species in a number of characters which appear to be perfectly constant. The arms are thirty in number instead of twenty or less, palmar series (2) being developed on the outer side of each distichal series in 2, 1, 1, 2 order; the third pinnule is as large as and resembles the second instead of being considerably smaller, as in *C. multicolor*; the cirri, while containing the same number of joints, are very different in appearance from those of *C. multicolor*; in the latter the joints in the distal half of the cirri are rounded ventrally, the distal ventral ends are even with the proximal ventral ends of the succeeding joints, the width is about twice the length in the middle lateral line, and the dorsal spines arise from one-half or rather less of the dorsal surface and are small and pointed; in *C. acanthaster* the distal half of the cirri is sharply carinate ventrally, and the distal ends of the joints are prominent, overlapping the bases of the succeeding joints; the joints themselves are broader, being about three times as broad as long in the lateral line, and the dorsal spines, which arise from the entire dorsal surface of the joints, are high, and terminate in a long ridge parallel to the median line of the joint instead of in a point.

Measurements.—Arms 60 mm., cirri 20 mm. long.

Color (in spirits).—Yellow, the cirri with a few narrow bands of deep purple, and the pinnules with large, indistinct blotches of light purplish; or purple, the centro-dorsal, costals, and blotches on the arms and pinnules white; or white, the arms with about every third brachial deep purple, the pinnules and cirri narrowly banded with purple.

Type.—Cat. No. 25446, U. S. N. M., from *Albatross Station* No. 5153; east of Port Dos Amigos, Tawi Tawi; 49 fathoms.

Genus *PTILOMETRA* A. H. Clark

PTILOMETRA TRICHOPODA, new species

Centro-dorsal columnar, the polar area a low truncated cone bearing five rather long, rounded tubercles which are radial in position; cirrus sockets in ten columns, two in each radial area, usually two cirrus sockets to a column.

Cirri xx, 80-85 (usually 84 or 85), very long and slender, tapering gradually from a moderately stout base to a slender tip; first joint short, second about twice as broad as long, the following gradually

increasing in length to the fifth, which is squarish, and still further increasing to the eighth, which is not quite half again as long as broad; the proportions of the following joints similar until the eighteenth or twentieth, after which the joints gradually decrease in length, the thirty-second to the thirty-fifth being squarish, the following gradually becoming broader than long, the terminal joints being very short; the fourth to about the sixteenth joints with a strong ventral overlap (though smooth dorsally), and the middle of the distal ventral border strongly produced in the form of a sharp and prominent spine, this condition reaching a maximum on the eighth or ninth joint, then gradually decreasing in intensity, disappearing after about the sixteenth; at about the twenty-fifth joint a slight prominence of the distal dorsal edge is noticeable; after the thirty-sixth the median part of the dorsal edge is produced into a small, sharp spine which projects forward in line with the rest of the dorsal surface of the joint; after about the fiftieth joint this spine begins to broaden basally, soon transforming into a high curved spine arising from the entire dorsal surface of the joints, just like the dorsal spines in the distal part of the cirri of *P. macronema*; last four joints decreasing rapidly in size; opposing spine very small (though of normal proportions when compared to the very small penultimate joint which bears it); terminal claw minute.

Ends of basal rays visible as dorso-ventrally elongated tubercles in the angles of the calyx; radials rather prominent, about four times as broad as long, with a rather low, rounded tubercle in the median part of their proximal border, first costals oblong, about three times as broad as long, in close lateral apposition and somewhat flattened laterally; costal axillaries rhombic, about twice as broad as long, with a tendency to rise into a low, rounded tubercle at the articulation with the first costals; distichals and palmars 2, the latter developed exteriorly in 2, 1, 1, 2 order; division-series and first four or five brachials sharply "wall-sided;" but, owing to the thinness of the joints dorso-ventrally, the flattened lateral area is comparatively narrow. Twenty-four to thirty arms; first eight brachials discoidal or oblong, about twice as broad as long, then gradually becoming more and more wedge-shaped, and after the twelfth obliquely wedge-shaped, not quite so long as broad, and in the distal portion of the arms less obliquely wedge-shaped again, but not increasing in length; arm ending abruptly with a few minute incurved joints, as in *P. macronema*, the terminal pinnules exceeding the arm tip by about 4 mm.; arms dorsally rounded and comparatively broad in the proximal half, becoming gradually strongly compressed and carinate dis-

tally, the brachials developing prominent overlapping spines, as in *P. macronema*. Syzygies occur between the third and fourth brachials (in one case the first syzygy is between the sixth and seventh), again between the thirteenth and fourteenth to nineteenth and twentieth (most commonly between the seventeenth and eighteenth, with rarely an additional syzygy between the seventh and eighth), and distally at intervals of six to twelve (usually seven or eight) oblique muscular articulations.

First pinnule small and weak, about 6.5 mm. long, with 10 or 12 joints, the first short, the second rather longer than its anterior diameter, decreasing in width distally, the remainder about two and one-half times as long as broad; second pinnule about 9 mm. long, stiff and spine-like, with fifteen joints, the first short, the second rather longer than its anterior diameter, the third not quite so long as broad, the following about twice as long as broad; the pinnule is sharply triangular, and the dorsal ridge on each joint is produced distally over the bases of the succeeding joints in the form of a slender spine; third and following pinnules similar to the second, but about 10 mm. long. The pinnules as a whole are considerably more delicate than are those of *P. macronema*; the plating of the disk and ambulacra is approximately as in *P. macronema*.

Measurements.—Arms 70 mm., cirri 60 mm. in length.

Color (in spirits).—White, the costals with a lateral line, the division-series with narrow transverse lines at the articulations, and the pinnules with a spot in the middle of each joint of very light purple; cirri deep violet in the distal two-thirds, in the proximal third white, with a lateral line of deep violet.

Another specimen is entirely deep purple.

Type.—Cat. No. 25447, U. S. N. M., from *Albatross Station* No. 5153; east of Port Dos Amigos, Tawi Tawi; 49 fathoms.

This species was also found at Station No. 5179; between Tablas and Romblon; 37 fathoms.

The large number of arms, the narrowness of the calyx and arm bases, the extraordinary spinous ventral overlap of the joints in the proximal third of the cirri, the regular arrangement of the cirri, and the greater delicacy of the entire animal distinguish this species at once from *P. macronema*. The number of arms alone is usually a sufficient character, for, although sometimes having as many as thirty, *P. macronema* usually has less than twenty.

Family THALASSOMETRIDÆ

Genus THALASSOMETRA A. H. Clark

THALASSOMETRA COMPRESSA (P. H. Carpenter)

Station No. 5110; off Talin Point, west Luzon (14° N. lat.); 139 fathoms.

Genus CHARITOMETRA A. H. Clark

CHARITOMETRA SMITHI, new species

This is a species of *Charitometra* falling in the division including *C. angusticalyx*, *C. inæqualis*, *C. distincta*, *C. brevipinna*, and *C. imbricata*, species with the second division-series usually 4 ($3 + 4$) and the third 2 ($1 + 2$), and with usually about thirty arms. The division-series and lower arm joints are in very close apposition so that the distichal pinnule is not visible exteriorly, as it is in *C. distincta* and *C. imbricata* (= *granulifera* of P. H. Carpenter, not of Pourtalès); the strong carination of the more distal cirrus joints and the presence of an opposing spine, combined with the smooth and evenly rounded division-series and arm bases distinguish it at once from *C. angusticalyx* and *C. brevipinna*, while the length of the proximal and the shortness of the distal cirrus joints, the latter having the distal dorsal edges so prominent as to appear almost spinous, preclude any possibility of confusion with *C. inæqualis*. It may be described as follows:

Centro-dorsal thick discoidal or short-columnar, the cirrus sockets arranged in two rows and roughly in three irregular columns in each radial area, though the middle column is sometimes lacking.

Cirri XXVII-XXX, 19-22 (usually 20); first joint very short, second about twice as broad as long, third nearly squarish, fourth slightly longer than broad, fifth nearly half again as long as broad; following joints decreasing very gradually in length, the tenth and following being about as long as their distal diameter; the joints after the eighth or ninth becoming rounded carinate dorsally, soon developing rather prominent rounded tubercles situated on the distal dorsal edge; opposing spine, though prominent, small, terminally situated, reaching a height equal to about half the diameter of the penultimate joint or rather less, its base occupying only the distal third of the joint; terminal claw about as long as the penultimate joint, rather stout and moderately curved.

Disk completely covered with small plates; side and covering plates of arms and pinnules very well developed.

Ends of basal rays just visible as more or less irregular tubercles in the angles of the calyx; radials quite concealed in the median line of the arm, though sometimes slightly visible over the ends of the basal rays; first costals very short, three or four times as broad as long, triangular, apex downward, laterally in close apposition, the dorsal surface coarsely rugose; costal axillaries triangular, rather more than twice as broad as long, the dorsal surface rugose; distichals 4 (3 + 4), rarely 2; palmars 2 (1 + 2), developed interiorly in 1, 2, 2, 1 order as a rule; first distichal more or less covered with small crowded tubercles, but the remaining joints of the division-series perfectly smooth; division-series and proximal six or eight brachials in close apposition and sharply flattened laterally. Twenty-eight arms (in the type); proximal twelve or fourteen brachials oblong, about twice as broad as long, then becoming triangular and nearly as long as broad, and in the distal part of the arm wedge-shaped and longer than broad. The first syzygy is usually between the first two brachials, but may be between the third and fourth, especially in arms springing direct from a distichal axillary; in arms where the first and second brachials are united by syzygy the third and fourth are often similarly united, the next syzygy is near the nineteenth to the twenty-fifth brachial (usually between the twentieth and twenty-first or one or two joints farther on), and the distal intersyzygial interval is from four to twelve (usually six or seven) oblique muscular articulations.

Distichal pinnule 13 mm. long, slender and evenly tapering, flagellate distally, with about 45 joints, in the proximal half about once and one-half as broad as long, becoming squarish distally; first brachial pinnule similar, but only about 9 mm. long with 35 joints, the first five of which are noticeably carinate; second brachial pinnule about the same length, but with only about 25 joints, the first four or five of which are carinate and slightly broader than those of the first pinnule, the terminal joints being about twice as long as broad. In the following pinnules the joints, except the first two, gradually become longer and fewer in number; the tenth pinnule is 8 mm. long with 17 joints, the first two not so long as broad and bearing a triangular or bluntly triangular process distally, the remainder squarish, gradually becoming slightly longer than broad; third to the seventh or eighth joints very slightly enlarged, protecting the genital glands, but the enlargement is not very noticeable and tapers off evenly in both directions; distal pinnules 9 mm. long with 17 or 18 joints, the first short and wedge-shaped, the second not quite so long as broad, the remainder approximately half again as long as broad.

Measurements.—Arms 60 mm.; cirri 20 mm. to 25 mm.

Color (in spirits).—Arms and cirri yellow, the calyx and division-series, and the first four or five brachials, dark brown.

Type.—Cat. No. 25448, U. S. N. M., from *Albatross* Station No. 5123; between Marinduque and Mindoro; 283 fathoms.

This species was also found at Station No. 5116; north of Maricaban Island (between Luzon and Mindoro); 200 fathoms; and at Station No. 5198; off Panglao (west of Bohol); 220 fathoms.

It gives me great pleasure to associate with this interesting species the name of Dr. Hugh M. Smith, of the United States Bureau of Fisheries.

Family ANTÉDONIDÆ

Genus PEROMETRA A. H. Clark

PEROMETRA ELONGATA, new species

A specimen, consisting of the centro-dorsal (with the cirri) calyx, and arm bases, belonging to a species of this genus, while agreeing in the main with Carpenter's description of *P. balanoides*, differs widely from his figure of that species, and probably represents a new form, which may be described as follows:

Centro-dorsal sharply conical and greatly elongated, 4 mm. long by 1.5 mm. broad at the base; cirrus sockets arranged in ten columns of four or five each, two columns in each radial area; sockets in each column closely crowded, but the pair of columns in each radial area separated from their neighbors by a shallow rounded furrow averaging about half as broad as the adjacent cirrus sockets, the two columns of each pair being separated by a line rather less than half as broad as the furrow separating the radial pairs; distal third of the centro-dorsal marked with partially obliterated cirrus sockets which bear no cirri.

Cirri XLV, 27-35 (usually nearer the latter), 20 mm. to 26 mm. long; first joint about twice as broad as long, second slightly longer than broad, third about twice and one-half as long as broad, fourth rather over three times as long as broad, fifth and following about four times as long as broad or rather over; after the tenth or twelfth the joints gradually decreasing in length, the terminal ten being squarish or only slightly longer than broad; after the first ten the distal dorsal edge of the joints begins to be somewhat prominent, this very gradually increasing distally; opposing spine rising from almost the entire dorsal surface of the penultimate joint, the apex terminal in position, rather stout, reaching not quite to the diameter of the penultimate joint in height; terminal claw moderately stout and moderately curved, about as long as the penultimate joint.

Radials rather long being, in the median line, about half as long as broad; first costals short, with concave distal ends and proximal borders, over twice as broad as their lateral length, decreasing slightly in diameter anteriorly, not in contact basally; costal axillaries rhombic, about as long as broad; first brachials small, about three times as long exteriorly as interiorly, not in contact interiorly, the distal border concave; second brachials much larger, irregularly quadrate; third and fourth brachials (syzygial pair) half again as long interiorly as exteriorly, about twice as broad as the exterior length; brachials as far as the second syzygy slightly wedge-shaped, about twice as broad as long; first pinnule on the fifth ("fourth," to use Carpenter's terminology) brachial, as in *P. balanoides*.

Color.—Centro-dorsal purple; arms purple, with a broad median line of white; pinnules and cirri white.

Type.—Cat. No. 25449, U. S. N. M., from *Albatross* Station No. 5178; north of Tablas Island; 78 fathoms.

The greatly elongated centro-dorsal, which does not have prominent interradiar furrows, the elongation of the proximal and the shortness of the distal cirrus joints, together with the length of the radials and the absence of synarthrial tubercles, appear to differentiate this species sharply from *P. balanoides*; the absence of the pinnule on the second brachial and the regular arrangement of the cirri in ten columns, separate it at once from *P. diomedea*.

EUMETRA, new genus

Centro-dorsal hemispherical, the moderately large polar area finely papillose; cirrus sockets forty to sixty in number, in four or five closely crowded alternating rows.

Cirri long and slender, compressed, deciduous, about one-third the length of the arms, with about twenty-five joints, all but the basal two of which are greatly elongated, three times as long as broad or longer; opposing spine absent; terminal claw not so long as the penultimate joint, slender, sharp, and nearly straight.

Costals and first two brachials in close lateral apposition, though not laterally flattened, the synarthrial tubercles very prominent; brachials essentially as in *Antedon*.

First pinnule small and weak; second pinnule half as long again, stouter and stiffer; third pinnule over one-third longer than the second, stouter, and very stiff; fourth resembling the second, but stiff like the third; following pinnules decreasing gradually in length and stiffness; distal pinnules about as long as the second, very slender, the first two joints very short, the remainder greatly elongated, as usual in the *Antedonidæ*.

Genotype.—*Eumetra chamberlaini*.

The numerous and slender cirri with greatly elongated joints, no opposing spine, and an almost straight terminal claw, combined with the very stiff lower pinnules of which the third is much the longest make this genus easily recognizable.

EUMETRA CHAMBERLAINI, new species

Centro-dorsal hemispherical, rather low, bearing forty to sixty cirrus sockets in four or five closely crowded alternating rows.

Cirri long, XL-LX, 25, slender and delicate; first joint very short, second squarish, third about half again as long as broad, fourth nearly four times as long as its proximal diameter, fifth and following about five times as long as their proximal diameter; terminal ten or twelve joints decreasing very slightly in length, so that the last three or four are only about two and one-half times as long as broad; penultimate joint slightly over twice as long as its proximal diameter, decreasing slightly in diameter distally; no opposing spine; terminal claw about three-quarters the length of the penultimate joint, slender, evenly tapering, very slightly curved; the distal half of each cirrus joint is slightly and very gradually expanded, and the distal edges are prominent; cirri rather strongly compressed throughout.

Radials even with the edge of the centro-dorsal; first costals extremely short, divided in the median line by a posterior projection from the costal axillaries, and bearing more or less prominent rounded tubercles in the antero-lateral angles; costal axillaries rhombic, about once and one-half as broad as long, the sides strongly concave, the anterior angle sharp and somewhat produced; costals and first two brachials in close apposition; synarthrial articulations between the costals and the first two brachials rising to a very prominent tubercle. Ten arms; first brachial about twice as long exteriorly as interiorly, deeply incised in the median line, the bases of adjacent first brachials just meeting over the anterior angles of the costal axillaries; second brachial much larger, irregularly quadrate, with a strong posterior prolongation incising the first brachial; third and fourth brachials (syzygial pair) rather more than twice as broad as long in the median line, rather longer inwardly than outwardly; next four brachials and the next syzygial pair (ninth and tenth brachials) slightly wedge-shaped, about twice as broad as long; brachials then becoming triangular, at first not so long as broad, soon becoming as long as broad, and distally wedge-shaped again, and, in the terminal portion of the arms elongate: brachials smooth, not overlapping. Syzygies occur between the third and

fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of, in one specimen, three, and in another four, oblique muscular articulations.

First pinnule 6 mm. long, somewhat stiff, slightly compressed, tapering evenly from the base to the tip, composed of 12 joints, the first not so long as broad, the third slightly longer than broad, the fourth about half again as long as broad, the remainder about twice as long as broad; second pinnule half as long again (9 mm.), stouter and stiffer than the first, containing about 16 joints, the first about twice as broad as long, the second squarish, the third rather longer than broad, the remainder about twice as long as broad; third pinnule the longest and stiffest, 13 mm. long, with 20 to 22 joints, the first short, the second squarish, the following increasing in length, the fifth and succeeding being about twice as long as broad, and slightly longer distally; fourth and fifth pinnules resembling the second; distal pinnules 9 mm. long with 18 or 19 joints, the first very short, the second about as long as its proximal diameter, slightly trapezoidal, the third and following greatly elongated and very slender, with slightly expanded articulations.

Measurements.—Arms 80 mm., cirri 25 mm. to 30 mm. in length.

Color (in spirits).—Yellow, the cirri white, the perisome brown.

Type.—Cat. No. 25450, U. S. N. M., from *Albatross Station* No. 5178; north of Tablas Island; 78 fathoms.

Genus IRIDOMETRA A. H. Clark

IRIDOMETRA SCITA, new species

This species comes nearest to *I. psyche* from Japan, in that the second pinnule is much the largest and longest on the arm; but it may be at once distinguished by its cirri which, though containing the same number of joints as those of *I. psyche*, have the proximal joints elongated and "dice-box shaped," and the distal squarish; the first and second pinnules also are proportionately rather larger than those of *I. psyche*, and have more numerous joints.

Measurements.—Arms 60 mm., cirri 10 mm. long.

Color (in spirits).—Purple, with blotches of darker.

Type.—Cat. No. 25451, U. S. N. M., from the Philippine Islands.

Genus TRICHOMETRA A. H. Clark

TRICHOMETRA EXPLICATA, new species

This new species resembles *T. aspera*, of the West Indies, in its general appearance and in the character of its cirri, having fewer joints in the latter than *T. revator*, of the Hawaiian Islands. All

the specimens are, unfortunately, badly broken, and only one has any cirri remaining.

The genus *Trichometra* was previously known only from the coast of the South Atlantic States (*T. aspera*) and from the Hawaiian Islands (*T. vexator*); as the fauna of both the West Indies (including the coasts of the Southern States) and the Hawaiian Islands belongs to what I have called the "Oceanic" area, the genera and species characterizing which are evidently derivatives from Indo-Pacific—Japanese stock, and mostly occur in the Indo-Pacific—Japanese region, though separated from the typical Indo-Pacific—Japanese genera and species by a considerable difference in depth of habitat, it was only to be expected that *Trichometra* would eventually be found in the East Indies. *Zenometra* is another such genus; though now known only from the West Indies (*Z. columnaris* and *Z. pyramidalis*) and the Hawaiian Islands (*Z. triserialis*), it undoubtedly occurs in the East Indian region, and will eventually be discovered there.

Centro-dorsal conical, in lateral view an equilateral triangle, with slightly convex sides; cirri in number, arrangement, and proportions of their joints resembling those of *T. aspera*; the cirrus joints number 25-28.

Radials even with the edge of the centro-dorsal; first costals short, in lateral apposition, much incised in the median line; costal axillaries rhombic, nearly as long as broad; costals and first two brachials in lateral apposition and laterally flattened; the synarthrial tubercles are slightly marked. Ten arms; first brachial about twice as broad as long exteriorly, inwardly united at the base; second brachial much larger, irregularly quadrate; first syzygial pair and following brachials about as long as broad, wedge-shaped, after the tenth becoming very obliquely wedge-shaped and considerably longer than broad, the length gradually increasing distally. The costals and lower brachials have abruptly everted, finely spinous distal edges, but these are somewhat broader than those of *T. aspera*, and do not stand out so high; this eversion of the distal edge of the brachials after the second syzygy gradually becomes more and more recumbent, taking the form of an overlapping of the distal ends of the brachials, which gradually dies away, disappearing after about the twentieth brachial. Syzygies occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of two oblique muscular articulations.

First pinnule 10 mm. long with 20 joints, resembling that of *T. aspera*, but proportionately stouter; second pinnule 7 mm. long with 16 joints, more slender than the first; the first three joints are

squarish, the following gradually increasing in length; third pinnule 7 mm. long with about 20 joints, rather stouter than the second; the first three joints are squarish; fourth pinnule 7 mm. long, with a small genital gland; following pinnules similar, but with larger genital glands. The distal part of the arms is lacking in all the specimens.

Color (in spirits).—Brownish yellow, probably yellow in life.

Type.—Cat. No. 25452, U. S. N. M., from *Albatross* Station No. 5123; between Marinduque and Mindoro, Philippine Islands; 283 fathoms.

Family PENTAMETROCRINIDÆ

Genus PENTAMETROCRINUS A. H. Clark

PENTAMETROCRINUS DIOMEDEÆ, new species

This species is most closely allied to *P. atlanticus* of Southern Europe and the West Indies; of the Pacific species it is nearest to *P. tuberculatus*.

Centro-dorsal conical, the sides gently convex, 3 mm. high and 4 mm. broad at the base, the cirrus sockets closely crowded, arranged roughly in two or three, with sometimes a partial fourth row, and four columns in each radial area.

Cirri XL-LX, 14-17 (usually 15-17), 15 mm. to 20 mm. long; first joint short, second squarish, third about twice as long as broad, fourth about three times as long as broad, fifth-seventh about four times as long as broad; following joints gradually decreasing in length, the antepenultimate joint being about twice as long as broad, and the penultimate about as long as broad; cirri not tapering distally, but the penultimate joint less in diameter than the antepenultimate; terminal claw considerably longer than the penultimate joint, stout basally, tapering distally, comparatively straight in the basal half, but curved strongly downward at the tip; cirrus joints practically oblong in lateral view, the distal ventral ends of the more proximal only very slightly prominent; cirri moderately compressed.

Arms and pinnules resembling those of *P. varians*, but the lowest pinnule present in that species is absent in *P. diomedea*, the first pinnule being on the fifth (epizygal) brachial and bearing a genital gland; proximal part of the arm moderately tubercular.

Measurements.—Arms about 100 mm. long; cirri 15 mm. to 20 mm. in length.

Color (in life).—Not distinguishable from *P. japonicus*.

Type.—Cat. No. 22699, U. S. N. M., from *Albatross* Station No. 4934; Eastern Sea, off Kagoshima Gulf, Japan; 152-103 fathoms.

A specimen was obtained at *Albatross* Station No. 5173; between Mindoro and Luzon.