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ECHINODERMA OF THE INDIAN MUSEUM, PART VII.  
CRINOIDEA.

THE  
CRINOIDS  
of the  
INDIAN OCEAN

By  
AUSTIN HOBART CLARK, B.A., F.R.G.S.

CALCUTTA

PRINTED BY ORDER OF THE TRUSTEES OF THE INDIAN MUSEUM.

1912.

Price Twenty Rupees.



Nov. 22, 1912

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## PREFACE.

At the suggestion of Dr. F. A. Bather the Indian Museum entrusted to me for study the magnificent collection of recent crinoids brought together mainly as a result of the operations of the Royal Indian Marine Survey Steamer "Investigator." Covering as it does the vast region from the Malay Archipelago to the Persian Gulf the collection is one of extraordinary interest, for by its aid the westward extension of many East Indian genera and species may be accurately traced, and it is possible to form a very clear concept of the progressive diminution in intensity of the wonderfully rich East Indian fauna as one travels westward. In addition to the "Investigator" material, the Indian Museum also sent all of its collections accumulated from other sources—collections of no small importance to the student of the Indian fauna.

Most of the species in the collection are represented by large series, and there is an astonishingly complete representation of those very small forms so common in the East Indian region which are frequently disposed of *in toto* as "unidentifiable young," graphically bringing out the thoroughness with which the collectors of the "Investigator" performed their labours.

While the work of studying these large collections was in progress, I received the material from the marine survey of the Philippine Islands, which was undertaken by the United States Fisheries Steamer "Albatross." This proved extremely rich in species as well as in individuals, and formed a most valuable supplement to that obtained by the "Investigator." I had myself in 1906, when naturalist of the "Albatross," made large collections off the coasts of Japan as well as further north, subsequently receiving the collection made by Mr. Alan Owston in shallower water off the southern shore, in the vicinity of Sagami Bay, and these were naturally most instructive in throwing light upon the northern limits of many East Indian genera and species. Recently the Australian Museum at Sydney, New South Wales, sent me its entire Australian collection to study so that I was able to form a good idea of the southward extension of the East Indian genera and species about the shores of that continent.

After the report was written I visited the chief museums of Europe for the purpose of studying the crinoids therein contained in connection with my forthcoming extended monograph on the group. I examined the Lamarekian and Müllerian types preserved at Leyden and at Paris (those at Berlin having previously passed through my hands), and studied other important collections at Bergen, Berlin, Copenhagen, Dresden, Kristiania, Lyons, Monaco, and Vienna. At the British Museum I was able to study an enormous amount of East Indian material, including the "Challenger" collections, those of the "Alert," "Penguin,"

“*Egeria*,” and “*Sea Lark*,” as well as others of historic interest, and at Hamburg I reviewed a large part of the material upon which Hartlaub’s monograph of the East Indian comatulids is based.

In this report all the information in regard to the crinoids inhabiting the seas from the East Coast of Africa to Japan is brought together, though only species in the Indian Museum collection are discussed in detail. Further information in regard to Australian species is contained in my work on the “Recent Crinoids of Australia,” while the African species are discussed in my “Recent Crinoids of the Coasts of Africa.”

The references and the synonymy as given will be found to be ample, when used in connection with the bibliography appended. The references given are not necessarily to the first appearance in print of the name, but are usually to the first adequate description. Many of the names ran for some years as *nomina uada* before any description was given with them; in most cases it has not been considered necessary to cite these as they may readily be found by consulting my paper on “The Nomenclature of the Recent Crinoids.”

In conclusion I wish to express my deep appreciation of the honour which has been done me by the authorities of the Indian Museum in entrusting me with the working out of their valuable collections. By the study of this material I have been able to acquire an insight into the crinoid fauna of the Indian Ocean which on account of the present rarity of recent crinoids in collections, and of the meagre literature on the group, could have been obtained in no other way.

The illustrations in this work have been carefully chosen with a view to supplementing those given in the “Challenger” Reports, as well as to elucidating the new species. The figures are all semi-conventional; that is, the arms and pinnules of the animals are arranged in a definite and arbitrary manner so that all difficulties due to the distortion of the actual specimen are overcome. Drawings from the animals as they are have proven in very many cases to be perfectly useless for comparative purposes, no matter how well executed, and have led to no end of trouble, as the somewhat complex synonymy of many species graphically shows. It is quite impossible to compare a figure of a species showing the arms curled up dorsally with one of a closely related species with the arms entangled in a mass over the disk, or with the side view of a third depicting the arms partially opened out. The comatulids especially have suffered at the hand of the artist, so much so that very many species are illustrated only by drawings which may represent any one of half a dozen forms equally well. Owing to their curious ecological position as passive scavengers depending upon a food supply which ordinarily is showered down upon them much like the falling of rain, but a very slight divergence from a given form is permitted, and hence the general external form of all the species is approximately the same, no matter how wide the difference in all the details may be. It follows naturally, therefore, that pictures of the whole animal must be drawn with the most elaborate attention to these details, even if their emphasis should, as it sometimes does, mar the general artistic effect.

The crinoids, especially the comatulids, are singularly like flowers in appearance, and, as if to emphasize that similarity, their specific interrelationships have many features comparable to those of plants instead of to those of other animals. The stamens of a flower may be said to be represented in the comatulids by the lowest pinnules which, with the cirri, form the best general guide to their systematic position, and which are arranged in a ring around the conical anal tube just as the stamens surround the pistil.

For the illustration of this report I was so fortunate as to be able to secure the services of Miss Violet Dandridge of Shepherdstown, West Virginia, U.S.A., who is herself an enthusiastic and earnest student of the echinoderms.

With the genera I have in all cases given the type species, in parentheses after the reference. This has seemed advisable on account of the very scattered literature and the consequent difficulty of securing all the papers except in a well-equipped library centre.



# THE CRINOIDS OF THE INDIAN OCEAN.

## 1. HISTORICAL INTRODUCTION.

The beautiful and delicate feather stars, often brilliantly coloured, which inhabit the shallow water along the shores of the Indian Ocean, must have been from the earliest times familiar objects to the people living near that sea, and probably attracted to themselves, from their exceeding grace and varied hues, more or less attention. In Japan, where they are much less plentiful, they have long been known, and their beauty has induced the fishermen to bestow upon them the name "komachi," originally borne by an exceptionally well-favoured lady of the court upwards of one thousand years ago. The stalked crinoids, however, are all at the present time inhabitants of comparatively deep water and their capture is, as a rule, under ordinary circumstances more or less accidental. There are but few records of their capture in the Indo-Pacific region before the day of cable-ships and specially equipped surveying steamers; but in the West Indies they have been known at least since the time of LINNÆUS (1761), while in Japan, where fishing is commonly carried on in very deep water, they are found with sufficient frequency to have received from the fishermen the vernacular appellation of "bird's foot."

Considering their curious form and elegant build, features which would place them in the first rank as curios, the introduction of the common Indian species into the cabinets of European naturalists was curiously slow; whereas the Mediterranean comatulid (*Antedon mediterranea*) was well described and figured in 1592, it is not until 1711 that we find an Indian species mentioned in the literature. In that year PETIVER figured his "*Stella chinensis perlegens*," from a broken specimen of *Capillaster multiradiata*. Twenty-two years afterwards LINCK, in his magnificent monograph upon the sea-stars, figured two more multibrachiate species, one a species of a genus of Mariametridæ, the other of a genus of Comasteridæ, calling them *Caput-Medusæ cinereum* (= *Dichrometra palmata*, according to Professor JOHANNES MÜLLER) and *Caput-Medusæ brunnum* respectively.

In 1758 LINNÆUS proposed the names *Asterias pectinata* and *Asterias multiradiata*, giving as the habitat of both, "Indian Seas." *Asterias pectinata* was a composite including *Antedon bifida*, *A. mediterranea*, and the *Stella chinensis perlegens* of PETIVER (= *Capillaster multiradiata*). None of these, however, came from the Indian Ocean; but the discrepancy is explained by the existence of a type-specimen at Lund which is not even generically identical with any one of them, belonging to the species now known as *Comatula pectinata*! *Asterias pectinata*

is described as having ten arms, but the figure of PETIVER cited in the reference shows thirteen! *Asterias multiradiata* is a more hopeless composite even than *A. pectinata*, for we are unable to identify any of the components; fortunately, there still exists the type-specimen, which fixes the name, and, curiously enough, *Capillaster multiradiata* (Linnæus) is the very same species to which the name *pectinata* would have to be applied were we forced to rely upon elimination instead of being able to consult the authentic type!

In his really wonderful work, the great Dutch collector, ALBERTUS SEBA, figured and described two multibrachiate species one of which was said to have come from Mexico, but both of which probably came from the East Indies. One of these, *Stella marina polyactis*, had twenty-nine arms, the other, *Luna marina altera*, thirty-seven; but in spite of that, LINNÆUS in 1767 placed both in the synonymy of the ten-armed *Asterias pectinata*. With this heterogeneous concept of the species it is no wonder that to his description of *Asterias multiradiata* he appends the remark that it is possibly only a variety of *A. pectinata*!

In 1783 RETZIUS re-examined the types of the Linnæan species, and published good descriptions of both of them.

Towards the end of the eighteenth century, PENNANT, FORSTER, and LATHAM and DAVIS, in the various editions of the "Faunula Indica," included both the Linnæan species, but solely on the authority of that author, being able to add no original matter of their own.

In 1815 Dr. WILLIAM ELFORD LEACH described as new the genus *Alecto*, including in it *A. horrida*, an unidentifiable form probably from India or the East Indies, and *A. carinata* which is supposed to be the *Comatula carinata* of Lamarek, and which may have come from India.

In the following year LAMARCK published the results of the studies of himself and of his friend PÉRON on the group, describing five new species from the Indian region, and identifying as the Linnæan *multiradiata* two forms which subsequently proved to be something quite different, one the interesting *Capillaster sentosa*, the other the first known species of a very remarkable genus (*Comaster*).

In 1817, in the "Description de l'Égypte," SAVIGNY figured under the name of *Comatula multiradiata* (identified by AUDOUIN) and *Comatula* sp. the species now known as *Heterometra savignii* and *Tropiometra encrinus*, his specimens having been taken in the Red Sea.

In 1819 SCHWEIGGER figured parts of an unidentifiable "*Comatula multiradiata*" probably from the Indian Ocean, and in 1833 LEUCKART cited "*Comatula leucomelas* Rüppel," as a Red Sea species, but without any description. Thanks to HARTLAUB's examination of the specimens collected by Rüppel, we now know that this form is *Dichrometra palmata*.

GEORG AUGUST GOLDFUSS, when engaged in studying the fossil crinoids of Germany in the preparation of his great work "Petrefacta Germaniæ," found at Bonn a specimen from the Indian Ocean which he called *Comatula multiradiata*, and which he figured in detail, this figure, by the way, being the first really



satisfactory representation of an Indian comatulid ever published; it represents the *Alecto bennetti* of MÜLLER.

The justly celebrated Professor JOHANNES MÜLLER was the first to undertake a really serious study of the recent crinoids. He re-examined the Linnæan types at Lund, and the Lamareckian types at Paris, and studied the collections in several other of the continental museums, more particularly those at Berlin and Leyden. As a result of his labours, we find in 1849, the date of publication of his complete monograph, twenty-seven species credited to the East Indian faunal area, of which number four have subsequently proved to be synonyms, leaving a total of twenty-three species definitely known from that region.

Nothing new was published in reference to the Indian crinoid fauna until 1858 when SCHULZE recorded two stalked species belonging to the Pentacrinidæ, but did not describe them.

In 1866 BÖHLSCHÉ described a specimen of *Comanthus bennetti* which had come from the Loyalty Islands, and LOVÉN described the peculiar *Phanogenia* (= *Comaster*) *typica* which has no cirri in the adult stage.

Two years afterward Professor SVEN LOVÉN announced the startling discovery of a recent cystid at Cape York which subsequently proved to be nothing but the detached visceral mass of one of the Zygometridæ, possibly *Zygometra multiradiata*. This "*Hyponome sarsii*" of LOVÉN was the first zygometrid known; but in the same year Professor CARL SEMPER introduced to science a second, the peculiar *Eudioerinus* ("*Ophioerinus*") *indivisus*, remarkable in possessing but five arms, whereas all the other comatulids then known had at least ten.

In 1875 GRUBE described three supposedly new comatulids from North Borneo, all of which have since proved to be the same as previously known forms.

Professor C. F. LÜTKEN was at this time interested in the comatulids, and was studying the specimens contained in the large East Indian collections of the Museum Godeffroy at Hamburg. He bestowed manuscript names upon many of them, intending to describe them when opportunity offered. Unfortunately, he never found time to do this. From the inclusion by him of many of these names as *nomina nuda* in the various "Catalogues" of the Museum Godeffroy and from the record of others who found them with duplicate specimens which had been distributed by that Museum, he is now known to have originated twenty-two names, nine of which are synonyms of earlier names. Had he published his descriptions, thirteen species would now be credited to him, four of which were subsequently described by CARPENTER, five by HARTLAUB, and three by myself, while the last is credited to LÜTKEN on the strength of a meagre diagnosis quoted by CARPENTER.

In 1879 EDGAR A. SMITH described *Comatula* (= *Stephanometra*) *indica* from Rodriguez, and PHILIP HERBERT CARPENTER published his splendid memoir "On the genus *Actinometra*" in which he described a supposedly new species and gave the morphological results of his studies on material collected by Professor CARL SEMPER in the Philippines. In 1881 CARPENTER published the results of

his studies on the collection of the Leyden Museum, redescribing some of MÜLLER's species, and establishing many new ones of his own.

The "Alert," report by Professor FRANCIS JEFFREY BELL upon collections from Australia, which appeared in 1884, gave a further insight into the Indian Ocean crinoid fauna, while the numerous papers published by CARPENTER, especially his "Atelecrinus and Eudiocrinus," "Comatulæ of the Hamburg Museum," and his preliminary reports on the stalked and unstalked crinoids collected by the American Coast Survey Steamer "Blake," added greatly to the general knowledge.

The magnificent "Challenger" monographs published in 1884 (Stalked Crinoids) and 1888 ("Comatulæ") present an epitome of all that had been previously known concerning these animals, and in addition contain an enormous amount of new data, the result of the epoch-making cruise of that vessel. Although the new forms from the littoral belt are comparatively few, the marvellous richness of crinoid life at the greater depths was demonstrated, especially in regard to the beautiful stalked species included in the genus *Metacrinus*. It is rather curious that the "Challenger" did not discover the genera *Bathycrinus* and *Rhizocrinus* in the East Indian region; the latter had been previously reported by KOROTNEFF (1886) from the vicinity of Krakatoa (the reference being unfortunately omitted by CARPENTER), while the former was not known from that region until 1907, in which year *no less than five species were described!*

Following the publication of the "Challenger" reports up to 1891 there was a period of quiet, broken by a few local lists by BELL, and an excellent report on the crinoids collected by Dr. JOHN ANDERSON at the Mergui Archipelago by CARPENTER; in that year Dr. CLEMENS HARTLAUB presented his most excellent monograph upon the comatulid fauna of the Indian region, based primarily upon the collections made by Dr. J. BROCK at Amboina, a work which is to-day the basis upon which the study of the East Indian comatulids must rest. Though the work is somewhat regrettably limited as to scope, the groups treated are handled in a masterly way, the descriptions of the species especially being clear and easily understood, which can scarcely be said of most of the descriptions previously published. No comprehensive work upon the comatulids has since appeared, but there have been numerous local lists by BELL, KEHLER, PFEFFER, DÖDERLEIN, and CHADWICK, those of the last four authors reaching a standard of excellence remarkable when the difficulties of studying these animals along the lines of CARPENTER's classification are considered.

The stalked crinoids of the Indian Ocean and adjacent seas remained for many years as CARPENTER had left them, the only additional records being of two from Singapore (*Metacrinus superbus* and *M. stewarti*), and one from Japan (previously reported ambiguously by Döderlein) (*Metacrinus rotundus*) by CARPENTER (1885), and of one, a "Challenger" species (*Metacrinus interruptus*), from the Sahul Bank by BELL (1893). In 1907, however, Professor L. DÖDERLEIN

completed his work upon those collected by the Dutch steamship "Siboga" in the Dutch East Indies and among the Philippines, including a new species of *Endococrinus*, several of *Metacrinus*, and numerous forms belonging to the Bourguetierinidae, heretofore known as inhabitants of the region only from the somewhat vague reference of KOROTNEFF.

## 2. COMPOSITION OF THE EAST INDIAN CRINOID FAUNA.

The great East Indian region, with its immediate zoögeographic dependencies, is now known to support nearly 400 species of recent crinoids of which about 350 are comatulids and about 50 stalked forms. These are distributed among 82 genera, of which 69 include comatulids and 13 stalked species. These genera are grouped into 19 families, 14 among the comatulids, and 5 to receive stalked species.

All of the species are peculiar to the region; of the comatulid genera 11 are found also in the Atlantic while 14 others have close allies in that ocean, making 25 in all represented there, and leaving 41 peculiar to, and characteristic of, the East Indian region; of the stalked genera five are found also in the Atlantic while two have close allies there, giving a total of seven represented in that ocean, and leaving six peculiar to, and characteristic of, the East Indian region. Taking the group as a whole we find that 16 of the genera occur in the Atlantic as well as in the East Indian region, while of the remainder 16 are represented by closely-allied forms, leaving 50, or nearly two-thirds, as peculiar to, and characteristic of, the East Indian region. Among the families of comatulids eight are found outside of the East Indian region while six, and one of the subfamilies of the Comasteridæ, are exclusively confined to it, while among the families of the stalked forms the numbers are three and two respectively. As a total we find 11 families out of the 19 represented also in the Atlantic while eight are confined to, and characteristic of, the East Indian region.

The preceding analysis graphically brings out the surpassing richness of the East Indian faunal region, but at the same time it somewhat curiously conceals the wealth of the other regions of the world. No families nor subfamilies are known which are not represented in the East Indies, excepting only the Holopida which includes the single genus *Holopus*, but in certain cases the East Indian representation falls far below that in other areas, both in regard to genera and to species. All the genera of the Atlantic, Antarctic, and Arctic Oceans are closely related to East India genera from which they were evidently derived in the remote past; but in many cases a single East Indian genus has apparently given rise to two or more Atlantic genera, all nearly equally related to the parent stock. For instance in the Antedonidae among the Heliometrinæ we find the genus *Cyclometra* in the East Indies, and *Solanometra* and *Promachocrinus* (derived from it) in the Antarctic; and also the genus *Trichometra*, represented both by other species of *Trichometra*

and by *Hathrometra* in the Atlantic, *Solanometra* and *Hathrometra* between them containing more species than all the other genera of the subfamily combined! In the East Indian region we find that 19 of the comatulid genera belong to the suborder Macrophreata, while 50 belong to the suborder Oligophreata; and of the species about 70 are macrophreate, and 280 oligophreate. Taking the remaining regions of the world together, we find the proportions between these two suborders just reversed, and the macrophreate forms far to outnumber the oligophreate, the latter being entirely absent from large areas, such as the Arctic and Antarctic seas and the western coast of North and South America.

A graphic idea of the composition of the East Indian crinoid fauna may be gathered from the following table:—

Families; those not occurring outside of the East Indian region are given in capitals.					Total number of genera in the East Indian region.	Genera also found in the Atlantic.	Genera represented by close allies in the Atlantic.	Genera exclusively confined to the East Indian region.	Species.
Comasteridae	..	..	..	..	10	0	4	6	55
Capillasterinae	..	..	..	..	(3)	0	(3)	0	(17)
Comactiniinae	..	..	..	..	(2)	0	(1)	(1)	(8)
COMASTERINÆ	..	..	..	..	(5)	0	0	(5)	(30)
ZYCOMETRIDÆ	..	..	..	..	3	0	0	3	15
HIMEROMETRIDÆ	..	..	..	..	4	0	0	4	38
Stephanometridæ	..	..	..	..	2	0	1	1	11
PONTIOMETRIDÆ	..	..	..	..	1	0	0	2	3
MARIAMETRIDÆ	..	..	..	..	3	0	0	3	22
COLOBOMETRIDÆ	..	..	..	..	5	0	0	5	41
Tropiometridæ	..	..	..	..	1	1	0	0	3
CALOMETRIDÆ	..	..	..	..	5	0	0	5	12
Thalassometridæ	..	..	..	..	9	2	2	5	54
Charitometridæ	..	..	..	..	6	0	1	5	27
Antedonida	..	..	..	..	16	5	6	5	59
Antedoninae	..	..	..	..	(4)	0	(1)	(3)	(18)
Perometrinae	..	..	..	..	(2)	0	(1)	(1)	(4)
Zenometrinae	..	..	..	..	(4)	(2)	(1)	(1)	(13)
Heliometrinae	..	..	..	..	(2)	(1)	(1)	0	(5)
Thysanometrinae	..	..	..	..	(2)	0	(2)	0	(4)
Bathymetrinae	..	..	..	..	(2)	(2)	0	0	(15)
Pentametrocrinidæ	..	..	..	..	2	2	0	0	10
Atelecrinidæ	..	..	..	..	1	1	0	0	2
<b>Total for all the Comatulid families</b>	..	..	..	..	<b>69</b>	<b>11</b>	<b>14</b>	<b>44</b>	<b>352</b>
Pentacrinitidæ	..	..	..	..	4	1	1	2	28
APIOCRINIDÆ	..	..	..	..	2	0	0	2	2
Hyoeriniidæ	..	..	..	..	4	2	1	1	5
Phrynoocrinidæ	..	..	..	..	1	0	0	1	1
Bourgueticrinidæ	..	..	..	..	2	2	0	0	11
<b>Total for all stalked families</b>	..	..	..	..	<b>13</b>	<b>5</b>	<b>2</b>	<b>6</b>	<b>47</b>
<b>Total for all crinoids</b>	..	..	..	..	<b>82</b>	<b>16</b>	<b>16</b>	<b>50</b>	<b>399</b>

[NOTE.—The figures given in the preceding discussion and in the above table are approximate only; since the discussion was written and the table prepared a

number of new species have been described, chiefly from the collections of the Dutch ship "Siboga." As these new forms do not alter the general conclusions expressed, or the general proportions as brought out by the table, it has seemed best to leave both as originally written rather than to run the risk of error involved in making changes.]

### 3. THE DISTRIBUTION OF CRINOIDS IN THE EAST INDIAN REGION.

In the case of many groups of marine organisms the Indian Ocean and the tropical Pacific, from the east coast of Africa almost to the west coast of America, exhibit everywhere practically the same faunal conditions. The same genera, or even the same species, exist everywhere throughout this great area, and, under similar conditions, are found in the same relative proportions and numbers. A new form first detected in the Hawaiian Islands may next be reported from the Red Sea or from Madagascar, or a new species described from a single specimen taken at Mauritius may prove to be abundant at Formosa or Fiji. But among the crinoids very different conditions obtain. Their sessile habit of life and their fixation as embryos to the pinnules of the adults, and later, as larvæ, to the sea floor or to growths upon it, render them incapable of rapid dissemination and have resulted in the demarkation of numerous zoögeographic areas within an area where, so far as we can see, the average conditions are practically everywhere the same.

Before taking up in detail the distribution of these animals it would be well to consider what barriers would be operative against their dispersal, the better to understand the significance of many of the facts brought out. First of all, the very short free-swimming stage of the young, coupled with the limited bathymetric altitude inhabited by the adults, renders them incapable of crossing wide stretches of deep water, for before they could drift across they would develop and drop to the bottom, dying as soon as they had reached a depth greater than the lowest limit of their restricted normal habitat; moreover, they cannot cross the mouths of wide and deep rivers; they are very sensitive to a change in salinity and, unless a river be shallow, they cannot pass under it.

There is a curious connection between the development of a rich littoral comatulid fauna and a copious rainfall which I have explained by assuming that the rain, which has a powerful toxic effect upon most pelagic animals due to the large amount of dissolved oxygen contained in it, kills and precipitates to the bottom a greatly increased supply of the small organisms which serve as crinoid food. This explains the absence or rarity of littoral crinoids on dry coasts.

The question of food plays a very great part in the local distribution of the crinoids. The small organisms upon which the crinoids feed are mostly lucifugous, but are strongly attracted by the rays at the violet end of the spectrum. I have suggested that this accounts for the common purple or violet coloration of

littoral species which would tend to attract these small organisms. Many crinoids are concentrically banded, and this, too, may attract the smaller marine animals, just as contrast spots on flowers do insects. In the north and in the south the maximum intensity of marine life is at and just below the surface, but in the tropics the lethal effect of the brilliant sunlight forces it downward nearly to the 200-fathom mark. The crinoids, are, of course, affected with the other organisms, but many of them cannot descend to that depth. They therefore lurk in dark holes under rocks, or, especially, in caves or under wharves, the darkness of their surroundings serving the double purpose of protecting them from the pathological effect of the sun's rays and of attracting the lucifugous organisms upon which they feed. This last is an important item, for upon the coast of France it has been noticed that specimens of the common *Antedon bifida* found under rocks are much larger than those found in the open, a condition, like the correlation between size and depth which I have previously discussed,<sup>1</sup> mainly to be accounted for by increased food supply.

Among the crinoids there is no differentiation into a shallow-water and a deep-water fauna comparable to that seen in certain other groups. The littoral or sublittoral character of their original ancestors persists in a marked degree among the present-day species, and there are but very few abyssal groups which do not yet preserve the traces of the line of march by which they descended to the depths. The known species belonging to eight of the 19 families are mainly littoral or sublittoral, while of the remaining 11, three possess a minority of littoral or sublittoral species, one is known to occur within 20 fathoms of the surface, and two within 30, leaving five not known except at considerable depths; these five are the Pentacrinitidæ (from 103 fathoms<sup>2</sup>); the Hyocrinidæ (from 240 fathoms); the Atelecrinidæ (from 552 fathoms<sup>3</sup>); the Apioicrinidæ (from 565 fathoms) and the Phrynocrinidæ (from 649 fathoms); but all of these are only slightly known, and we are justified in supposing that they occur much nearer the surface than present records would indicate.

Of course the deeper down a crinoid genus or family extends the greater will be its geographical range. Uniform conditions, the absence of the littoral barriers, and the ability to attain a progressively more and more perfect circular dispersal figure, due to the absence of strong directive influences such as currents and steady winds which cause the dispersal figure to become elliptical, fan-shaped, or even linear, allow of a rapid dissemination in all directions.

<sup>1</sup> Cf. "The Recent Crinoids and their Relation to Land and Sea," *Geographical Journal*, December 1908, pp. 602—607; also "Some Points in the Ecology of Recent Crinoids," *American Naturalist*, vol. 42, No. 503, pp. 717—726, November 1908.

For a more detailed discussion of the ecology of recent crinoids and the factors influencing their distribution, see *Vid. Med.*, 1909, pp. 115—194; and *Science*, n. s., vol. 29, No. 747, p. 677, April 1909.

<sup>2</sup> But occurring within 5 fathoms of the surface in the West Indies.

<sup>3</sup> Occurring at 450 fathoms in the West Indies.

Owing to the existence of many and varied barriers to the dispersal of the littoral individuals we may confidently assume that when we find a family, genus, or species widely spread along the shores that that species, genus or family, has a considerable bathymetric range, and the reverse. For instance the entire genus *Zygometra* is known only from an area delimited by the northern coast of Australia, the Mergui Archipelago, Singapore, Hong Kong, and the Philippine Islands. We may assume, therefore, that it is confined to the littoral belt, and the facts, so far as they are known, bear us out. Moreover, as it occurs in the Jura of Europe as a fossil, we may assume a past littoral connection between Europe and the East Indies. Upon finding an *Isocrinus* in the West Indies in 5 fathoms and a *Metacrinus* in Japan in 60, we would assume that the Pentacrinitidæ are able to live in deep water, and here again the known facts accord with the deductions. This rule, of course, does not hold good for animals capable of dissemination as pelagic larvæ or eggs.

The East Indian faunal region or, as I have called it, the Indo-Pacific-Japanese, includes the east coast of Africa from Suez to the Cape, and extends thence eastward, embracing the southern shores of Asia, all the shores of Australia and Tasmania (but not New Zealand), reaching the Tonga Islands, Fiji, Samoa, the Caroline Islands, the Philippines, and, to the northward, southern Japan and the Korean Straits. The conditions within this region are far from being uniform. With an area of maximum intensity within a triangle whose apices are Luzon, Borneo, and New Guinea in which 18 of the 19 families (all but the Phrynocrinidæ) and 71 of the 82 genera (all except *Cominia*, *Ptilometra*, *Mastigometra*, *Erythrometra*, *Zenometra*, *Comastrocrinus*, *Carpenterocrinus*, *Calamocrinus*, *Ptilocrinus*, *Hyocrinus*, and *Phrynocrinus*) are known to occur, the fauna extends southward about Australia, becoming modified on the northern coast by a great reduction in the number of species (only about one-eighth of the total number occurring here), the absence of nine families, and four of the five subfamilies of Antedonidæ (Stephanometridæ, Pontiométridæ, Calometridæ, Perometrinæ, Zenometrinæ, Heliometrinæ, Thysanometrinæ, Atelecrinitidæ, and all the stalked families except the Pentacrinitidæ), and the absence of 19 genera (*Comissia*, *Cominia*, *Endiocrinus*, *Catoptometra*, *Himerometra*, *Selenometra*, *Mariametra*, *Cyllometra*, *Pterometra*, *Stenometra*, *Parametra*, *Glyptometra*, *Chlorometra*, *Pæcilometra*, *Strotometra*, *Charitometra*, *Mastigometra*, *Iridometra*, and *Toxometra*); this loss is partly compensated by additional species in the genera *Comatulula*, *Zygometra*, *Comaster*, *Heterometra*, and *Dichrometra*, while these, together with distinctive local species, characterized by curiously exaggerated peculiarities of structure, supplanting the common East Indian forms, in *Comanthina* and *Oligometra*, give to the fauna a definite facies; to the southward attenuation and specialisation increase until on the southern coast we find only seven species, all peculiar to the region, furnished by five genera, of which two are confined to this district (*Comatulella*; *Ptilometra*); these seven species are, *Comatulella brachiolata*, *Comanthus trichoptera*, *Oligometra thetidis*, *Ptilometra macronema*, *Pt. mülleri*,

*Compsometra loveni*, and *C. incommoda*. To the eastward the fauna gradually dies away among the South Sea islands, the littoral genera disappearing first, then those from deeper water. Only the following genera, all from deep water, reach the Hawaiian Islands: *Glyptometra*, *Cosmiometra* (two species), *Parametra*, *Thalassometra* (two species), *Psathyrometra*, *Zenometra*, *Compsometra*, *Trichometra*, *Decametrocrinus*, and *Atelecrinus*. To the northward the fauna gradually becomes attenuated such primarily littoral genera as *Comanthina*, *Zygometra*, and *Craspedometra* not extending beyond Hong Kong, and the primarily tropical species of *Amphimetra* not extending beyond Formosa (Taiwan); along the southern Japanese coast we find a fauna including about one-fifth of the total number of East Indian species, but greatly modified in its general facies, and totally different from the modified fauna which occurs on the northern Australian coast. Whereas in northern Australia nine families and four of the five subfamilies of Antedonidæ are absent, in southern Japan only three families, the Pontiométridæ, Stephanométridæ, and Hyocrinidæ, are lacking, and their loss is compensated by the occurrence of a family peculiar to the region, the Phrynocrinidæ. The missing genera, however, number 29 (*Comissia*, *Comatula*, *Comanthina*, *Zygometra*, *Himerometra*, *Craspedometra*, *Heterometra*, *Selenometra*, *Cenometra*, *Colobometra*, *Oreometra*, *Gephyrometra*, *Ptilometra*, *Pterometra*, *Crotalometra*, *Stiremetra*, *Charitometra*, *Mastigometra*, *Toxometra*, *Zenometra*, *Adelometra*, *Balanometra*, *Trichometra*, *Eumetra*, *Atelecrinus*, *Comastrocrinus*, *Hypalocrinus*, *Proisocrinus*, and *Rhizocrinus*) instead of only 19 as in the case of northern Australia, the difference falling mainly in regard to the shallow-water genera which are unable to maintain a foothold in the uncertain surface temperatures prevalent about southern Japan. It will be noted that the genera which give to northern Australia its distinctive characters are absent from southern Japan, while other genera, represented by curious local species in Australia, are unrepresented, or represented by species entirely lacking the exaggerated special characters distinctive of those from Australia. The loss of East Indian genera in southern Japan is partially made up by the local development of four genera confined to the region (*Cominia*, *Carpenterocrinus*, *Erythro-metra*, and *Phrynocrinus*, the last named being the representative of a distinct family). The southern Japanese fauna is remarkable for the great development of Calometridæ, Thalassometridæ, and Charitometridæ, and of local species in the genus *Catoptometra* and in the *Bennettia* group in *Comanthus*, three of the five known species of the former and three of the seven of the latter being peculiar to the region. It is curious that about 80% of the crinoids known from southern Japan are peculiar to that district, while almost all of those inhabiting the north coast of Australia are immigrants from the north.

Our knowledge of the crinoid fauna on the west coast of the Malay Peninsula is as yet very insufficient; but from the indications it would seem that the coast from Singapore to the Irrawaddy river, including the Mergui Archipelago, the Andaman and the Nicobar Islands, was essentially the same in character as the coasts of Borneo or of the Philippines, though poorer in species. One new genus



(*Comastrocrinus*) appears at the Andamans, and is the only stalked crinoid known from the region. This district limits the westward extension of the Zygometridæ, the Pontiométridæ, the genus *Mariametra* of the Mariametridæ, the Calometridæ, and the Zenometrinæ; of the family Zygometridæ the genus *Zygometra* is found in the Mergui Archipelago, and *Eudiocrinus* in the Andamans; *Pontiometra* occurs in the Mergui Archipelago, while *Psathyrometra* and *Neometra* are known from the Andamans. A significant feature is the absence of the family Apioeriniidæ, and of the following 18 genera, which are found no further west: *Comatula*, *Comantheria*, *Catoptometra*, *Asterometra*, *Stenometa*, *Stiremetra*, *Parametra*, *Glyptometra*, *Chlorometra*, *Pacilometra*, *Charitometra*, *Strotometra*, *Compsometra*, *Toxometra*, *Balanometra*, *Thysanometra*, *Hypalocrinus*, and *Metacrinus*, as well as of the large species of *Tropiometra*.

The general trend of the East Indian fauna is now directly across the Bay of Bengal to Ceylon, the coast line to the north of the mouths of the Irrawaddy, and to the north of Ceylon being very poor in crinoids and supporting only a few common and very wide-ranging species, or representatives of a few very common and wide-ranging genera.

About the coasts of Ceylon and in the Maldive and Laccadive Archipelagoes are found 30 species of crinoids representing 21 genera and nine families (Comasteridæ—*Comatella*, *Capillaster*, *Comissia*, *Comaster*, *Comanthina*, *Comanthus* (*Vania* group); Himerometridæ—*Amphimetra*, *Himerometra*, *Heterometra*; Stephanometridæ—*Stephanometra*; Mariametridæ—*Dichrometra*, *Selenometra*; Colobometridæ—*Cenometa*, *Decametra*, *Colobometra*, *Oligometra*; Tropiométridæ—*Tropiometra*; Thalassometridæ—*Pterometra*; Antedonidæ—*Mastigometra*, *Trichometra*; Pentaerinitidæ—*Comastrocrinus*); besides these, 11 genera representing three additional families occur both to the eastward and to the westward of Ceylon and undoubtedly exist there; these are, the *Bennettia* group of *Comanthus*; *Craspedometra*, *Cyllometra*, *Thalassometra*, the Charitometridæ (*Pachylometra*), and *Perometra*; and *Cyclometra*, *Thaumatometra*, *Bathymetra*, the Pentametrocrinidæ (*Pentametrocrinus*), and the Bourgueticrinidæ (*Rhizocrinus*); a single species, *Himerometra persica*, is known from either side of Ceylon but has not yet been found there. Adding these, the crinoid fauna of Ceylon may be considered as made up of 32 genera, representing 12 families.

Ceylon is the only definitely ascertained habitat of the genus *Mastigometra* which, however, undoubtedly occurs to the eastward. Including the Maldive and the Laccadive Islands, Ceylon marks the furthest westward extension of the genera *Comanthina*, *Pterometra* and *Comastrocrinus*, and all of the very large highly multibrachiate species of all genera such as *Comatella*, *Capillaster*, *Comaster*, *Comanthina*, *Comanthus*, *Amphimetra*, *Himerometra*, *Heterometra*, *Stephanometra* and *Cenometa*, and of the large species of such genera as *Colobometra* and *Oligometra*.

Like the fauna of the Andaman Islands and the Malay Peninsula, that of Ceylon is not characterized by a development of endemic or curious sporadic

forms; there are only a few (possibly in reality no) species not found elsewhere, and these are not greatly different from others either to the east or to the west. The partial "explosion" of the faunal units seen in northern Australia and southern Japan is totally absent here.

On going westward from Ceylon we find that the fauna undergoes a curious segregation of its component genera and species, one section extending northward along the coast of Persia and Arabia to the Red Sea, and the other southward and westward to south-eastern Africa, reaching the region from Mombasa south to Cape Colony.

In the Red Sea region we find a fauna composed of 18 species, representing 16 genera distributed among 11 families; these are: Comasteridæ—*Comanthus* (*Vania* group); Himerometridæ—*Craspedometra*, *Heterometra*; Stephanometridæ—*Stephanometra*; Mariametridæ—*Dichrometra*; Colobometridæ—*Decametra*, *Colobometra*, *Oligometra*; Tropiometridæ—*Tropiometra*; Thalassometridæ—*Thalassometra*; Charitometridæ—*Pachylometra*; Antedonidæ—*Iridometra*, *Thaumatometra*, *Cyclometra*; Pentametrocrinidæ—*Pentametrocrinus*; Bourguetierinidæ—*Rhizocrinus*.

The genera *Himerometra* and *Cyllometra* reach the Persian Gulf, but not the Red Sea.

All of these genera are widely distributed, none being characteristic of the region; but of the species 13 out of the 18 are found nowhere else. Another interesting feature is that, with one exception, each genus is only represented here by a single species which, when characteristic, is smaller than the average of the species in the same genus elsewhere.

Along the south-eastern coast of Africa, from Mombasa southward to the Cape, including Madagascar, Mauritius, and the other outlying islands, there exists a richer fauna. Here are found 22 species distributed among 18 genera, which, strictly speaking, should be considered as four more than the number inhabiting the Red Sea region, for no opportunity has offered for determining the presence of *Thaumatometra*, *Cyclometra*, *Rhizocrinus*, or *Pentametrocrinus* here, though doubtless they occur. These 18 genera represent nine families, as follows: Comasteridæ—*Comatella*, *Capillaster*, *Comissia*, *Comanthus* (*Vania*, *Bennettia*); Himerometridæ—*Amphimetra*, *Craspedometra*, *Heterometra*; Stephanometridæ—*Stephanometra*; Mariametridæ—*Dichrometra*; Colobometridæ—*Cenometra*, *Decametra*, *Oligometra*; Tropiometridæ—*Tropiometra*; Thalassometridæ—*Thalassometra*, *Cosmiometra*; Charitometridæ—*Pachylometra*; Antedonidæ—*Iridometra*, *Perometra*. Of the 22 species 18 are confined to the region while four occur in Ceylon, three of these ranging also much further east. All of the genera are very widely spread throughout the East Indian region, and all of the species are related to corresponding species in the East Indies, there being no widely divergent forms as in northern Australia. *Comanthus* (*Bennettia*) *wahlbergii*, which occurs about the southern extremity of Africa and as far north as Natal, is

related to *C. (Bennettia) trichoptera* of southern Australia, denoting a southern sub-region distinct from that of the rest of the south-eastern coast.

Beyond the east coast of Africa, the Mediterranean Sea and the coasts of Europe as far north as Norway are inhabited by an extremely attenuated fauna derived directly from the East Indian, characterized by *Antedon* (closely related to *Mastigometra*) and *Leptometa* (closely related to *Psathyrometra*) as well as by *Bathyrinus recuperatus*, which is close to *B. paradoxus*. It is very curious that this fauna should be characterized by forms all of whose nearest relatives are found in the Bay of Bengal and are absent from the seas to the westward of Ceylon, and it is equally strange that the fossil crinoid fauna of Europe, in so far as it is comparable to the recent, should also agree with the fauna of the region of the eastern part of the Bay of Bengal and the districts to the east and south. It seems almost certain that the crinoid fauna of Europe has reached its present location by passing north of India (or at least of southern India), avoiding the present basin of the Arabian Sea and, originally almost as rich as that of the East Indies to-day, has been gradually altered by the disappearance of such forms as were unable to adapt themselves to the changing conditions, eventually becoming reduced to its present dimensions.

The south-east African fauna reappears in a slightly modified form off north-western Africa and south-western Europe, extending thence westward to and throughout the West Indies. Almost all of the genera have become somewhat altered so that they are not quite the same as their East Indian progenitors, but the alteration has never progressed far enough to obscure their affinities. The West Indian genera with their East Indian ancestors are as follows:—

EAST INDIAN GENUS.		CORRESPONDING WEST INDIAN GENUS.
Comasteridæ.		
<i>Capillaster.</i>		<i>Nemaster.</i>
<i>Comatella.</i>		<i>Neocomatella.</i>
<i>Comissia.</i>		{ <i>Leptonemaster.</i>
<i>Comatula.</i>		{ <i>Comatilia.</i>
		<i>Comactinia.</i>
Stephanometridæ.		
<i>Stephanometra.</i>		<i>Analcilometra.</i>
Thalassometridæ.		
<i>Cosmiometra.</i>		<i>Stylometra.</i>
Charitometridæ.		
<i>Pachylometra.</i> }		<i>Crinometra.</i>
<i>Glyptometra.</i> }		

Antedonidæ.	
<i>Perometra</i> <i>Psathyrometra.</i> <i>Thysanometra.</i>	<i>Hypalometra.</i> <i>Zenometra.</i> <i>Coccometra.</i>
Pentacrinitidæ.	
<i>Comastrocrinus.</i> } <i>Metacrinus.</i> }	<i>Isocrinus.</i>

To the southward certain of the East Indian genera have extended, undergoing various curious changes, forming an Antarctic fauna. This Antarctic fauna has crept up the west coast of South and North America, passing into deep water in the tropics, and now is found in the Bering Sea and along the Pacific coasts of the Kuril Islands and of Japan, as far south as Tokyo Bay. The Arctic and north Atlantic Oceans, from western Greenland and Nova Scotia to northern Norway and as far east as the Kara Sea, contain a similar fauna, which, curiously enough, is found also in the Okhotsk Sea, the Gulf of Tartary, and along the western coast of the Sea of Japan as far south as Korea, where it replaces the Antarctic fauna which is confined, in the north, to the open Pacific Ocean and to the Bering Sea.

The genera inhabiting very deep water in the Indian Ocean are, almost all of them, found also under the same conditions in the Atlantic, but they do not, except *Bathyrinus*, enter the deep cold pools such as that north of the Wyville Thomson ridge. Contrary to what is found in many groups, the Atlantic species always differ from those occurring in the Pacific.

It has been mentioned that the geographic range of a genus and species increases proportionately to the depth inhabited by that genus or species. Not only do genera or species which extend from the shore line down to 200 fathoms or so have a range much greater than those which do not extend downward half as far, but the genera and species confined to the deeper water also participate in this increased range.

Taken as a whole the East Indian crinoid fauna may be roughly divided bathymetrically into (1) a Littoral, (2) an Intermediate, and (3) an Oceanic section; but these different sections are not so well differentiated as is the case with most bottom inhabiting marine organisms.

The Littoral groups have the most restricted distribution, as is exemplified best by the Zygometridæ; but the Capillasterinæ are in general almost as strictly littoral in the East Indies, yet occur only at intermediate depths (with two littoral records) in the West Indies, and the same is also true of several other groups.

The Intermediate fauna is characterized chiefly by the families Thalassometridæ, Charitometridæ, Atelecrinidæ and Pentacrinitidæ; and certain genera of Bourgueticrinidæ, Zenometrinæ and Heliometrinæ; but three species of the Thalassometridæ are littoral, one species of the Charitometridæ comes within 30 fathoms of the surface, one of the Pentacrinitidæ within 5, and several of the two antedonid subfamilies are sublittoral. Taken broadly, the Intermediate

fauna shows exactly the same features of distribution as does the Littoral, though we must enlarge the area of maximum intensity so as to make the apices of the triangle Ceylon, the Kermadec Islands, and southern Japan, and magnify the ranges of the component genera in the same proportion. Whereas southern Japan, Fiji, northern Australia, and the east coast of Africa mark roughly the attenuated outer limits or fringe of the East Indian Littoral fauna, for the Intermediate we must enlarge these boundaries to include the western Aleutian Islands, the Hawaiian Islands, the Galápagos Islands, the Kermadec Islands and, properly speaking, on the west the West Indies.

The Oceanic fauna is but an exaggerated derivative from the Intermediate, and can no more be definitely distinguished from the Intermediate than the Intermediate can from the Littoral. Its chief character is given by species of *Bathyrinus* (Bourgueticrinidæ), *Bathymetra* (Antedonidæ, Bathymetrinæ), and *Thalassometra*, and by the family Pentametrocrinidæ. Species of most of these Oceanic groups occur everywhere in very deep water, except in enclosed cold and stagnant basins, but each of the groups include species living in Intermediate, or even quite Littoral depths.

Although *Bathymetra* is found in the Pacific at 2,900 fathoms it does not occur at all in the north Atlantic, while *Thalassometra* does not occur at all on the American side of the Atlantic, and only south of the Bay of Biscay on the European side.

Whereas the large littoral crinoids are confined to the central East Indian region and the representatives of the groups including them become smaller as one moves away from this area, the crinoids of the Intermediate zone, though they decrease gradually in size to the westward, increase to the eastward and northward so that the largest species are found in northern Japan, the Hawaiian, or the Galápagos Islands.

There is one zoological principle well brought out by the crinoids of the East Indian region which I cannot remember to have seen stated anywhere, though it is equally well shown in many groups, both terrestrial and aquatic, and that is, that in all natural genera which are adequately known, and sufficiently well represented in the present fauna, there exists typically a single species which covers the entire range inhabited by all the other species of the genus collectively. This species is always the most variable, individually, of all contained within the genus and, if the species of the genus be arranged according to the development of the specific characters in them, this species typically falls midway between the two extremes. In each family also there is typically to be found a genus which in every way corresponds to this species.

It is noteworthy that in the case of most, if not all, species, individuals from the outskirts of its geographical range are the most variable, the coefficient of variability decreasing toward the centre; and in each natural genus the species inhabiting the extremes, bathymetrical or geographical, of the genus as a whole exhibit the same peculiarity.

It is possible, through a detailed study of the component species of the various subregions which collectively make up the East Indian faunal region, to arrive at definite conclusions in regard to their comparative age; for faunas, like individuals, species and genera, pass through a period of youth, of adolescence, of maturity, and of senescence.

In a very young fauna the various genera are represented by several species each, and each of these species is very variable; all of the species are near the mean in their respective genera, none being highly specialized and none retrogressive.

Introduced species which become acclimated and thrive in their new surroundings are found to be, where they have been studied, exceedingly variable. This is equally true in regard to fish, birds, mammals, molluscs and insects, and probably holds good throughout the animal kingdom. We have numerous illustrations of this in such animals as have been introduced into North America from Europe, Africa and Asia.

A young fauna is in effect a fauna composed of species all of which are recently introduced and all of which, maintaining themselves under optimum conditions, with a minimum of parasites and predaceous enemies and a maximum of food, are able greatly to increase their coefficient of variation.

Adolescent faunas exhibit a comparative stability of specific types, coupled with the incipient formation of new genera as a result of a growing tendency of the species to depart widely from the generic mean.

In mature faunas the species are fixed, save only for the species at the mean of each genus, which always remains variable, and new generic types are found which have become separated off from the parent genera through the suppression of intermediates, or have arisen by discontinuous variation. As a result of the formation of these new generic types the number of species in each genus is diminished, and the species are found to approach more or less closely the means of the original genera, or the means of the genera newly formed.

Senescent faunas have lost a considerable proportion of the genera which they possessed at maturity; the genera which remain include aberrant species in which certain characters have become greatly exaggerated, giving to these species a curiously unbalanced appearance. There is typically but a single species in each genus; but there may be two or more, each with a different set of characters exaggerated, in which case they are usually treated as aberrant monotypic genera.

A pathological fauna may resemble a senescent fauna in its general facies; but in a pathological fauna all the species, besides being aberrant, are excessively variable, which is never the case in a senescent fauna. Pathological faunas occur usually on the limits of faunal areas, or on the boundary between two very different faunal areas, and are composed in the latter case of intrusive species from both the adjacent areas.

Occasionally faunas are found which combine the characteristics of two or more of the faunas described above; these are rejuvenated faunas, faunas which

have progressed to the extreme point indicated (or perhaps slightly further) and then have been subjected to some change in environmental conditions which has served as a stimulus and sent a greater or lesser part of the fauna some distance back along the phylogenetic faunal path.

The fauna of the Bering Sea appears to be a very young fauna. The crinoids of the shallower waters here are abundant, but all the species, which are very variable, belong to the genus *Solanometra*, an intrusion from the antarctic regions. Of the other echinoderms the starfish present a wealth of forms maddening to the systematist; the number of varieties and of incipient and valid species produced from the *Ctenodiscus*, *Hippasteria*, *Solaster*, *Henricia*, and other types is almost incredible. Conditions are the same among the echinoids and among the ophiuroids, and apparently among many, if not most, other animal groups as well. Yet with all this variability there is but a slight tendency to produce pathological, defective, or unbalanced types, types which depart widely from the generic mean as calculated from a study of the same genera in other areas.

So far as the crinoids are concerned the antarctic region is very young; here we have *Solanometra* and *Promachocrinus* (the latter merely differing from the former in the doubling of all the radials) each with several very variable species, though none so variable as the Bering Sea representatives of the same group.

The crinoid fauna of southern Japan might be considered as an adolescent fauna; here we find many genera including several species, each very stable and showing comparatively little variation, such as *Catoptometra*, *Comanthus*, *Dichrometra*, *Parametra*, *Pectinometra*, *Thaumatometra* and *Pentametrocrinus*, while *Erythrometra*, *Nanometra*, *Calometra*, *Carpenterocrinus* and *Phrynocrinus* are not known elsewhere though the two last, being from deep water, probably occur to the southward.

The West Indian crinoid fauna appears to be approximately a mature fauna. It contains a number of peculiar genera, while almost all of the East Indian genera which occur here have become more or less differentiated from the original stock forming new genera parallel to the original East Indian types.

The Australian fauna is a perfect example of a senescent fauna. It includes about fifty-five species, nearly all of which are remarkable for the grotesque exaggeration of their specific characters. Even in certain wide-ranging forms, such as *Comatula solaris* or *C. pectinata*, Australian specimens have their characters greatly accentuated over those from other regions.

A rejuvenated fauna is indicated by the crinoids about the shores of the large East Indian Islands; some of these approach, in the exaggeration of their specific characters, the Australian species, while others are very generalized with several closely related forms. The crinoid fauna of western Europe is also a rejuvenated fauna; in the case of each of the two component genera the more primitive species are found in the Mediterranean Sea.

It is possible to analyze a fauna on the basis of a single character in a group.

Suppose, for instance, we take the type of the centrodorsal in the Comasteridae. This organ differs in the several genera and species composing the family only in the degree of specialization, the development lines being everywhere the same. In some species, as in *Comanthus bennetti*, the centrodorsal always remains essentially as in the young, but increases in size throughout the life of the individual. Usually, however, resorption takes place at the dorsal pole which is gradually planed off, as it were, so that the centrodorsal changes from the primitive hemispherical form and becomes discoidal, the rows of cirri dropping off as the sockets are resorbed. In extreme cases the resorption results in reducing the centrodorsal to a thin stellate plate without any traces of cirrus sockets, counter-sunk within the centre of the dorsal surface of the radial pentagon.

We may arrange all comasterid centrodorsals in a linear series, calling the least developed (*Comanthus bennetti*) type A, and the atrophied stellate disk D, B and C denoting intermediate stages.

Now the species of the Australian fauna have centrodorsals which run from A to D, but with especial emphasis on the D; the species of the East Indian fauna also run from A to D, but the emphasis is between B and C; the Japanese species run from A to C, with especial emphasis at B; the West Indian and the East African species are confined between B and C. This holds good regardless of the subfamily or genus to which the species may belong, and exactly the same thing may be worked out in regard to other characters in this family, and with other characters in other families.

The recent crinoids of the Australian coasts are evidently senescent, unmistakably indicating very great age. The crinoids of Australia came from the northward, from the great East Indian archipelago; but here continual changes in the distribution of land and sea have constantly rejuvenated the fauna so that none of its component species has been permitted to drift into the peaceful old age so obvious in almost all of the species along the Australian shores.

The fossil crinoids of Europe (belonging to genera still existing) appear to be senescent; but they are no more so than, if as much as, the recent crinoids of Australia. Judging from the evidence offered by the recent forms alone the European crinoids reached the European seas by passage from what is now the Bay of Bengal north of what is now India, or at least southern India. It was probably before this that the same genera spread southward from the parent central East Indian region to Australia.

The crinoids of south-eastern Africa represent a comparatively young fauna; they must have reached their present habitat by passage south-westward from Ceylon along a more or less complete land bridge since submerged; but few of them have as yet entered the Arabian Sea.

The West Indian fauna is younger again than that of the south-eastern shores of Africa from which it was derived. It must have reached the West Indies by following a land which extended from Madagascar to the Antilles, north of what is now southern Africa.



The fauna of southern Japan is apparently younger than that of the West Indies.

The central sea connecting the Bay of Bengal with central Europe had an arm stretching northward across Russia. Certain adaptable genera, becoming acclimated, followed this arm northward and gave rise to the present arctic fauna. More recently one of these genera has spread southward over the north Atlantic.

At a considerably later date a connection was formed whereby the East Indian crinoids, becoming slowly acclimated, reached the antarctic regions. There was also a connection between the antarctic regions and southern South America, whereby these forms secured a foothold on the western coast of that continent spreading rapidly northward to the Aleutian Islands (dipping downward into deep water when passing under the tropics), and thence southward along the east coast of Japan to Tokyo Bay. The antarctic fauna is apparently the youngest of all the existing faunas, and the evidence of youth increases as we go northward along the American coast.

There are two significant facts in connection with the distribution of the recent crinoids which should be noticed, though the data so far accumulated is not sufficient to admit of definite and conclusive statements in regard to them. The north Atlantic lacks certain deep water and intermediate forms which occur in the south and central Atlantic, its fauna being composed of species all primarily inhabitants of shallow water, though some of these deep-water and intermediate forms have worked northward along the east American coast to Greenland. We might infer from this that there was a land barrier across the mid-Atlantic at one time and that the sea to the south of this barrier received its crinoids both from the East Indian littoral and from the deeper parts of the Indian Ocean, while the sea to the north received only shallow-water species which came both from the Mediterranean region and from the arctic. While the time since the complete removal of this barrier has been insufficient for the southern forms everywhere to extend their ranges into the north Atlantic, some, aided by currents, have been able to do this in the western part.

In the Pacific we find a similar condition. There is no continuity between the north and the south except along the western coast of South and North America, and in the abysses, the species in which might just as well have spread from south to north in the eastern part as in the western. Apparently there was a great tropical barrier, a continent or an archipelago lying in a shallow sea, which prevented the northward extension of southern forms in the western Pacific though this has been permitted in the eastern portion of that ocean.

#### 4. DISTRIBUTION OF THE EAST INDIAN CRINOIDS BY FAMILIES.

##### *Comasterida.*

Species of the family Comasteridæ occur throughout the East Indian region, giving to its fauna one of its most distinctive characteristics. The great majority of these species are littoral and sublittoral, occurring from the low tide mark down to a depth of usually less than 50 fathoms. Small species of the family are found everywhere, but the large species with very numerous arms are almost all confined to the area lying between the northern coast of Australia, the Nicobar and Andaman Islands, Luzon and New Guinea, a very few, more hardy or more enterprising than the rest, extending to Ceylon and the Maldivé Islands on the west, Fiji on the east, and to Japan on the north. In this district, also, are found the smallest species, showing that the extremes within a single family, as we have seen the extremes within the whole class, do not wander far from the area offering the optimum conditions for existence, only the more generalized medium-sized types being sufficiently adaptable to enable them to intrude into new territory.

Of the three subfamilies, the Comasterinæ, which contains the largest and most multibrachiate, as well as the smallest species, is the most restricted, both geographically and bathymetrically. This subfamily occurs from East Africa to Tasmania and South Australia, Samoa, Tonga, Fiji and Japan—even a single one of its species covering most of this territory—but of its 30 species 18, or nearly two-thirds, are confined to the centre of the East Indian region. Only three of the species are known to occur deeper than 50 fathoms, and these are all from southern Japan, and all species peculiar to that region.

The subfamily Comactiniinæ is especially characteristic of Australia, and five of the eight species are confined to the shores of that continent, or at most occurring in southern New Guinea. One species ranges north to Singapore and the Philippine Islands, and another even reaches Hong Kong, while a curious form is only known from the Andaman Islands. The single species of the genus *Cominia* occurs in the Korean Straits. Though mostly littoral and sublittoral, one species (*Cominia decameros*) extends downward to 170 fathoms. Curiously enough, though so restricted in geographical range in the East Indies, this subfamily reappears in the Caribbean Sea ranging on the American Atlantic coast from Brazil to Carolina.

The species of the subfamily Capillasterinæ are somewhat more general in their distribution than are those of the other subfamilies. Representatives of all the three genera occur from south-eastern Africa to the South Sea Islands and Japan, and are found from the shore line down to 60 (*Comissia*), 140 (*Comatella*), and 160 (*Capillaster*) fathoms. Each of these genera has a close ally in the tropical Atlantic (*Leptonemaster*, *Neocomatella*, *Nemaster*).

*Zygometridae.*

The family Zygometridae has a singularly restricted habitat, all the species being confined within an area delimited by the northern Australian coast, the Andaman Islands, and the Mergui Archipelago, the Philippine Islands, Hong Kong, and southern Japan. Like the Comasterinæ it is not represented in the Atlantic, but many species, representing all the three genera, occur as fossils in the later horizons of Europe. I have already suggested that the genera of this family and those of the Comasterinæ, which occur fossil in Europe, as well as the recent genus *Leptometra* which evidently was derived from *Psathyrometra* through such species as *Ps. gracillima* and *Ps. mira*, and *Antedon*, probably reached Europe by passage "overland" north of what is now India.

Of the three genera of the family inhabiting the recent seas, *Catoptometra* has the most restricted range, occurring only from the Philippine Islands to Japan. *Eudiocrinus* inhabits the same area, but extends also to the Moluccas and the Andaman Islands. *Zygometra* is more southern, occurring abundantly on the northern coast of Australia, and thence northward to the Mergui Archipelago, Singapore, Hong Kong and the Philippine Islands, its distribution closely paralleling that of *Comatula solaris* and *C. pectinata*.

All of the species composing this family are primarily inhabitants of shallow water; only three of them, all belonging to the genus *Catoptometra*, and all occurring in, and peculiar to, southern Japan pass the 60-fathom line, and the greatest depth is only 153 fathoms (*C. harilaubi*).

*Himerometridæ.*

As we found to be the case with the Comasterinæ and the Zygometridae, all of the species of the Himerometridæ are confined to the East Indian region. The distribution of the family very closely resembles that of the Comasterinæ, and as a whole it covers exactly the same area, occurring from the east coast of Africa to northern Australia and Japan. All of the species are littoral, none extending deeper than 50 fathoms. Of the 38 species 23, or about two-thirds, are confined to the region limited by the northern coast of Australia, the Andaman Islands, Singapore, the Philippine Islands, and New Guinea. This number includes almost all of the ten-armed species, and also nearly all of those with a very great number of arms, each type being an equally great deviation from the family mean, or the average for the family. Outside of this area the species are of medium size and have about twenty-five arms.

The genus *Amphimetra* is found throughout the range of the family, from east Africa to Japan, *Craspedometra* and *Heterometra* occur from east Africa to northern Australia, Hong Kong, and the Philippine Islands, while *Himerometra* is known from the region between the Persian Gulf and the Philippine Islands, not being found in Australia; a single species, *H. persica*, covers the entire range inhabited by the other seven species of the genus, besides extending further to the westward than any of them.

*Stephanometridæ.*

The range of the family Stephanometridæ is from the east coast of Africa to northern Australia, Tonga, Fiji and the Philippine Islands, and here again one of the eleven species covers the range of all the others, though west of Ceylon its character becomes somewhat changed. The species of the Stephanometrinæ are exclusively littoral, the greatest recorded depth for any one of them being 35 fathoms. All of the large species, or the species in which the generic characters have become greatly accentuated, are confined to the Philippines, Moluccas, and the Solomon Islands, while the more extreme genus, *Oxymetra*, is not known except from the Philippines.

The family is represented in the western Atlantic by the genus *Anulcidometra*, a curious type first confused with the genus *Oligometra* (*O. caribbea*).

*Pontiometridæ.*

Only three species belonging to the family Pontiometridæ are known, all of them being confined to the central East Indian region; one only is known from outside of the Philippine Archipelago, this (*Pontiometra andersoni*) reaching the Andaman Islands, the Mergui Archipelago, New Caledonia, and the Pelew Islands. The family is exclusively littoral, reaching a maximum depth of only 58 fathoms, one of the two genera, however, not being known beyond 24.

*Mariametridæ.*

The family Mariametridæ is confined entirely to the East Indian region, but its species are widely distributed, being found everywhere except in southern Australia and the extreme south of Africa. Two of the three genera, however, are restricted in their range, *Selenometra* occurring only between the Andamans, New Britain, and the Philippine Islands, and *Mariametra* between the Andaman Islands, the Macclesfield Bank, and Japan. All of the species are littoral, only one, a Japanese species, extending downward beyond 40 fathoms, and that only to 59. As usual, all the very large or otherwise remarkable species are confined to the region between northern Australia and the Philippines.

*Colobometridæ.*

Although all the species are confined to the East Indian region, the genera composing the family Colobometridæ, five in number, have each a very wide range. The family as a whole occurs from east Africa to northern Australia and southern Japan; *Oligometra* and *Decametra* are found everywhere throughout this area; *Cyllometra* occurs from the Persian Gulf to northern Australia and Japan; *Colobometra* ranges from the Red Sea to Australia and the Philippine Islands; and *Cenometra* is found from the Seychelles and Mauritius to Australia and the Philippines. Most of the species are littoral, though the average habitat is rather deeper than is the case with the majority of the preceding families; the

maximum depth attained is 140 fathoms. As with the preceding families, the large or remarkable species are confined to the region between Australia and the Philippine Islands.

*Tropiometridæ.*

The family Tropiometridæ includes but a single genus, *Tropiometra*, which itself contains only four species, three very closely related and one very distinct, much larger than the others (*T. afra*). This larger species occurs from Queensland to Japan, reaching a depth of 50 fathoms; the other species range from the South Sea Islands and China to East Africa where they are found from Suez to the Cape, and from West Africa to Brazil, the West Indies, and Venezuela. Although the genus is almost everywhere confined to very shallow water, in the Lesser Antilles the local species (*T. picta*) is only found at very considerable depths, and, as the same is true of another widely different littoral species in the same region (*Nemaster lineata*), we seem to have here evidence suggesting that those islands have gradually subsided, carrying down these two littoral forms to a level which, though once the coast line, is now more than 100 fathoms beneath the surface.

*Calometridæ.*

The family Calometridæ is exclusively confined to the East Indian region, the species occurring from the Andaman to the Ki and Philippine Islands, and thence northward to Japan; the bathymetric range is from 20 to 240 fathoms so that, while not littoral, the family occurs only at moderate depths, the average being about 95 fathoms. One of the genera is only known from southern Japan in 107—139 fathoms (*Calometra*); another only from the Ki and Philippine Islands in 140—240 fathoms (*Gephyrometra*); a third from Japan and the Philippine Islands in 53—160 fathoms (*Pectinometra*); a fourth from the Andaman and Philippine Islands and Japan in 20—110 fathoms (*Neometra*); while the habitat of the fifth is quite unknown. The first known species was described in 1888, and all of the others have been described within the last three years.

*Thalassometridæ.*

The family Thalassometridæ occurs from the Bay of Biscay and the Caribbean Sea to the islands south of Africa, and from the east coast of Africa throughout the Indian and Pacific Oceans, reaching southern Australia and the Galápagos Islands, Hawaii, and the western Aleutian Islands. Within the East Indian area it includes 54 species distributed in nine genera, and ranges bathymetrically from the shore line down to 1,600 fathoms.

The genus *Thalassometra* includes, in the East Indian region, 17 species occurring in water of from 30 to 1,600 fathoms, being most abundantly represented between 300 and 500, but common as far as 800 fathoms. It is known from Arabia, South Africa, and the Crozet Islands to south-eastern Australia, the Galá-

pagos Islands, Hawaii, and the western Aleutian Islands. Several species are known from the deeper parts of the Atlantic also. On the outskirts of its range the species keep near to or below the bathymetric average of the genus, not occurring above 300 fathoms, but occurring from that depth down to 1,600. In the central East Indian region two species are known from only 30 fathoms but, on the other hand, none descend deeper than 650 fathoms.

All of the nine other genera of the family which occur in the East Indian region are peculiar to it, and the range of most of them is quite restricted, at least geographically.

*Cosmiometra*, next to *Thalassometra*, is the most widely spread; while it does not itself occur in the Atlantic, it has a close relative there (*Stylometra*). Found in the south-western part of the Indian Ocean, *Cosmiometra* extends to northern Australia, the Hawaiian Islands, and southern Japan, ranging in depth, so far as is known, between 136 and 319 fathoms, both of these extremes being found in the Hawaiian Islands.

The genus *Stiremetra* is interesting in having the greatest range in depth of any comatulid genus, from the shore line down to 1,350 fathoms. Its four species are found from New South Wales and Queensland to Fiji, the Kermadec Islands, and the Philippines.

The genus *Ptilometra* occurs only in shallow water (down to 35 fathoms) about the coasts of southern Australia, being represented in the Philippines and thence east to Ceylon by the closely allied genus *Pterometra* which is found in water from 37 to 58 fathoms in depth. Another closely allied genus is *Asterometra*, found from northern Australia to the Ki and Philippine Islands and southern Japan in depths of from 28 to 140 fathoms.

The genus *Crotalometra* is found from the Meangis and Kermadec to the Philippine Islands in depths of from 340 to 630 fathoms, *Stenometra* occurs in the Ki Islands, the Philippines, and in southern Japan, in water from 80 to 170 fathoms deep, and *Parametra* ranges geographically from the Ki and Philippine Islands and southern Japan to the Hawaiian Islands and bathymetrically from 97 certainly to about 200 fathoms, possibly to 352.

#### *Charitometridæ.*

The distribution of the Charitometridæ closely parallels that of the Thallasometridæ though it is somewhat more restricted, but, while the average depth inhabited by the species is about the same, none of them are found in such deep water as are those of the latter, and neither are there any littoral species, though one comes within 30 fathoms of the surface.

Geographically, members of the family are found from the Hawaiian and Meangis Islands and southern Japan to the Red Sea, and also in the West Indies, all these localities supporting representatives of the genera *Pachylometra*, *Glyptometra*, or *Crinometra*, three genera which are very closely related and which, for purposes of zoögeography, may well be considered as one. Collectively, they are

approximately the equivalent of the thalassometrid genus *Thalassometra*. It is in the genus *Pachylometra* that each extreme of depth is found, one species occurring in 30 fathoms, another in 1,200. The remaining four genera, *Chlorometra*, *Pacilometra*, *Strotometra*, and *Charitometra*, each composed entirely of ten-armed species, and including between them only nine of the 28 East Indian species, are only found between the Meangis Islands and southern Japan in water of between 95 and 630 fathoms in depth.

#### *Antedonidæ.*

Strictly speaking, the family Antedonidæ as at present constituted is the macrophreate equivalent of all the oligophreate families combined, each of its subfamilies being in reality comparable to an oligophreate family; but these subfamilies must be united under one general family heading in order properly to show the relationships of the Pentametrocrinidæ and Ateleerinidæ, both of which are closely akin to the true antedonid type, yet differ profoundly from it in fundamental points of structure. Species of the Antedonidæ occur everywhere, on all shores, in the warmest and coldest water, and from between tide marks down to 2,900 fathoms. All of the subfamilies occur in the Atlantic as well as in the Indian Ocean, and all of them reach the American side. In all the extra-tropical regions, excepting only the southern shores of Australia and Africa, as well as on the tropical west American coast, the Antedonidæ supply almost all, in many places quite all, of the endemic species.

The subfamily Antedoninæ among the macrophreate forms corresponds in many ways to such families as the Comasteridæ or Himerometridæ among the oligophreate. The four genera included in the subfamily are composed entirely of small littoral species ranging collectively from southern Japan, the Hawaiian Islands, Tonga, Fiji, and southern Australia to the east coast of Africa, and in depth ranging from the shore line down to 78 fathoms in the East Indies, and from 146 to 163 fathoms in the Hawaiian Islands. Ceylon is the only ascertained habitat for *Mastigometra*; *Compsometra* occurs from southern Japan and the Hawaiian Islands to the southern coast of Australia; while *Iridometra* (species related to *I. mana*) is found throughout the range of the subfamily, except in southern Australia and the Hawaiian Islands; one third of the species, however, are only known from the Philippines, to which group of islands the closely allied genus *Toxometra* is, so far as we know, confined. Outside of the Indian Ocean the genus *Antedon*, closely allied to *Mastigometra*, occurs throughout the Mediterranean, and from the Gulf of Guinea to Norway, with a single species on the Brazilian coast. It appears to have reached the Atlantic by passage from the Bay of Bengal "overland" north of India.

The subfamily Prometrinæ belongs to the Intermediate fauna, though to the higher levels in it. It ranges from southern Japan and the Ki Islands to Madagascar in water of from 51 to 140 fathoms in depth, and reappears in the Caribbean Sea where the local representative is the commonest, as well as the

smallest, crinoid of the Greater Antilles. The genus *Perometra* is found throughout the range of the subfamily in the East Indian region, while the genus *Erythrometra*, so far as known, is confined to south-western Japan, occurring in water of from 55 to 105 fathoms in depth.

The subfamily Zenometrinæ is confined, in the East Indian region, to between the depths of 78 and 1,588 fathoms; one of the genera, *Balanometra*, is only known from the Philippine Islands in water having a depth of from 78 to 82 fathoms; *Adelometra* occurs in 140 fathoms off the Ki Islands, and in 211 fathoms off Cuba. *Zenometra* is found in the Hawaiian Islands in from 192 to 352 fathoms, and in the northern West Indies; both of these doubtless occur throughout the Indian Ocean. *Psathyrometra* is found from the Galápagos Islands, British Columbia, and the western Aleutian Islands to the Andaman Islands and the Burmese coast, the northern and eastern species being the largest and the western the smallest, and reappears, somewhat modified, as the genus *Leptometra* in the Mediterranean and along the eastern coast of the Atlantic from Madeira to the Farøe Islands. *Psathyrometra* ranges from 188 to 1,588 fathoms, more than half of the species occurring below the 500-fathom line. In view of this it is rather curious that it does not extend, unchanged, into the Atlantic.

The subfamily Heliometrinæ is represented in the East Indian region by two genera, *Cyclometra* and *Trichometra*; the former ranging from the mouth of the Red Sea to southern Japan in from 107 to 1,200 fathoms, and the latter from the Hawaiian Islands nearly to Ceylon in from 138 to 430 fathoms, also occurring in the West Indies and on the south-eastern coast of the United States. *Cyclometra* is closely allied to *Heliometra*, *Solanometra* and *Promachocrinus*, while *Trichometra* is allied to *Hathrometra*. These two genera, therefore, appear to have been the starting point whence has been derived the characteristic fauna of the Antarctic region, which extends northward along the west coast of South and North America to the Bering Sea and southward again to southern Japan, and the characteristic fauna of the north Atlantic, the Arctic Ocean, the Sea of Okhotsk, the Gulf of Tartary, and the western coast of the Sea of Japan.

The subfamily Thysanometrinæ includes only two genera in the East Indian region, and is found only in southern Japan, the Philippine Islands, and the Andaman Islands, ranging in depth from 70 to 150 fathoms. One of the genera (*Eumetra*) occurs in the Andaman and in the Philippine Islands, the other (*Thysanometra*) in the Philippines and off southern Japan. The latter is closely related to a common genus (*Coccometra*) in the Caribbean Sea.

Species of the two genera of Bathymetrinæ occur from the west coast of America and the Aleutian Islands to the Antarctic seas and the east coast of Africa, *Thaumatometra* inhabiting water of from 80 to 1,600 fathoms in depth, and *Bathymetra* being found between 1,200 and 2,900 fathoms, the latter being the greatest depth at which crinoids have been dredged. *Thaumatometra* occurs in the extreme south of the Atlantic, while *Bathymetra* is known from as far north in that ocean as the Abrolhos Islands in Brazil.



*Pentametrocrinidæ.*

The family *Pentametrocrinidæ* is composed almost entirely of deep-water species. Both *Decametrocrinus* and *Pentametrocrinus* range from Greenland to the extreme south of the Indian Ocean, and thence from East Africa to the East Indies and Japan, *Decametrocrinus* reaching the Meangis and Hawaiian Islands. As a family the range in depth is from 103 to 1,800 fathoms but, while attaining the same abyssal limit, *Decametrocrinus* does not occur above 361 fathoms.

*Atelecrinidæ.*

The *Atelecrinidæ*, in many ways the most interesting, is the least known of any of the comatulid families. Four species are recognized, one from the west tropical Atlantic, the others from the Philippine Islands, Fiji, and the Hawaiian Islands, the last (*A. conifer*) being much the largest. The range in depth in the East Indian region is from 552 to 809 fathoms.

*Pentacrinitidæ.*

The family *Pentacrinitidæ* includes, in the East Indian region, 28 species, distributed in 4 genera of which one, *Metacrinus*, contains 22. Collectively the species range from southern Japan to Fiji and the Kermadec Islands, and westward to the west coast of India, but all the species belonging to three genera, 25 in all, are found within the locality of maximum intensity for Intermediate forms; the fourth genus is not found in this area at all, occurring eastward only to the Malay Peninsula. In depth the East Indian species of *Pentacrinitidæ* range from about 60 to 1,350 fathoms, occurring most abundantly between 200 and 600. Three of the four genera are confined to the East Indian region, but *Endoxocrinus* occurs on both coasts of the mid-Atlantic. In the Caribbean Sea another genus is found, *Isocrinus*, represented by three species one of which, *I. asteria*, is a shallow-water form occurring up to 5 fathoms or even less. *Isocrinus* is abundantly represented as a fossil in various horizons, especially in Europe, but none of the other genera are known except in the recent seas. One of the most abundant, best known, and handsomest of the fossil crinoid groups is the genus *Pentacrinites* which so far has not been discovered in the recent seas.

*Apiocrinidæ.*

The family *Apiocrinidæ*, including many of the best known of the fossil crinoids, is represented in the recent seas by two genera, each with a single species; these are *Carpenterocrinus mollis* from southern Japan, in 565 fathoms of water, and *Proisocrinus ruberrimus* from the Philippine Islands, in 940 fathoms.

*Hyocrinidæ.*

The family *Hyocrinidæ* includes five genera which collectively occur from the Queen Charlotte Islands, off British Columbia, and the Philippine Islands to the

Antarctic Ocean, and north, in the Atlantic, to the Canaries; but none of the genera are well understood. *Calamocrinus* is found in the Galápagos Islands and off the west coast of Central America in from 392 to 782 fathoms; *Ptilocrinus* is known from the Queen Charlotte Islands in 1,588 fathoms, from the extreme south of the Pacific in 240 fathoms, and from the extreme south of the Atlantic; *Thalassocrinus* occurs in the Philippines in 1,262 fathoms; and *Hyocrinus* in the Crozet Islands, south of Africa, in 1,600 fathoms. *Gephyrocrinus* is from the Canary Islands.

*Phrynocrinidae.*

The family Phrynocrinidae is as yet only known from the single specimen of the type species of *Phrynocrinus* which I dredged off southern Japan in 649 fathoms.

*Bourgueticrinidae.*

The genus *Rhizocrinus* of the family Bourgueticrinidae was first known to occur in the recent seas through having been discovered, together with a human skeleton, in a recent breccia at Guadeloupe in the Lesser Antilles, a few years later being found off Norway, and almost at the same time off Barbados and off Portugal. At the present time it is known from Norway and Cape Cod to the Argentine, and from Somaliland to the Philippine Islands, in the East Indian region extending from 56 to 1,025 fathoms. *Bathycrinus*, the other recent genus of the family, occurs everywhere in deep water, entering the deep cold stagnant basins, ranging in the Indian and Pacific Oceans from 650 down to 2,320 fathoms.<sup>1</sup>

## 5. THE IMPORTANCE OF CRINOIDS.

Economically the crinoids serve no useful purpose, at least up to now they have been put to none. Owing to their ordinarily fixed mode of life, however, they can be used as an accurate index to the plankton content of the surrounding water, whereby an accurate idea may be had, at a small expenditure of time, labour, and money, of its ability to support other marine life such as marketable fish, coral, sponges, or pearl oysters. A careful study of the crinoid species, their ecology, their food (as evidenced by their stomach contents), and their habits should be undertaken so that the information offered by them, undoubtedly of considerable value, may be readily appreciated. So far absolutely nothing has been done in this direction.

The chief interest in the crinoids lies in their relation to the study of fossils.

<sup>1</sup> *Holopidae.*

The family Holopidae has been created to contain the curious genus *Holopus*, an extraordinary massive short-armed crinoid with an asymmetrical crown, sessile, or mounted upon a short thick unjointed stem. It occurs, so far as is now known, only in the West Indies, among the Lesser Antilles, in water of from 5 to 100 fathoms in depth. Two species have been described, *H. rangii* from Martinique, with eight arms, and *H. rawsoni* from Barbados, with ten; both, however, represent the same form. Carpenter unfortunately overlooked the latter in the preparation of the "Challenger" report.

This genus is especially to be looked for in the East Indies.

The palaeontological record is astonishingly complete, and many of the recent genera run far back in geological time. The correlation between the Jurassic and later horizons and the present East Indian crinoid fauna will show many very interesting facts when properly worked out. At the present state of knowledge it would seem as if the European Jurassic had received its fauna by means of a past sea connection north of what is now India, a suggestion which it is well worth while to follow up, as it is supplemented by other similar facts indicated in other groups.

Like many other animals the crinoids have suffered at the hands of the palaeontologists through being forced to show many things geologically perhaps probable, but zoologically very doubtful. Especially has this been the case with the phylogeny. Very highly specialized types have been made to appear as the ancestors of more generalized types simply because they happened to precede them in the rocks. Exquisite phylogenetic trees have been constructed showing the development from the earliest to the recent species, which, zoologically, would be much more logical and correct if inverted and constructed from the recent species as a base to the earliest forms at the top. In the study of the crinoids each geological horizon should be treated in the light of a zoogeographic or faunal region, on the same plane as the recent zoogeographic regions, and much more of truth will result than by the use of the commonly accepted methods.

## 6. CORRELATION OF THE RECORDS OF PREVIOUS AUTHORS.

In the course of my studies upon the recent crinoids I have reviewed the original material which has served as the basis for almost all of the papers that have been published upon the species inhabiting the Indian Ocean and adjacent seas, and, naturally, I have discovered a number of cases of erroneous identification. In order that the works of the earlier authors may be readily understood I have prepared the following lists in which the left-hand column gives the name of the species as recorded, and the right-hand the names as now accepted of the species represented by the specimen or specimens upon which the record is actually based, as determined from my study of the original example. Taken in conjunction with the synonymy given for each species these lists should make the comprehension of the records heretofore published, at present very difficult, comparatively easy.

### HISTOIRE NATURELLE DES ANIMAUX SANS VERTÉBRES— LES COMATULES.

M. le Chevalier de Lamarck, 1816.

p. 533 <i>Comatula solaris</i>	..	..	<i>Comatula solaris</i> .
<i>Comatula multiradiata</i>		..	{ <i>Cupilaster sentosa</i> , <i>Comaster multifida</i> .

p. 534	<i>Comatula rotalaria</i>	..	..	<i>Comatula rotalaria.</i>
	<i>Comatula fimbriata</i>	..	..	<i>Capillaster multiradiata</i>
	<i>Comatula carinata</i>	..	..	<i>Tropiometra carinata.</i>
p. 535	<i>Comatula adeona</i>	..	..	<i>Oligometra adeonæ.</i>
	<i>Comatula brachiolata</i>	..	..	<i>Comatulella brachiolata</i>

## DIE GATTUNG COMATULA.

J. Müller, 1849.

p. 248	<i>Comatula (Actinometra) solaris</i>	..	..	<i>Comatula solaris.</i>
p. 249	<i>Comatula brachiolata</i>	..	..	<i>Comatulella brachiolata.</i>
p. 250	<i>Comatula rosea</i>	..	..	<i>Comatulella brachiolata</i>
	<i>Comatula (Alecto) echinoptera</i>	..	..	<i>Comactinia echinoptera.</i>
p. 251	<i>Comatula tessellata</i>	..	..	?
	<i>Comatula milleri</i>	..	..	<i>Antedon bifida.</i>
	<i>Comatula adeonæ</i>	..	..	<i>Oligometra adeonæ.</i>
p. 252	<i>Comatula (Alecto) carinata</i>	..	..	<i>Tropiometra carinata.</i>
	<i>Comatula (Alecto) mediterranea</i>	..	..	<i>Antedon mediterranea.</i>
p. 253	<i>Comatula (Alecto) phalangium</i>	..	..	<i>Leptometra phalangium.</i>
	<i>Comatula (Alecto) petasus</i>	..	..	<i>Antedon petasus.</i>
p. 254	<i>Comatula (Alecto) sarsi</i>	..	..	<i>Hathrometra sarsi.</i>
	<i>Comatula (Alecto) eschrichtii</i>	..	..	<i>Heliometra glacialis.</i>
p. 255	<i>Comatula (Alecto) milberti</i>	..	..	<i>Amphimetra milberti.</i>
	<i>Comatula jacquinoti</i>	..	..	<i>Amphimetra milberti.</i>
	<i>Comatula cumingii</i>	..	..	<i>Comatula pectinata.</i>
p. 256	<i>Comatula (Actinometra) rotalaria</i>	..	..	<i>Comatula rotalaria.</i>
	<i>Comatula (Actinometra) wahlbergii</i>	..	..	<i>Comanthus wahlbergii.</i>
p. 257	<i>Comatula (Alecto) savignii</i>	..	..	<i>Heterometra savignii.</i>
	<i>Comatula elongata</i>	..	..	<i>Dichrometra flagellata.</i>
	<i>Comatula trichoptera</i>	..	..	<i>Comanthus trichoptera.</i>
p. 258	<i>Comatula (Alecto) fimbriata</i>	..	..	<i>Capillaster multiradiata.</i>
	<i>Comatula macronema</i>	..	..	<i>Ptilometra macronema.</i>
p. 259	<i>Comatula (Alecto) reynaudii</i>	..	..	<i>Heterometra reynaudii.</i>
	<i>Comatula philiberti</i>	..	..	<i>Amphimetra philiberti.</i>
p. 260	<i>Comatula (Alecto) parvicirra</i>	..	..	<i>Comanthus parvicirra.</i>
	<i>Comatula japonica</i>	..	..	<i>Comanthus japonica.</i>
p. 261	<i>Comatula (Alecto) palmata</i>	..	..	<i>Dichrometra palmata.</i>
	<i>Comatula (Alecto) multiradiata</i>	..	..	<i>Capillaster multiradiata</i>
p. 262	<i>Comatula multifida</i>	..	..	<i>Comaster multifida.</i>
p. 263	<i>Comatula timorensis</i>	..	..	<i>Comanthus parvicirra.</i>
	<i>Comatula flagellata</i>	..	..	<i>Dichrometra flagellata.</i>
	<i>Comatula (Alecto) articulata</i>	..	..	<i>Dichrometra articulata.</i>



THE EAST INDIAN CRINOIDS INCLUDED IN THE  
"CHALLENGER" REPORT.

THE STALKED CRINOIDS.

P. Herbert Carpenter, 1884.

p. 386	<i>Hyocrinus bethellianus</i>	..	<i>Hyocrinus bethellianus</i> .
	<i>Bathyrinus aldrichianus</i>	..	<i>Bathyrinus australis</i> .
	<i>Bathyrinus campbellianus</i>	..	<i>Bathyrinus aldrichianus</i> .
	<i>Pentacrinus alternicirrus</i>	..	<i>Endoxocrinus alternicirrus</i> .
p. 387	<i>Pentacrinus mollis</i>	..	<i>Carpenterocrinus mollis</i> .
	<i>Pentacrinus naresianus</i>	..	<i>Hypalocrinus naresianus</i> .
	<i>Metacrinus angulatus</i>	..	<i>Metacrinus angulatus</i> .
	<i>Metacrinus cingulatus</i>	..	<i>Metacrinus cingulatus</i> .
	<i>Metacrinus costatus</i>	..	<i>Metacrinus costatus</i> .
	<i>Metacrinus interruptus</i>	..	<i>Metacrinus interruptus</i> .
	<i>Metacrinus moseleyi</i>	..	<i>Metacrinus moseleyi</i> .
	<i>Metacrinus murrayi</i>	..	<i>Metacrinus nobilis</i> , var. <i>murrayi</i> .
	<i>Metacrinus nobilis</i>	..	<i>Metacrinus nobilis</i> .
	<i>Metacrinus nodosus</i>	..	<i>Metacrinus nodosus</i> .
	<i>Metacrinus rotundus</i>	..	<i>Metacrinus rotundus</i> .
	<i>Metacrinus stewarti</i>	..	<i>Metacrinus stewarti</i> .
	<i>Metacrinus superbus</i>	..	<i>Metacrinus superbus</i> .
	<i>Metacrinus tuberosus</i>	..	<i>Metacrinus tuberosus</i> .
	<i>Metacrinus varians</i>	..	<i>Metacrinus varians</i> .
	<i>Metacrinus wyvillii</i>	..	<i>Metacrinus wyvillii</i> .
	<i>Metacrinus</i> , sp.	..	<i>Metacrinus rotundus</i> .

REPORT ON A COLLECTION OF ECHINODERMS FROM  
THE ANDAMAN ISLANDS.

F. Jeffrey Bell, 1887.

p. 146	<i>Antedon</i> , sp.	..	..	<i>Pontiometra andersoni</i> .
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THE EAST INDIAN CRINOIDS INCLUDED IN THE  
"CHALLENGER" REPORT.

THE COMATULIDS.

P. Herbert Carpenter, 1888.

p. 374	<i>Thaumatocrinus renovatus</i>	..	<i>Pentametrocrinus</i> , sp.
	<i>Atelecrinus wyvillii</i>	..	<i>Atelecrinus wyvillii</i> .
	<i>Eudiocrinus indivisus</i>	..	<i>Eudiocrinus indivisus</i>

	<i>Eudiocrinus japonicus</i>	..	<i>Pentametrocrinus japonicus</i> .
	<i>Eudiocrinus semperi</i>	..	<i>Pentametrocrinus semperi</i> .
	<i>Eudiocrinus varians</i>	..	<i>Pentametrocrinus varians</i> .
	<i>Promachocrinus abyssorum</i>	..	<i>Decametrocrinus abyssorum</i> .
	<i>Promachocrinus naresi</i>	..	<i>Decametrocrinus naresi</i> .
p. 375	<i>Antedon elegans</i>	..	{ <i>Zygometra elegans</i> .
			{ <i>Zygometra comata</i>
	<i>Antedon microdiscus</i>	..	<i>Zygometra microdiscus</i> .
	<i>Antedon multiradiata</i>	..	<i>Zygometra multiradiata</i> .
	<i>Antedon aculeata</i>	..	<i>Chlorometra aculeata</i> .
	<i>Antedon acutiradia</i>	..	<i>Stiremetra acutiradia</i> .
	<i>Antedon basicurva</i>	..	<i>Charitometra basicurva</i> .
	<i>Antedon bispinosa</i>	..	<i>Thalassometra bispinosa</i> .
	<i>Antedon breviradia</i>	..	<i>Stiremetra breviradia</i> .
	<i>Antedon denticulata</i>	..	<i>Amphimetra denticulata</i> .
	<i>Antedon echinata</i>	..	<i>Thalassometra echinata</i> .
	<i>Antedon flexilis</i>	..	<i>Pachylometra flexilis</i> .
	<i>Antedon gracilis</i>	..	<i>Thalassometra pergracilis</i> .
	<i>Antedon incerta</i>	..	<i>Crotalometra incerta</i> .
	<i>Antedon incisa</i>	..	<i>Charitometra incisa</i> .
	<i>Antedon latipinna</i>	..	<i>Thalassometra latipinna</i> .
	<i>Antedon longicirra</i>	..	<i>Asterometra longicirra</i> .
p. 376	<i>Antedon parvipinna</i>	..	<i>Strotometra parvipinna</i> .
	<i>Antedon pusilla</i>	..	<i>Perometra pusilla</i> .
	<i>Antedon spinicirra</i>	..	<i>Stiremetra spinicirra</i> .
	<i>Antedon tuberosa</i>	..	<i>Glyptometa tuberosa</i> .
	<i>Antedon valida</i>	..	<i>Crotalometra valida</i> .
	<i>Antedon acœla</i>	..	<i>Pœcilometra acœla</i> .
	<i>Antedon discoidea</i>	..	<i>Gephyrometra discoidea</i> .
	<i>Antedon abyssicola</i>	..	{ <i>Bathymetra abyssicola</i> .
			{ <i>Bathymetra carpenteri</i> .
	<i>Antedon abyssorum</i>	..	<i>Thaumatometra abyssorum</i> .
	<i>Antedon alternata</i>	..	<i>Thaumatometra alternata</i> .
p. 377	<i>Antedon exigua</i>	..	<i>Thaumatometra exigua</i> .
	<i>Antedon hirsuta</i>	..	<i>Thaumatometra hirsuta</i> .
	<i>Antedon levis</i>	..	<i>Thaumatometra levis</i> .
	<i>Antedon remota</i>	..	<i>Thaumatometra remota</i> .
	<i>Antedon tenuicirra</i>	..	<i>Thysanometra tenuicirra</i> .
	<i>Antedon anceps</i>	..	<i>Craspedometra anceps</i> .
	<i>Antedon carinata</i>	..	{ <i>Tropiometra carinata</i> .
			{ <i>Tropiometra encrinus</i> .
			{ ( <i>Tropiometra picta</i> .)
	<i>Antedon carpenteri</i>	..	<i>Oligometra carpenteri</i> .
	<i>Antedon informis</i>	..	<i>Decametra informis</i> .

p. 378	<i>Antedon laevisissima</i>	..	..	<i>Amphimetra milberti</i> .
	<i>Antedon loveni</i>	..	..	<i>Colobometra perspinosa</i> .
	<i>Antedon milberti</i>	..	..	{ <i>Amphimetra milberti</i> , <i>Amphimetra discoidea</i> , <i>Amphimetra molleri</i> .
	<i>Antedon parvicirra</i>	..	..	<i>Iridometra parvicirra</i> .
	<i>Antedon perspinosa</i>	..	..	<i>Colobometra perspinosa</i> .
	<i>Antedon pinniformis</i>	..	..	<i>Amphimetra pinniformis</i> .
	<i>Antedon pumila</i>	..	..	<i>Compsometra loveni</i> .
	<i>Antedon serripinna</i>	..	..	<i>Oligometra serripinna</i> .
	<i>Antedon tessellata</i>	..	..	?
	<i>Antedon variipinna</i>	..	..	<i>Amphimetra variipinna</i> .
	<i>Antedon aedeone</i>	..	..	<i>Oligometra aedeone</i> .
	<i>Antedon balanoides</i>	..	..	<i>Balanometra balanoides</i> .
	<i>Antedon bidens</i>	..	..	<i>Oligometra aedeone</i>
	<i>Antedon impinnata</i>	..	..	?
	<i>Antedon levipinna</i>	..	..	<i>Amphimetra milberti</i> .
	<i>Antedon compressa</i>	..	..	<i>Parametra compressa</i> .
	<i>Antedon flexilis</i>	..	..	<i>Pachylometra flexilis</i> .
	<i>Antedon macronema</i>	..	..	{ <i>Ptilometra macronema</i> , <i>Ptilometra mülleri</i> .
p. 379	<i>Antedon patula</i>	..	..	<i>Pachylometra patula</i> .
	<i>Antedon quinquecostata</i>	..	..	<i>Stenometra quinquecostata</i> .
	<i>Antedon robusta</i>	..	..	<i>Pachylometra robusta</i> .
	<i>Antedon aequipinna</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon articulata</i>	..	..	<i>Dichrometra articulata</i> .
	<i>Antedon bimaculata</i>	..	..	<i>Dichrometra bimaculata</i> .
	<i>Antedon brevicuneata</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon clemens</i>	..	..	<i>Craspedometra anceps</i> .
	<i>Antedon conjungens</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon disciformis</i>	..	..	<i>Cyllometra disciformis</i> .
	<i>Antedon elongata</i>	}	..	<i>Dichrometra flagellata</i> .
	<i>Antedon flagellata</i>			
	<i>Antedon gyges</i>	..	..	<i>Dichrometra gyges</i> .
	<i>Antedon imparipinna</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon indica</i>	..	..	<i>Stephanometra indica</i> .
	<i>Antedon levicirra</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon manca</i>	..	..	<i>Cyllometra manca</i> .
	<i>Antedon marginata</i>	..	..	<i>Stephanometra marginata</i> .
	<i>Antedon occulta</i>	..	..	<i>Dichrometra occulta</i> .
	<i>Antedon palmata</i>	..	..	<i>Dichrometra palmata</i> .
	<i>Antedon protecta</i>	..	..	<i>Dichrometra protectus</i> .
	<i>Antedon regalis</i>	..	..	<i>Dichrometra regalis</i> .



	<i>Antedon reginæ</i>	..	..	<i>Dichrometra reginæ</i> .
	<i>Antedon similis</i>	..	..	<i>Dichrometra similis</i> .
p. 380	<i>Antedon spicata</i>	..	..	<i>Stephanometra spicata</i> .
	<i>Antedon tuberculata</i>	..	..	<i>Stephanometra tuberculata</i> .
	<i>Antedon angusticalyx</i>	..	..	<i>Pachylometra angusticalyx</i> .
	<i>Antedon distincta</i>	..	..	<i>Pachylometra distincta</i> .
	<i>Antedon inæqualis</i>	..	..	<i>Pachylometra inæqualis</i> .
	<i>Antedon acuticirra</i>	..	..	<i>Craspedometra acuticirra</i> .
	<i>Antedon anceps</i>	..	..	<i>Craspedometra anceps</i> .
	<i>Antedon angustiradia</i>	..	..	<i>Adelometra angustiradia</i> .
	<i>Antedon bipartipinna</i>	..	..	<i>Craspedometra acuticirra</i> .
	<i>Antedon ludovici</i>	..	..	{ <i>Craspedometra acuticirra</i> .
				{ <i>Craspedometra amboine</i> .
	<i>Antedon philiberti</i>	..	..	<i>Amphimetra philiberti</i> .
	<i>Antedon quinduplicava</i>	..	..	<i>Heterometra quinduplicava</i> .
	<i>Antedon reynaudi</i>	..	..	<i>Heterometra reynaudii</i> .
	<i>Antedon savignyi</i>	..	..	<i>Heterometra savignii</i> .
	<i>Antedon variipinna</i>	..	..	<i>Amphimetra variipinna</i> .
	<i>Actinometra brachiolata</i>	..	..	<i>Comatulella brachiolata</i> .
p. 381	<i>Actinometra pectinata</i>	..	..	<i>Comatula pectinata</i> .
	<i>Actinometra solaris</i>	..	..	<i>Comatula solaris</i> .
	<i>Actinometra paucicirra</i>	..	..	<i>Comatula rotalaria</i> .
	<i>Actinometra distincta</i>	..	..	<i>Comaster distincta</i> .
	<i>Actinometra multibrachiata</i>	..	..	<i>Comaster multibrachiata</i> .
	<i>Actinometra novæ-guinæ</i>	..	..	<i>Comaster novæguineæ</i> .
	<i>Actinometra typica</i>	..	..	<i>Comaster typica</i> .
	<i>Actinometra cumingi</i>	..	..	<i>Comatula pectinata</i> .
	<i>Actinometra pulchella</i>	..	..	<i>Comatella maculata</i> . <sup>1</sup>
	<i>Actinometra maculata</i>	..	..	<i>Comatella maculata</i> .
	<i>Actinometra nigra</i>	..	..	<i>Comatella nigra</i> .
	<i>Actinometra pulchella</i>	..	..	(see three lines above).
	<i>Actinometra stelligera</i>	..	..	<i>Comatella stelligera</i> .
p. 382	<i>Actinometra elongata</i>	..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra rotalaria</i>	..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra simplex</i>	..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra valida</i>	..	..	<i>Comanthus annulata</i> .
	<i>Actinometra borneensis</i>	..	..	<i>Capillaster multiradiata</i> .
	<i>Actinometra coppingeri</i>	..	..	<i>Capillaster multiradiata</i> .
	<i>Actinometra fimbriata</i>	..	..	<i>Capillaster multiradiata</i> .
	<i>Actinometra multiradiata</i>	..	..	<i>Capillaster multiradiata</i> .
	<i>Actinometra sentosa</i>	..	..	<i>Capillaster sentosa</i> .

<sup>1</sup> East Indian specimen only; the Atlantic and Caribbean specimens belong to the genus *Neocomatella*.

	<i>Actinometra alternans</i> ..	..	<i>Comantheria alternans</i> .
	<i>Actinometra belli</i> ..	..	<i>Comantheria belli</i> .
	<i>Actinometra bennetti</i> ..	..	<i>Comanthus bennetti</i> .
	<i>Actinometra briareus</i> ..	..	<i>Comantheria briareus</i> .
	<i>Actinometra divaricata</i> ..	..	<i>Comantheria briareus</i> .
	<i>Actinometra duplex</i> ..	..	<i>Comantheria schlegelii</i> .
	<i>Actinometra grandicalyx</i> ..	..	<i>Comantheria grandicalyx</i> .
	<i>Actinometra japonica</i> ..	..	<i>Comanthus japonica</i> .
	<i>Actinometra littoralis</i> ..	..	<i>Comanthus annulata</i> .
	<i>Actinometra magnifica</i> ..	..	<i>Comantheria magnifica</i> .
p. 383	<i>Actinometra multifida</i> ..	..	<i>Comaster multifida</i> .
	<i>Actinometra nobilis</i> ..	..	<i>Comantheria schlegelii</i> .
	<i>Actinometra parvicirra</i> ..	..	{ <i>Comaster distincta</i> .
			{ <i>Comanthus annulata</i> .
			{ <i>Comanthus samoana</i> .
			{ <i>Comanthus wahlbergii</i> .
			{ <i>Comanthus parvicirra</i> .
	<i>Actinometra peroni</i> ..	..	<i>Comanthus bennetti</i> .
	<i>Actinometra quadrata</i> ..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra regalis</i> ..	..	<i>Comantheria schlegelii</i> .
	<i>Actinometra robustipinna</i> ..	..	<i>Himerometra? crassipinna</i> .
	<i>Actinometra schlegelii</i> ..	..	<i>Comantheria schlegelii</i> .
	<i>Actinometra trichoptera</i> ..	..	<i>Comanthus trichoptera</i> .
	<i>Actinometra variabilis</i> ..	..	{ <i>Comaster typica</i> .
			{ <i>Comaster multifida</i> .

## THE COMATULÆ OF THE MERGUI ARCHIPELAGO.

P. Herbert Carpenter, 1889.

p. 305	<i>Antedon elegans</i> ..	..	<i>Zygometa comata</i> .
p. 306	<i>Antedon andersoni</i> ..	..	<i>Pontometra andersoni</i> .
p. 310	<i>Antedon milberti</i> ..	..	<i>Amphimetra milberti</i> .
	<i>Antedon spicata</i> ..	..	<i>Stephanometra spicata</i> .
p. 311	<i>Antedon conjungens</i> ..	..	<i>Dichrometra protectus</i> .
p. 312	<i>Actinometra notata</i> ..	..	<i>Comatella stelligera</i> .

BEITRAG ZUR KENNTNISS DER COMATULIDENFAUNA  
DES INDISCHEN ARCHIPELS.

C. Hartlaub, 1891.

p. 19	<i>Antedon bengalensis</i> ..	..	<i>Heterometra bengalensis</i> .
p. 21	<i>Antedon martensi</i> ..	..	<i>Heterometra martensi</i> .
p. 22	<i>Antedon kraepelini</i> ..	..	<i>Himerometra kraepelini</i> .
p. 23	<i>Antedon brockii</i> ..	..	<i>Heterometra brockii</i> .

p. 25	<i>Antedon affinis</i>	..	..	<i>Heterometra affinis.</i>
p. 27	<i>Antedon nematodon</i>	..	..	<i>Heterometra nematodon.</i>
p. 29	<i>Antedon ludovici</i>	..	..	
p. 32	<i>Antedon crassipinna</i>	..	..	<i>Himerometra crassipinna.</i>
p. 41	<i>Antedon claræ</i>	..	..	<i>Cyllometra claræ.</i>
p. 43	<i>Antedon bella</i>	..	..	<i>Cenometa bella.</i>
p. 44	<i>Antedon bella</i> , var. <i>brunnea</i>	..	..	<i>Cenometa brunnea.</i>
p. 46	<i>Antedon klunzingeri</i>	..	..	<i>Dichrometra klunzingeri.</i>
p. 47	<i>Antedon finschii</i>	..	..	<i>Selenometra finschii.</i>
p. 49	<i>Antedon palmata</i>	..	..	<i>Dichrometra palmata.</i>
p. 52	<i>Antedon erinacea</i>	..	..	<i>Oxymetra erinacea.</i>
p. 54	<i>Antedon tenuipinna</i>	..	..	<i>Stephanometra tenuipinna.</i>
p. 55	<i>Antedon oxyacantha</i>	..	..	<i>Stephanometra oxyacantha.</i>
p. 59	<i>Antedon monacantha</i>	..	..	<i>Stephanometra monacantha.</i>
p. 61	<i>Antedon spinipinna</i>	..	..	<i>Stephanometra spinipinna.</i>
p. 63	<i>Antedon imparipinna</i>	..	..	<i>Dichrometra protectus.</i>
p. 66	<i>Antedon tenera</i>	..	..	<i>Dichrometra tenera.</i>
p. 68	<i>Antedon brevicuneata</i>	..	..	<i>Dichrometra protectus.</i>
p. 71	<i>Antedon elongata</i>	}	..	<i>Dichrometra flagellata.</i>
p. 73	<i>Antedon flagellata</i>			
p. 76	<i>Antedon conifera</i>	..	..	<i>Cosmiometra conifera.</i>
p. 78	<i>Antedon macronema</i>	..	..	<i>Ptilometra mülleri.</i>
	<i>Antedon andersoni</i>	..	..	<i>Pontiometa andersoni.</i>
p. 81	<i>Antedon milberti</i>	..	}	<i>Amphimetra milberti.</i>
		..		<i>Amphimetra mollerii.</i>
p. 82	<i>Antedon serripinna</i>	..	..	<i>Oligometra serripinna.</i>
p. 84	<i>Antedon japonica</i>	..	..	<i>Oligometra japonica.</i>
p. 85	<i>Antedon perspinosa</i>	..	..	<i>Colobometra perspinosa.</i>
p. 86	<i>Antedon afra</i>	..	..	<i>Tropiometra afra.</i>
p. 88	<i>Antedon hupferi</i>	..	..	<i>Antedon hupferi.</i>
p. 89	<i>Antedon nana</i>	..	..	<i>Iridometra nana.</i>
p. 94	<i>Actinometra divaricata</i>	..	..	<i>Comantheria briareus.</i>
p. 95	<i>Actinometra bennetti</i>	..	..	<i>Comanthus bennetti.</i>
p. 96	<i>Actinometra parvicirra</i>	..	}	<i>Comanthina schlegelii.</i>
		..		<i>Comanthus samoana.</i>
		..		<i>Comanthus parvicirra.</i>
p. 99	<i>Actinometra regalis</i>	..	..	<i>Comanthina schlegelii.</i>
p. 101	<i>Actinometra coppingeri</i>	..	..	<i>Capillaster multiradiata.</i>
	<i>Actinometra macrobrachius</i>	..	..	<i>Capillaster macrobrachius.</i>
p. 102	<i>Actinometra fimbriata</i>	..	..	<i>Capillaster multiradiata.</i>
p. 103	<i>Actinometra multiradiata</i>	..	..	<i>Capillaster multiradiata.</i>
p. 104	<i>Actinometra stelligera</i>	..	..	<i>Comatella stelligera.</i>
p. 105	<i>Actinometra maculata</i>	..	..	<i>Comatella maculata.</i>
	<i>Actinometra pulchella</i>	..	..	<i>Comatella maculata.</i>

p. 107	<i>Actinometra solaris</i>	..	..	<i>Comatula solaris</i> .
	<i>Actinometra pectinata</i>	..	..	<i>Comatula pectinata</i> .
	<i>Actinometra brachiolata</i>	..	..	<i>Comatula pectinata</i> .
p. 108	<i>Actinometra typica</i>	..	..	<i>Comaster typica</i> .
p. 111	<i>Actinometra gracilis</i>	..	..	<i>Comaster gracilis</i> .

ECHINODERMS FROM THE MACCLESFIELD BANK.  
II. CRINOIDEA.

F. Jeffrey Bell, 1894.

p. 396	<i>Eudiocrinus granulatus</i>	..	..	<i>Eudiocrinus indivisus</i> .
	<i>Antedon carinata</i>	..	..	<i>Oligometra serripinna</i> .
	<i>Antedon ? spicata</i>	..	..	<i>Stephanometra tuberculata</i> .
	<i>Antedon inopinata</i>	..	..	<i>Himerometra inopinata</i> .
	<i>Antedon bassett-smithi</i>	..	..	<i>Comatella stelligera</i> .
	<i>Antedon vicaria</i>	..	..	<i>Mariametra vicaria</i> .
	<i>Antedon brevicirra</i>	..	..	<i>Comaster distincta</i> .
	<i>Antedon flavomaculata</i>	..	..	<i>Stephanometra monacantha</i> .
	<i>Antedon moorei</i>	..	..	<i>Dichrometra similis</i> .
	<i>Antedon fieldi</i>	..	..	?
	<i>Antedon ? variispina</i>	..	..	<i>Mariametra vicaria</i> .
	<i>Actinometra fimbriata</i>	..	..	<i>Capillaster multiradiata</i> .
	<i>Actinometra parvicirra</i>	..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra bennetti</i>	..	..	<i>Comanthus bennetti</i> .
	<i>Actinometra simplex</i>	..	..	<i>Comatella maculata</i> .
	<i>Actinometra duplex</i>	..	..	<i>Comanthina schlegelii</i> .
	<i>Actinometra maculata</i>	..	..	<i>Comatella stelligera</i> .
	<i>Actinometra rotalaria</i>	..	..	<i>Comanthus parvicirra</i> .
	<i>Actinometra regalis</i>	..	..	<i>Comaster multibrachiata</i> .
	<i>Actinometra peregrina</i>	..	..	<i>Comissia peregrina</i> .

LIST OF THE ECHINODERMS OF NORTH-WEST  
AUSTRALIA. II. CRINOIDEA.

(“ The chief localities are Holothuria Bank, Magnetic Shoal, Cossack Island, and Baudin Island (14° 08' S., 125° 36' E.).”)

F. Jeffrey Bell, 1894.

p. 394	<i>Antedon milberti</i>	..	..	{ <i>Amphimetra discoidea</i> .
				{ <i>Oligometra carpenteri</i> .
	<i>Antedon serripinna</i>	..	..	<i>Oligometra carpenteri</i> .
	<i>Antedon variipinna</i>	..	..	<i>Amphimetra variipinna</i> .
	<i>Antedon</i> sp. (near <i>macronema</i> )	..	..	<i>Cenometra cornuta</i> .

<i>Actinometra pectinata</i> ..	..	{ <i>Comatula pectinata</i> .
		{ <i>Comatula purpurea</i> .
<i>Actinometra nobilis</i> ..	..	<i>Comanthina belli</i> .
<i>Actinometra paucicirra</i> ..	..	<i>Comatula rotalaria</i> .
<i>Actinometra parvicirra</i> ..	..	{ <i>Comatula pectinata</i> .
		{ <i>Comantheria briareus</i> .
<i>Actinometra variabilis</i> ..	..	<i>Comanthus parvicirra</i> .
<i>Actinometra multifida</i> ..	..	{ <i>Comaster typica</i> .
		{ <i>Comanthina belli</i> .
<i>Actinometra multiradiata</i> ..	..	<i>Capillaster multiradiata</i> .

## ECHINODERMS OF THE ARAFURA AND BANDA SEAS. II. CRINOIDEA.

F. Jeffrey Bell, 1894.

p. 395 <i>Actinometra maculata</i> ..	..	<i>Comatella maculata</i> .
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## COMATULIDEN VON AMBOINA UND THURSDAY ISLAND.

L. Döderlein, 1898.

p. 475 <i>Antedon elegans</i> ..	..	<i>Zygometa elegans</i> .
p. 476 <i>Antedon microdiscus</i> ..	..	<i>Zygometa microdiscus</i> .
<i>Antedon bidens</i> ..	..	<i>Oligometra aedeonæ</i> .
p. 477 <i>Antedon ludovici</i> ..	..	<i>Craspedometra acuticirra</i>
<i>Antedon imparipinna</i> ..	..	<i>Dichrometra protectus</i>
p. 478 <i>Actinometra pectinata</i> ..	..	<i>Comatula pectinata</i> .
<i>Actinometra solaris</i> ..	..	<i>Comatula solaris</i> .
p. 479 <i>Actinometra paucicirra</i> ..	..	<i>Comatula rotalaria</i> .
<i>Actinometra belli</i> ..	..	{ <i>Comaster multifida</i> .
		{ <i>Comanthina belli</i> .
<i>Actinometra parvicirra</i> ..	..	{ <i>Comanthus annulata</i> .
		{ <i>Comanthus parvicirra</i> .
<i>Actinometra regalis</i> ..	..	<i>Comanthina schlegelii</i> .

## REPORT ON THE CRINOIDS COLLECTED BY DR. WILLEY

F. Jeffrey Bell, 1899.

p. 133 <i>Antedon indica</i> ..	..	<i>Dichrometra protectus</i> .
<i>Antedon tuberculata</i> ..	..	<i>Stephanometra tuberculata</i> .
p. 134 <i>Actinometra typica</i> ..	..	{ <i>Comaster typica</i> .
		{ <i>Comaster gracilis</i> .
<i>Actinometra grandicalyx</i> ..	..	<i>Comanthus bennetti</i> .
<i>Actinometra bennetti</i> ..	..	<i>Comanthus bennetti</i> .
<i>Actinometra parvicirra</i> ..	..	<i>Comanthus parvicirra</i> .

THE ACTIGONIDIATE ECHINODERMS OF THE MALDIVE  
AND LACCADIVE ISLANDS.

F. Jeffrey Bell, 1902.

p. 224	<i>Antedon laevissima</i>	..	..	{	<i>Amphimetra producta.</i>
					<i>Amphimetra molleri.</i>
					<i>Decametra taprobanes.</i>
					<i>Decametra möbiusi.</i>
	<i>Antedon milberti</i>	..	..	{	<i>Amphimetra producta.</i>
					<i>Amphimetra molleri.</i>
	<i>Antedon palmata</i>	..	..		<i>Himerometra sol.</i>
	<i>Antedon indica</i>	..	..		<i>Comaster gracilis.</i>
	<i>Antedon varripinna</i>	..	..		?
p. 225	<i>Actinometra typica</i>	..	..		<i>Comanthina schlegelii.</i>
	<i>Actinometra fimbriata</i>	..	..		<i>Capillaster multiradiata.</i>
	<i>Actinometra multiradiata</i>	..	..		<i>Capillaster multiradiata.</i>
	<i>Actinometra sentosa</i>	..	..		<i>Capillaster sentosa.</i>
	<i>Actinometra maculata</i>	..	..		<i>Stephanometra indica.</i>

REPORT ON THE CRINOIDEA COLLECTED BY PROFESSOR  
HERDMAN AT CEYLON IN 1902.

Herbert C. Chadwick, 1904.

p. 153	<i>Antedon serripinna</i>	..	..		<i>Oligometra serripinna.</i>
p. 154	<i>Antedon milberti</i>	..	..		<i>Amphimetra milberti.</i>
	<i>Antedon carinata</i>	..	..		<i>Tropiometra enerinus.</i>
	<i>Antedon marginata</i>	..	..		<i>Stephanometra marginata.</i>
	<i>Antedon indica</i>	..	..		<i>Stephanometra indica.</i>
p. 155	<i>Antedon bella</i>	..	..		<i>Cenometra herdmani.</i>
	<i>Antedon okelli</i>	..	..		<i>Dichrometra protectus.</i>
p. 156	<i>Antedon reynaudi</i>	..	..		<i>Heterometra reynaudii.</i>
p. 157	<i>Antedon anceps</i>	..	..		<i>Heterometra bengalensis.</i>
	<i>Antedon varripinna</i>	..	..		<i>Heterometra reynaudii.</i>
	<i>Actinometra notata</i>	..	..		<i>Comatella stelligera.</i>
	<i>Actinometra multiradiata</i>	..	..		<i>Capillaster multiradiata.</i>
p. 158	<i>Actinometra parvicirra</i>	..	..	{	<i>Comanthus annulata.</i>
					<i>Comanthus parvicirra.</i>
					<i>Comissia</i> sp. nov.

THE ECHINODERMA FOUND OFF THE COAST OF SOUTH  
AFRICA. PART IV. CRINOIDEA.

F. Jeffrey Bell, 1905.

p. 139	<i>Antedon capensis</i>	..	..		<i>Tropiometra carinata.</i>
p. 140	<i>Antedon sclateri</i>	..	..		<i>Pachylometra sclateri.</i>

- p. 141 *Antedon magnicirra* .. .. *Thalassometra magnicirra*.  
*Actinometra parvicirra* .. .. *Comanthus wahlbergii*.

REPORTS ON THE MARINE BIOLOGY OF THE RED SEA.  
 VII. THE CRINOIDEA.

Herbert C. Chadwick, 1907.

- p. 44 *Antedon serripinna* .. .. *Colobometra chadwicki*.  
 p. 45 *Antedon parvicirra* .. .. *Iridometra aegyptica*.  
*Antedon marginata* .. .. ? *Stephanometra marginata*.  
 p. 46 *Antedon imparipinna* .. .. *Dichrometra protectus*.  
 p. 47 *Antedon palmata* .. .. *Dichrometra palmata*.  
*Antedon savignyi* .. .. *Heterometra savignii*.

DIE GESTIELTEN CRINOIDEN DER SIBOGA-EXPEDITION.

L. Döderlein, 1907.

- p. 8 *Bathycrinus minimus* .. .. *Bathycrinus minimus*.  
 p. 9 *Bathycrinus nodipes* .. .. *Bathycrinus nodipes*.  
 p. 12 *Bathycrinus poculum* .. .. *Bathycrinus poculum*.  
 p. 14 *Rhizocrinus chuni* .. .. *Rhizocrinus chuni*.  
 p. 15 *Rhizocrinus weberi* .. .. *Rhizocrinus weberi*.  
 p. 18 *Isocrinus siboga* .. .. *Endoxocrinus siboga*.  
 p. 20 *Isocrinus naresianus* .. .. *Hypalocrinus naresianus*.  
 p. 35 *Metacrinus acutus* .. .. *Metacrinus acutus*.  
 p. 37 *Metacrinus serratus* .. .. *Metacrinus serratus*.  
 p. 39 *Metacrinus cingulatus* .. .. *Metacrinus cingulatus*.  
 p. 41 *Metacrinus varians* .. .. *Metacrinus varians*.  
 p. 43 *Metacrinus nobilis* .. .. *Metacrinus nobilis*.  
     var. *typica* .. .. var. *typica*.  
     var. *murrayi* .. .. var. *murrayi*.  
     var. *timorensis* .. .. var. *timorensis*.  
 p. 47 *Metacrinus suluensis* .. .. *Metacrinus suluensis*.  
 p. 48 *Metacrinus superbus* .. .. *Metacrinus superbus*.

CRINOIDS OBTAINED BY THE "SEA LARK" EXPEDITION  
 TO THE SOUTH-WESTERN PART OF THE INDIAN OCEAN.

F. Jeffrey Bell, 1909.

- p. 20 *Actinometra multiradiata* .. .. *Comatella maculata*.  
*Antedon carinata* .. .. ? *Cosmiometra gardineri*.  
*Antedon palmata* .. .. *Stephanometra indica*.  
*Antedon spicata* .. .. *Cenometra emendatrix*.

## 7. CHANGES IN CLASSIFICATION.

A few innovations in classification have been incorporated in this report which seem to be called for by recent accessions to our knowledge. The family Tropiometridæ, including the genera *Tropiometra*, *Calometra*, *Ptilometra*, *Pterometra*, and *Asterometra*, has proved to be quite artificial. It is true that the species of all these genera agree in having the muscles very greatly reduced and the arms ending very abruptly as if broken off, but I find upon close study that the muscles have been reduced from three distinct original types, while the abbreviated arm tips occur in one of the genera of the Thalassometridæ. I have therefore retained the family Tropiometridæ as covering *Tropiometra* only, a curious genus with no very close affinities, created a new family Calometridæ containing four new genera for the numerous species which I formerly placed in *Calometra*, and placed *Ptilometra*, *Pterometra*, and *Asterometra* in the Thalassometridæ where they undoubtedly belong. The Charitometridæ I have made a family instead of a subfamily, of equal rank with the family Thalassometridæ (formerly the subfamily Thalassometrinxæ).

Recent discoveries have shown that the Zygometridæ are not nearly so sharply differentiated from the so-called Himerometridæ as was previously supposed, and it has seemed best to discard the latter family altogether, raising the three subfamilies previously included within it to family rank.

## 8. KEYS FOR THE IDENTIFICATION OF EAST INDIAN CRINOIDS.

To facilitate the identification of Indian Ocean crinoids analytical keys are given to the higher groups and to the genera. At the present time the determination of the families and genera presents a problem of no little difficulty owing to the scattered literature and to the fragmentary way in which the present classification has been built up. This has been, unfortunately, unavoidable; it is due mainly to the enormous additions to the numbers of known species within the past few years, additions affecting first one group and then another, so that no stable classification has heretofore been possible. Each classification proposed has in turn fallen as a result of the discovery of many new species completely altering our concept of the crinoid fauna as a whole.

It has not been considered necessary to carry the keys beyond the genera, as almost all of the species have been described within very recent years, and the descriptions are easily obtainable. Moreover, large accessions to the numbers of new species are to be expected in the near future which would soon render specific keys obsolete and misleading, while it is not probable that the interrelationships of the genera will be greatly altered for some time to come.

The following keys are arranged only for the East Indian representatives of the families and genera given, and consequently are not always available for



Atlantic forms. Many of the Atlantic genera are very close to the corresponding East Indian genera, and their inclusion in these keys, while serving no useful purpose, might lead to considerable confusion.

## 9. EXPLANATION OF TERMS.

In the description of a comatulid the number of the cirri is expressed by Roman numerals, and the number of their component segments by Arabic; thus "cirri XVII, 25" means that the animal has seventeen cirri, each with twenty-five segments.

The division series are indicated by the letters "Br," preceded by the number of the series; thus "I Br" means the first division series following the radials, the "costals" of P. H. Carpenter's terminology in his later works, and the "second and third radials" of the "Challenger" reports; "II Br" is equivalent to "distichal series," "III Br" to "palmar series," "IV Br" to "post-palmar series," etc. The individual elements of the division series are indicated by so-called inferior numbers; thus IIBr<sub>1</sub> means the first distichal, or the first ossicle of the second division series.

The presence of a syzygy is indicated by the use of the symbol "+"; thus IIBr 4 (3+4) means that the second division series, the "distichals," is composed of four ossicles of which the third and fourth are united by syzygy. In the "Challenger" report this is expressed as "three distichals, with a syzygy in the axillary."

The outer pinnules of an arm are numbered in regular sequence, P<sub>1</sub>, P<sub>2</sub>, P<sub>3</sub>, etc.; the inner pinnules are lettered P<sub>a</sub>, P<sub>b</sub>, P<sub>c</sub>, etc. The I Br, or "costal," pinnule (only found in the genus *Eudiocrinus*) is given as P<sub>0</sub>, the II Br, or "distichal," pinnule as P<sub>D</sub>, and the III Br, or "palmar," pinnule as P<sub>P</sub>, the use of these inferior capitals serving to differentiate these pinnules from those of the inner side of the arm.

### 1.—KEY TO THE SUBORDERS OF THE COMATULIDA.<sup>1</sup>

a<sup>1</sup> Cavity in the centrodorsal containing the chambered organ and overlying structures very small; both the radial and interradial processes of the rosette form "spout-like" processes; rosette sunk below the level of the dorsal surface of the radials; pinnules, at least the proximal, wholly or in part prismatic, and composed of short segments; the post-radial series usually divide two or more times.

COMATULIDA OLIGOPHREATA, p. 68.

(Cf. keys 2-5; 7-18.)

<sup>1</sup> In the following keys the oligophreate families are not kept separate from the macrophreate, but all the families are considered as if belonging to a single suborder. This renders accurate identification much more easy, as in many cases, while the family characters are prominent, the subordinal characters are very obscure. The family names in the keys are preceded with the letters "O" or "M" in parentheses, signifying to which of the suborders they belong, so that an individual whose family rank is determined may be readily tested in the key to the suborders.

a<sup>2</sup> cavity in the centrodorsal containing the chambered organ and overlying structures very large; only the interradial processes of the rosette (when present) form "spout-like" processes; rosette nearly or quite on a level with the dorsal surface of the radials; pinnules all cylindrical or more or less flattened, and slender, all (rarely excepting P<sub>1</sub>) composed of much elongated segments; the post-radial series divide but once, or not at all.

COMATULIDA MACROPHREATA, p. 227.  
(*Cf.* keys 2—5; 19—22.)

2.—KEY TO THE COMATULID FAMILIES.

a<sup>1</sup> the arms do not divide, but are composed of a linear series of ossicles, of which the radial is the first.

b<sup>1</sup> five short arms; a pseudo-syzygy between the first two post-radial ossicles, and a syzygy between the fifth and sixth; proximal pinnules stout and triangular in cross section; disk small and compact, never black.

(O) ZYGOMETRIDÆ, p. 99.  
(*Cf.* keys 3—5; 9.)

b<sup>2</sup> five or ten very long and very slender arms; the first syzygy is between the fourth and fifth post-radial ossicles; proximal pinnules long and very slender, cylindrical or slightly flattened; disk black, the perisome extending far up on the arms.

(M) PENTAMETROCRINIDÆ, p. 247.  
(*Cf.* keys 3, 4, 21.)

a<sup>2</sup> the arms always divide at the second post-radial ossicle, and may divide still further.

b<sup>1</sup> a circlet of basals separates the centrodorsal from the radials; centrodorsal long, conical, the cirrus sockets in 10 or 15 columns, well-separated, each with a raised horse-shoe-shaped rim proximally and laterally; no pinnules on the first 10 or 12 brachials.

(M) ATELECRINIDÆ, p. 251.  
(*Cf.* keys 4, 22.)

b<sup>2</sup> no basals; cirrus sockets without a raised rim; pinnules from the second, or at furthest the fourth, brachial, onward.

c<sup>1</sup> oral pinnules long and slender, composed of very numerous short segments and bearing a comb distally; mouth usually marginal to subcentral; anal tube usually central.

(O) COMASTERIDÆ, p. 68.  
(*Cf.* keys 4, 5, 7, 8.)

c<sup>2</sup> oral pinnules smooth distally, without a comb; mouth always quite, or very nearly, central; anal tube lateral.

d<sup>1</sup> elements of the IBr series united by pseudo-syzygy, in external view appearing just as if united by a true syzygy.

(O) ZYGOMETRIDÆ, p. 99.

(Cf. keys 3—5; 9.)

d<sup>2</sup> elements of the IBr series united by synarthry.

e<sup>1</sup> all the pinnules sharply triangular or prismatic, rather stout, the outer with comparatively short segments which do not have swollen articulations, their ambulacra bordered with well-developed side and covering plates.

f<sup>1</sup> P<sub>1</sub> very delicate, flexible, and weak, the first two segments, especially the former, greatly enlarged, the remainder very small and squarish; P<sub>2</sub> or P<sub>3</sub> much enlarged and stiffened, with elongated segments; elements of the division series thin dorsoventrally and well separated, but sometimes with broad, more or less irregular, ventrolateral processes; disk globose, compact, entirely enclosed by a solid pavement of plates; muscular fossæ on the articular faces of the radials transversely linear.

(O) CALOMETRIDÆ, p. 177.

(Cf. keys 4, 5, 16.)

f<sup>2</sup> P<sub>1</sub> without any special modification of the earlier segments, longer than, or resembling P<sub>2</sub>, which resembles the succeeding pinnules; elements of the division series very deep dorsoventrally and sharply flattened laterally against their neighbours, without ventrolateral processes; ventral surface of disk usually slightly concave, the sides not visible exteriorly; disk studded with rounded calcareous plates which very rarely form a compact pavement; muscular fossæ on the articular faces of the radials very high, much higher than broad.

g<sup>1</sup> cirri comparatively slender, often enormously elongated, with at least 25 segments, of which the distal are short and bear dorsal spines; P<sub>1</sub> usually much enlarged, with stout segments, more rarely like P<sub>2</sub> but slightly shorter; the genital pinnules are not expanded.

(O) THALASSOMETRIDÆ, p. 188.

(Cf. keys 4, 5, 17.)

g<sup>2</sup> cirri stout, with less than 25 segments which are subequal and do not develop dorsal spines distally; P<sub>1</sub> and P<sub>2</sub> longer and more slender than the following, composed of very numerous short segments; genital pinnules expanded, protecting the genital glands.

(O) CHARITOMETRIDÆ, p. 215.

(Cf. keys 4, 5, 18.)

e<sup>2</sup> at least the distal pinnules exceedingly slender, cylindrical, composed of much elongated segments, the articulations somewhat swollen; side and covering plates entirely absent, or feebly developed and not visible in ordinary examination.

f<sup>1</sup> genital pinnules triangular in cross section, and longer than the distal; cirri short, stout, with subequal segments which do not bear dorsal spines distally.

(O) TROPIOMETRIDÆ, p. 176.

(Cf. keys 4, 15.)

f<sup>2</sup> genital pinnules slender and cylindrical like the distal, but shorter.  
g<sup>1</sup> cirrus segments subequal, almost never longer than broad, bearing a serrate transverse ridge (rarely two) or paired or tricuspid spines dorsally; enlarged lower pinnules with spinous processes on the distal ends of the segments.

(O) COLOBOMETRIDÆ, p. 153.

(Cf. keys 4, 5, 14.)

g<sup>2</sup> some at least of the cirrus segments longer than broad; cirri smooth, carinate dorsally, or bearing single median dorsal spines.

h<sup>1</sup> P<sub>1</sub> slender and delicate, usually flagellate, with much elongated segments; cirri delicate, deciduous, with much expanded articulations, at least in the proximal half; very rarely more than ten arms; brachials triangular, as long as, or longer than, broad; syzygies regularly distributed.<sup>1</sup>

(M) ANTEDONIDÆ, p. 227.

(Cf. keys 4, 5, 19, 20.)

h<sup>2</sup> cirri robust, tenacious, the articulations not expanded, or only very slightly so; brachials wedge-shaped or discoidal, broader than long; syzygies irregularly spaced, occurring only at long intervals; almost always more than ten arms; if only ten arms the brachials are very short and discoidal.

i<sup>1</sup> IBr 4 (3+4), or with ten arms.

(O) HIMEROMETRIDÆ, p. 107.

(Cf. keys 4, 5, 10.)

i<sup>2</sup> IBr 2.

j<sup>1</sup> P<sub>1</sub> greatly elongated, much longer than the very short succeeding pinnules.

(O) PONTIOMETRIDÆ, p. 138.

(Cf. keys 5, 12.)

<sup>1</sup> The East Indian species are all of small size; the largest as well as the smallest of the comatulids belong to this family.

$j^3$   $P_1$  usually small and weak, much shorter than the succeeding pinnules, rarely similar to, and as large as, or slightly larger than  $P_{\frac{1}{2}}$ .

$k^1$  one or more of the proximal pinnules enlarged, stiffened, and spine-like, usually with less than 18 segments; division series well separated, the component ossicles with prominent ventrolateral processes.

(O) STEPHANOMETRIDÆ, p. 131.

(Cf. keys 5, 11.)

$k^3$  proximal pinnules all flagellate, at least distally, with more than 20 segments; division series usually in close apposition laterally, without lateral processes.

(O) MARIAMETRIDÆ, p. 139.

(Cf. keys 5, 13.)

### 3.—KEY TO THE FAMILIES OF THE COMATULIDS INCLUDING SPECIES WITH FIVE ARMS ONLY.

$a^1$  Arms short; a pseudo-syzygy between the first two post-radial ossicles (the equivalents of the elements of the IBr series) and a syzygy between the fifth and sixth; proximal pinnules stout and triangular, with short segments, the first always on the second and the second always on the fourth post-radial ossicle; third post-radial ossicle always without a pinnule; disk small and compact, never black.

(O) ZYGOMETRIDÆ, p. 99.

(Cf. key 9.)

$a^2$  arms very long and exceedingly slender; never a pseudo-syzygy between the first two post-radial ossicles (IBr series absent); proximal pinnules exceedingly slender, with much elongated segments; first pinnule usually on the fourth post-radial ossicle; but if it occurs on the second, then the second is on the third; disk large, extending far up on the arms, black in colour.

(M) PENTAMETROCRINIDÆ, p. 247.

(Cf. key 21.)

### 4.—KEYS TO THE FAMILIES OF THE COMATULIDS INCLUDING SPECIES WITH TEN ARMS.

$a^1$  Ten radials, each bearing an undivided arm.

(M) PENTAMETROCRINIDÆ, p. 247.

(Cf. key 21.)

$a^2$  five radials, each bearing a post-radial series which divides once.

$b^1$  a cirlet of basals separates the centrodorsal from the radials; centrodorsal

long, conical, the cirrus sockets in two or three columns in each radial area, well separated, each with a raised horse-shoe-shaped rim which surrounds it proximally and laterally; no pinnules on the first 10 or 12 brachials.

(M) ATELECRINIDÆ, p. 251.

(Cf. key 22.)

b<sup>2</sup> no basals; cirrus sockets without a raised rim; pinnules from the second, or at furthest the fourth, brachial, onward.

c<sup>1</sup> oral pinnules long and slender, composed of very numerous short segments and bearing a terminal comb; mouth usually marginal to sub-central; anal tube usually central.

(O) COMASTERIDÆ, p. 68.

(Cf. keys 5, 7, 8.)

c<sup>2</sup> oral pinnules smooth distally, without a comb; mouth always central, or nearly so; anal tube lateral.

d<sup>1</sup> elements of the IBr series united by pseudo-syzygy, not differing externally from a true syzygy.

(O) ZYGOMETRIDÆ, p. 99.

(Cf. keys 5, 9.)

d<sup>2</sup> elements of the IBr series united by synarthry.

e<sup>1</sup> all the pinnules sharply triangular or prismatic, rather stout, the outer with comparatively short segments which do not have swollen articulations, their ambulacra bordered with well-developed side and covering plates.

f<sup>1</sup> P<sub>1</sub> very delicate, short, flexible, and weak, the first two segments greatly enlarged, the remainder very small and squarish; P<sub>2</sub> much enlarged and stiffened, with elongated segments; elements of the division series thin dorsoventrally and well separated, but sometimes with more or less irregular ventrolateral processes; disk globose, compact, entirely enclosed by a solid pavement of plates; muscular fossæ on the articular faces of the radials transversely linear.

(O) CALOMETRIDÆ, p. 177.

(Cf. keys 5, 16.)

f<sup>2</sup> P<sub>1</sub> longer than P<sub>2</sub>, or, if shorter, of the same character; P<sub>2</sub> resembling the succeeding pinnules; elements of the division series very deep dorsoventrally and sharply flattened laterally against their neighbours, without ventrolateral processes; ventral surface of disk usually slightly concave, the sides not visible; disk studded with rounded calcareous plates which very rarely form a compact pavement; muscular fossæ on the articular faces of the radials very high, much higher than broad, and narrow.

$g^1$  cirri comparatively slender, with more than 25 segments, the distal short and bearing dorsal spines;  $P_1$  usually much enlarged with stout segments, sometimes like  $P_2$  but shorter; genital pinnules not expanded.

(O) THALASSOMETRIDÆ, p. 188.

(Cf. keys 5, 17.)

$g^2$  cirri stout with usually less than 25 segments which are subequal and do not develop dorsal spines distally;  $P_1$  and  $P_2$  longer and more slender than the following, composed of very numerous short segments; genital pinnules laterally expanded.

(O) CHARITOMETRIDÆ, p. 215.

(Cf. keys 5, 18.)

$e^2$  at least the distal pinnules exceedingly slender, cylindrical, composed of much elongated segments; side and covering plates entirely absent or feebly developed and not visible in ordinary examination.

$f^1$  genital pinnules prismatic and longer than the distal; cirri short, stout, with subequal segments which do not bear dorsal processes distally.

(O) TROPIOMETRIDÆ, p. 176.

(Cf. key 15.)

$f^2$  genital pinnules slender and cylindrical, of the same character as the distal, but shorter.

$g^1$  cirrus segments subequal, almost never longer than broad, bearing a serrate transverse ridge or paired or tricuspid spines dorsally;  $P_2$  and sometimes also  $P_3$  much enlarged, with spinous processes on the distal ends of the segments.

(O) COLOBOMETRIDÆ, p. 153.

(Cf. keys 5, 14.)

$g^2$  some at least of the cirrus segments longer than broad; cirri smooth, carinate dorsally, or bearing single median dorsal spines.

$h^1$  cirri robust, tenacious, the articulations not expanded; brachials exceedingly short, very much broader than long, discoidal;  $P_1$  shorter and weaker than  $P_2$ , with numerous short segments; syzygies irregularly spaced and widely separated.

(O) HIMEROMETRIDÆ, p. 107.

(Cf. keys 5, 10.)

$h^2$   $P_1$  slender and delicate, usually flagellate, with much elongated segments; cirri delicate, deciduous, with much expanded articulations, at least in the proximal half; syzygies regularly spaced and close together.

(M) ANTEDONIDÆ, p. 227.

(Cf. keys 5, 19, 20.)

## 5.—KEY TO THE FAMILIES OF COMATULIDS INCLUDING SPECIES WITH MORE THAN TEN ARMS.

a<sup>1</sup> Ten radials; each post-radial series divides once, giving twenty arms.

(M) ANTEDONIDÆ, p. 227.

(Cf. keys 19, 20.)

a<sup>2</sup> five radials; one or more of the post-radial series divides at least twice.

b<sup>1</sup> IBr 2.

c<sup>1</sup> oral pinnules long and slender, composed of very numerous short segments and bearing a comb distally; mouth usually marginal to sub-central; anal tube usually central, or nearly so.

(O) COMASTERIDÆ, p. 68.

(Cf. keys 7, 8.)

c<sup>2</sup> oral pinnules smooth distally, without a comb; mouth always central; anal tube lateral.

d<sup>1</sup> elements of the IBr series united by pseudo-syzygy, appearing like a true syzygy externally.

(O) ZYGOMETRIDÆ, p. 99.

(Cf. key 9.)

d<sup>2</sup> elements of the IBr series united by synarthry.

e<sup>1</sup> all the pinnules sharply triangular or prismatic, rather stout, the outer with comparatively short segments which do not have swollen articulations; pinnule ambulacra bordered with well-developed side and covering plates.

f<sup>1</sup> P<sub>1</sub> very delicate, flexible, and weak, the first two segments greatly enlarged, the remainder very small and squarish; P<sub>2</sub> and usually also some of the following pinnules much elongated, enlarged, and stiffened, with elongated segments; elements of the division series thin dorsoventrally and well separated, but sometimes with broad, more or less irregular, ventrolateral processes; disk globose, compact, entirely enclosed by a solid pavement of plates; muscular fossæ on the articular faces of the radials transversely linear.

(O) CALOMETRIDÆ, p. 177.

(Cf. key 16.)

f<sup>2</sup> P<sub>1</sub> longer than P<sub>2</sub>; or, if shorter, resembling it; P<sub>2</sub> resembling the succeeding pinnules; elements of the division series very deep dorsoventrally and sharply flattened laterally against their neighbours, without ventrolateral processes; ventral surface of disk usually concave, the sides not visible; surface of disk studded with rounded calcareous plates which very rarely form a compact pavement; muscular fossæ on the articular faces of the radials very high, much higher than broad.



$g^1$  cirri comparatively slender, with more than 25 segments, of which the distal are short and bear dorsal spines;  $P_1$  usually much enlarged with stout segments, sometimes like  $P_2$  but slightly shorter; genital pinnules not expanded.

(O) THALASSOMETRIDÆ, p. 188.

(Cf. key 17.)

$g^2$  cirri stout, with usually less than 25 segments which are subequal and do not develop dorsal spines distally;  $P_1$  and  $P_2$  longer and more slender than the following, composed of very numerous short segments; genital pinnules expanded.

(O) CHARITOMETRIDÆ, p. 215.

(Cf. key 18.)

$e^1$  middle and distal pinnules slender, cylindrical, composed of elongated segments which, in the distal, have swollen articulations; side and covering plates entirely absent, or very feebly developed.

$f^1$  cirrus segments subequal, almost never longer than broad, bearing paired spines dorsally; lower pinnules with spinous processes on the distal ends of the segments.

(O) COLOBOMETRIDÆ, p. 153.

(Cf. key 14.)

$f^2$  some at least of the cirrus segments as long as or longer than broad; cirri smooth, carinate dorsally, or bearing single median dorsal spines.

$g^1$   $P_1$  slender and delicate, usually flagellate, with much elongated segments; cirri delicate, deciduous, with expanded articulations in the proximal half; never more than twelve arms.

(M) ANTEDONIDÆ, p. 227.

(Cf. keys 19, 20.)

$g^2$   $P_1$  if slender and delicate, composed of shorter and more numerous segments than its successors, which are considerably enlarged;  $P_1$  may be much longer than its successors with very numerous short segments, or it may resemble its successors in being stiff and spine-like; always at least twenty, usually over thirty, arms.

$h^1$  one or more of the proximal pinnules enlarged, stiffened, and spine-like, usually with less than 18 long segments; division series well separated, the component ossicles with prominent ventrolateral processes.

(O) STEPHANOMETRIDÆ, p. 131.

(Cf. key 11.)

h<sup>2</sup> none of the lower pinnules stiffened and spine-like; the enlarged lower pinnules have at least 20 segments and are flagellate distally; no ventrolateral processes on the division series.

i<sup>1</sup> P<sub>1</sub> greatly elongated, much longer than the very short succeeding pinnules; division series very widely separated.

(O) PONTIOMETRIDÆ, p. 138.

(Cf. key 12.)

i<sup>2</sup> P<sub>1</sub> shorter than the succeeding pinnules; division series usually in close lateral apposition.

(O) MARIAMETRIDÆ, p. 139.

(Cf. key 13.)

b<sup>3</sup> IBr 4 (3+4).

c<sup>1</sup> oral pinnules long and slender, composed of very numerous short segments and bearing a comb distally; mouth usually marginal to sub-central; anal tube usually lateral.

(O) COMASTERIDÆ, p. 68.

(Cf. key 7, 8.)

c<sup>1</sup> oral pinnules smooth distally, without a comb; mouth always central; anal tube lateral.

d<sup>1</sup> elements of the IBr series united by pseudo-syzygy, not differing externally from a true syzygy.

(O) ZYGOMETRIDÆ, p. 99.

(Cf. key 9.)

d<sup>2</sup> elements of the IBr series united by synarthry.

e<sup>1</sup> all the pinnules sharply triangular or prismatic, rather stout, the outer with comparatively short segments which do not have swollen articulations; pinnule ambulacra bordered with well-developed side and covering plates.

f<sup>1</sup> P<sub>1</sub> very delicate, flexible, and weak, the first two segments enlarged, the remainder very short and squarish; disk globose, compact, entirely enclosed by a solid pavement of small plates; muscular fossæ on the articular faces of the radials transversely linear.

(O) CALOMETRIDÆ, p. 177.

(Cf. key 16.)

f<sup>2</sup> P<sub>1</sub> longer than, or resembling P<sub>2</sub>; ventral surface of disk slightly concave, studded with scattered calcareous plates which rarely form a complete pavement; muscular fossæ on the articular faces of the radials high, much higher than broad, and narrow.

g<sup>1</sup> cirri comparatively slender, with more than 25 segments, of which the distal are short and bear dorsal spines; P<sub>1</sub> usually much

enlarged with stout segments, sometimes like  $P_2$  but slightly smaller; genital pinnules not expanded.

(O) THALASSOMETRIDÆ, p. 188.

(Cf. key 17.)

$g^2$  cirri stout, with usually less than 25 segments which are subequal and do not develop dorsal spines distally;  $P_1$  and  $P_3$  longer and more slender than the following pinnules and composed of very numerous short segments; genital pinnules expanded.

(O) CHARITOMETRIDÆ, p. 215.

(Cf. key 18.)

$e^2$  middle and distal pinnules slender, cylindrical, composed of elongated segments which, in the distal, have swollen articulations; side and covering plates entirely absent, or very feebly developed.

(O) HIMEROMETRIDÆ, p. 107.

(Cf. key 10.)

#### 6.—KEY TO THE FAMILIES OF THE STALKED CRINOIDS.

$a^1$  Stem entirely composed of very short more or less pentagonal columnars with petaloid markings upon their apposed faces, and including regularly spaced nodals bearing whorls of cirri; distal end of stem always discarded in the adult.

PENTACRINITIDÆ, p. 252.

(Cf. key 23.)

$a^2$  stem always terminating distally in a terminal stem plate or root; nodals and cirri entirely absent, or confined to the proximal portion of the stem and rudimentary.

$b^1$  proximal columnars pentagonal or stellate, sometimes including nodals bearing rudimentary cirri, but the greater part of the stem composed of short columnars which are circular in outline, and without nodals.

APIOCRINIDÆ, p. 271.

(Cf. key 24.)

$b^2$  all the columnars with circular or elliptical ends, never pentagonal or stellate; no trace of nodes or cirri.

$c^1$  columnars cylindrical, their articular faces marked with radial crenellæ; arm bases occupying only a part of the distal border of the radials; usually three basals.

HYOCRINIDÆ, p. 272.

(Cf. key 25.)

$c^2$  columnars with elliptical ends, the axes of succeeding ellipses making nearly or quite a right angle with each other, the articular faces marked

by a strong transverse ridge; always five basals; arm bases occupying the entire distal border of the radials.

d<sup>1</sup> stem terminating in a large heavy terminal plate; basals very small, triangular, barely in apposition laterally; at least eleven brachials before the first axillary; lowest pinnule on the fifth brachial (*i.e.*, anterior to the first axillary).

PHRYNOCRINIDÆ, p. 273.

(*Cf.* key 26.)

d<sup>2</sup> stem terminating in a diffuse branching root; basals large, trapezoidal, closely united or fused laterally; rays dividing on the second post-radial ossicle, or not at all; no pinnules anterior to the first axillary.

BOURGUETICRINIDÆ, p. 274.

(*Cf.* key 27.)

#### 7.—KEY TO THE SUBFAMILIES OF COMASTERIDÆ.

a<sup>1</sup> The distal segments of the cirri bear dorsal processes; the segments of the genital pinnules are not especially short nor broad.

b<sup>1</sup> ten or more arms; if the latter, the division series are all 2, or the IIBr series are 4 (3+4), the following 3 (2+3), and the first syzygy is, at least on the inner arms, between the first and second or second and third (never between the third and fourth) brachials.

CAPILLASTERINÆ, p. 68.

b<sup>2</sup> always more than ten arms; some or all of the IIBr series 4 (3+4); following division series 4 (3+4) or 2; a syzygy always occurs between the third and fourth brachials of the free undivided arms.

COMASTERINÆ, p. 83.

a<sup>2</sup> cirrus segments always smooth; segments of the genital pinnules very short and broad, more or less produced distally; rarely more than ten arms; IIBr series, when present, always like the IBr series, and united by pseudo-syzygy, appearing externally as if united by a true syzygy.

COMACTINIINÆ, p. 78.

#### 8.—KEY TO THE GENERA OF COMASTERIDÆ.

a<sup>1</sup> Elements of the IBr series and first two brachials united by pseudo-syzygy, not differing externally from a true syzygy; rarely more than ten arms; IIBr series, when present, similar to the IBr series and similarly united; segments of the genital pinnules very short and broad; cirri present or absent.

COMATULA, p. 78.

a<sup>2</sup> elements of the IBr series united by synarthry; or, if by pseudo-syzygy, the IIBr series are always present, 4 (3+4).

b<sup>1</sup> cirri present.

- c<sup>1</sup> cirri slender and numerous; all the segments elongated and without dorsal spines or projections.  
COMINIA, p. 83.
- c<sup>2</sup> cirri stout, comparatively few in number, the distal segments short and bearing dorsal processes.
- d<sup>1</sup> ten arms; synarthrial tubercles usually prominent.  
COMISSIA, p. 77.
- d<sup>2</sup> more than ten arms; synarthrial tubercles not developed.
- e<sup>1</sup> a pinnule on the first brachial of arms arising from a IIBr or subsequent axillary; a syzygy between the second and third brachials of the free undivided arm.  
CAPILLASTER, p. 73.
- e<sup>2</sup> no pinnule on the first brachial of any arm.
- f<sup>1</sup> division series all 2; a syzygy between the first two brachials, at least on the inner arms.  
COMATELLA, p. 68.
- f<sup>2</sup> at least half of the IIBr or further division series 4 (3+4).
- g<sup>1</sup> IIBr series 4 (3+4), further division series 2 (1+2), or 2; proximal pinnules more slender than the succeeding; terminal combs occur at intervals on the distal pinnules.  
COMASTER, p. 83.
- g<sup>2</sup> some or all of the outer division series 4 (3+4); proximal pinnules stouter than the succeeding; no combs on the distal pinnules.
- h<sup>1</sup> IIB series all 2.  
COMANTHERIA, p. 89.
- h<sup>2</sup> IIBr series 2 externally, 4 (3+4) internally.  
COMANTHINA, p. 91.
- h<sup>3</sup> IIBr series 4 (3+4).  
COMANTHUS, p. 89.
- b<sup>2</sup> cirri absent; centrodorsal reduced to a small thin pentagonal or stellate plate.
- c<sup>1</sup> a pinnule on the first brachial of arms springing from a IIBr or subsequent axillary.  
CAPILLASTER, p. 73.
- c<sup>2</sup> the first brachial never bears a pinnule.
- d<sup>1</sup> IIBr series 4 (3+4); subsequent series 2 (1+2) or 2; proximal pinnules more slender than the succeeding; terminal combs occur at intervals along the distal pinnules.  
COMASTER, p. 83.

d<sup>2</sup> some or all of the distal division series 4 (3+4); no division series 2 (1+2); proximal pinnules stouter than the succeeding; no combs on the distal pinnules.

e<sup>1</sup> III Br series all 2.

COMANTHERIA, p. 89.

e<sup>2</sup> III B series 2 externally, 4 (3+4) internally.

COMANTHINA, p. 91.

e<sup>3</sup> III Br series 4 (3+4).

COMANTHUS, p. 89.

9.—KEY TO THE GENERA OF ZYOMETRIDÆ.

a<sup>1</sup> Five arms only.

EUDIOCRINUS, p. 99.

a<sup>2</sup> ten or more arms.

b<sup>1</sup> cirri short and stout, without dorsal spines or tubercles, and composed of less than 25 segments.

CATOPTOMETRA, p. 106.

b<sup>2</sup> cirri long and more slender, with at least 20, and usually more than 30, segments, of which the distal bear sharp dorsal spines.

ZYOMETRA, p. 103.

10.—KEY TO THE GENERA OF HIMEROMETRIDÆ.

a<sup>1</sup> P<sub>D</sub> larger and longer than P<sub>1</sub>, which in turn is larger and longer than P<sub>2</sub>; more than 30 arms.

HIMEROMETRA, p. 114.

a<sup>2</sup> P<sub>D</sub> smaller and weaker than P<sub>1</sub>, which, again, is smaller and weaker than P<sub>2</sub>.

b<sup>1</sup> cirri tapering to a point distally; distal cirrus segments twice as long as broad; no dorsal spines nor carination, and no opposing spine; terminal claw long and nearly straight; more than ten arms.

CRASPEDOMETRA, p. 117.

b<sup>2</sup> cirri uniform, not tapering distally; distal segments not so long as broad, carinate, tubercular, or spinous dorsally; opposing spine present; terminal claw short, more or less strongly curved.

c<sup>1</sup> middle and distal brachials exceedingly short and discoidal; IBr ossicles and lower brachials swollen; ten or more arms.

AMPHIMETRA, p. 107.

c<sup>2</sup> middle and distal brachials not especially short, more or less obliquely wedge-shaped; ossicles of the IBr series and lower brachials not swollen; more than ten arms.

HETEROMETRA, p. 120.

## 11.—KEY TO THE GENERA OF STEPHANOMETRIDÆ.

a<sup>1</sup> Cirri long with more than 50 segments; P<sub>1</sub> and P<sub>2</sub> the longest, with about 25 short segments.

OXYMETRA, p. 131.

a<sup>2</sup> cirri short, with less than 35 segments; the spine-like lower pinnules have less than 20 segments.

STEPHANOMETRA, p. 132.

## 12.—KEY TO THE GENERA OF PONTIOMETRIDÆ.

a<sup>1</sup> Size large; all the pinnules present; P<sub>1</sub> on the outer arms by far the longest pinnule; more than 40 cirrus segments.

PONTIOMETRA, p. 138.

a<sup>2</sup> size small; P<sub>α</sub> absent on the outer arms, P<sub>α</sub> and P<sub>1</sub> on the inner; P<sub>β</sub> on the inner arms the longest pinnule; less than 40 cirrus segments.

EPIMETRA, p. 138.

## 13.—KEY TO THE GENERA OF MARIAMETRIDÆ.

a<sup>1</sup> Disk plated; division series with a fine median carination; sides of division series and first two brachials with a tuberculous or finely spinous ornamentation.

MARIAMETRA, p. 139.

a<sup>2</sup> disk naked; division series without any trace of a median carination; sides of division series and of the first two brachials without any ornamentation.

b<sup>1</sup> cirri long, with 45 or more segments.

SELENOMETRA, p. 139

b<sup>2</sup> cirri shorter, with fewer than 40 segments.

DICHROMETRA, p. 143.

## 14.—KEY TO THE GENERA OF COLOBOMETRIDÆ.

a<sup>1</sup> P<sub>α</sub> absent on all or nearly all of the arms.

b<sup>1</sup> cirri long and comparatively slender with 24 or more segments, the more proximal with spinous distal ends, the distal with paired dorsal spines; proximal pinnule segments slightly longer than the distal; all the pinnules, especially the proximal, stiffened, with very spinous distal ends to the component segments; none of the lower pinnules greatly longer than the others; ten arms.

COLOBOMETRA, p. 164.

b<sup>2</sup> cirri short and stout with less than 30 segments which are usually subequal, none with spinous distal ends, at least dorsally; outer cirrus segments with paired or tricuspid spines dorsally; one or two of the proximal pinnules enlarged and stiffened, but the remaining pinnules soft and delicate.

c<sup>1</sup> more than ten arms.

CYLOMETRA, p. 156.

c<sup>2</sup> ten arms.

DECAMETRA, p. 158.

a<sup>2</sup> P<sub>a</sub> present on all the arms.

b<sup>1</sup> ten arms; size small; distal cirrus segments nearly or quite as long as broad, cirrus segments with a strong serrate transverse ridge (rarely two); usually several of the proximal pinnules have segments with strongly produced and spinous distal ends.

OLIGOMETRA, p. 168.

b<sup>2</sup> more than ten arms; size medium or large; cirrus segments subequal, short, bearing dorsally paired spines or tubercles; segments of the greatly enlarged P<sub>2</sub> with produced and spinous distal ends; P<sub>2</sub> much larger and stiffer than P<sub>1</sub> or P<sub>3</sub>, recurved and horn-like.

CENOMETRA, p. 153.

#### 15.—FAMILY TROPIOMETRIDÆ.

The family Tropiometridæ includes only the single genus *Tropiometra*.

#### 16.—KEY TO THE GENERA OF CALOMETRIDÆ.

a<sup>1</sup> IBr series 4 (3+4).

OREOMETRA, p. 179.

a<sup>2</sup> IBr series 2, or with ten arms only.

b<sup>1</sup> all the lower pinnules slender, comparatively short, subequal in length; 10-15 arms.

CALOMETRA, p. 177.

b<sup>2</sup> P<sub>1</sub> or P<sub>2</sub> considerably longer than, usually from half again to twice as long as, the earlier genital pinnules, more or less enlarged and stiffened; more than 15 arms.

c<sup>1</sup> rays and division series in apposition laterally through more or less irregularly developed lateral processes; the lower part of the animal is compact, the sides making a comparatively small angle with the dorsoventral axis.

PECTINOMETRA, p. 185.

c<sup>2</sup> rays and division series (at least beyond the IBr<sub>1</sub>) very widely separated, with smooth lateral margins; the rays and division series make a very large angle with the dorsoventral axis, sometimes being practically at right angles to it.

d<sup>1</sup> the anterior interradial processes of the radials separate widely the bases of the IBr<sub>1</sub>; the lower pinnules are comparatively stout; arms short, with less than 100 brachials.

NEOMETRA, p. 181.

d<sup>2</sup> the anterior interradial processes of the radials are narrow and short, so that the IBr<sub>1</sub> are in apposition beyond them; the lower pinnules are very slender; arms long, with more than 120 brachials.

GEPHYROMETRA, p. 184.



## 17.—KEY TO THE GENERA OF THALASSOMETRIDÆ.

- a<sup>1</sup> P<sub>1</sub> shorter and smaller than P<sub>2</sub>, but similar to it.  
 b<sub>1</sub> cirrus sockets close together, irregularly distributed, but tending to arrange themselves in fifteen columns, or in three columns in each radial area ; 12—30 arms.  
 PTILOMETRA, p. 189.
- b<sup>2</sup> cirrus sockets not crowded, arranged in ten columns, two in each radial area.  
 c<sup>1</sup> cirri comparatively stout distally, with the ventral surface smooth ; 10—20 arms.  
 ASTEROMETRA, p. 190.
- c<sup>2</sup> cirri slender distally, the proximal segments bearing long ventral spines ; 15—30 arms.  
 PTEROMETRA, p. 189.
- a<sup>2</sup> P<sub>1</sub> larger and longer than P<sub>2</sub>.  
 b<sup>1</sup> ten arms.  
 c<sup>1</sup> calyx and arm bases spinous.  
 THALASSOMETRA, p. 195.
- c<sup>2</sup> calyx and arm bases smooth.  
 d<sup>1</sup> calyx and arm bases rounded, not carinate ; cirri very stout.  
 CROTALOMETRA, p. 209.
- d<sup>2</sup> IBr series strongly carinate.  
 c<sup>1</sup> P<sub>1</sub> only slightly larger than P<sub>2</sub> ; arms strongly carinate throughout.  
 STENOMETRA, p. 209.
- e<sup>2</sup> P<sub>1</sub> much larger than P<sub>2</sub> ; arms rounded, not carinate.  
 STIREMETRA, p. 210.
- b<sup>2</sup> more than ten arms.  
 c<sup>1</sup> calyx and arm bases very spinous ; P<sub>1</sub> very much larger than P<sub>2</sub>.  
 THALASSOMETRA, p. 195.
- c<sup>2</sup> calyx and arm bases not spinous ; P<sub>1</sub> not greatly larger than P<sub>2</sub> ; division series all 2.  
 d<sup>1</sup> division series and arms strongly carinate throughout.  
 STENOMETRA, p. 209.
- d<sup>2</sup> division series and arms with no trace of, or with only a very faintly indicated, carination.  
 e<sup>1</sup> less than 30 cirrus segments ; genital pinnules short ; lateral flattening of rays not marked.  
 PARAMETRA, p. 213.
- e<sup>2</sup> more than 40 cirrus segments ; genital pinnules moderately long ; rays and division series (when present) sharply flattened laterally.  
 COSMIOMETRA, p. 214.

## 18.—KEY TO THE GENERA OF CHARITOMETRIDÆ.

a<sup>1</sup> IBr and further division series (when present) with a prominent tubercular ornamentation, and a more or less marked tuberculous median keel; rarely more than ten arms.

GLYPTOMETRA, p. 224.

a<sup>2</sup> IBr and further division series (when present) without any tubercular ornamentation, and without a median keel.

b<sup>1</sup> IBr segments and first two brachials with the proximal and lateral edges produced, forming thin flange-like dorsolateral borders; ten arms.

PŒCILOMETRA, p. 225.

b<sup>2</sup> IBr segments and lower brachials with the dorsolateral borders not produced.

c<sup>1</sup> third and fourth segments of the genital pinnules broad and nearly flat on the outer side, but the fifth segment smaller; ten arms.

d<sup>1</sup> less than 12 cirrus segments; elements of the IBr series and arm bases diverging at a wide angle so that the lower part of the animal is broad and rounded.

STROTOMETRA, p. 226.

d<sup>2</sup> more than 15 cirrus segments; IBr series and arm bases diverging at a relatively small angle so that the lower part of the animal appears conical.

CHARITOMETRA, p. 226.

c<sup>2</sup> genital pinnules evenly, and only slightly, expanded.

d<sup>1</sup> more than ten arms; division series and arm bases rounded dorsally.

PACHYLOMETRA, p. 215.

d<sup>2</sup> ten arms; division series and arm bases subcarinate.

CHLOROMETRA, p. 225.

## 19.—KEY TO THE SUBFAMILIES OF ANTEDONIDÆ.

a<sup>1</sup> Centrodorsal large, conical, the cirrus sockets well separated, at least laterally, and arranged in definite columns; cirri absent from the interradial portions of the centrodorsal; the cirri are large and long, with numerous segments.

ZENOMETRINÆ, p. 233.

a<sup>2</sup> centrodorsal smaller, rounded conical to hemispherical or even discoidal, the cirrus sockets exhibiting no regular arrangement and usually closely crowded.

b<sup>1</sup> one or more of the proximal pinnules is absent; the cirri, which have numerous segments, shorter distally than proximally, are evenly distributed and closely crowded on a hemispherical or more or less conical centrodorsal.

PEROMETRINÆ, p. 232.

b<sup>2</sup> all the pinnules are present.

c<sup>1</sup> P<sub>2</sub> bears a genital gland and, with the following, is as long as, or even much longer than, the first; the cirri are short with few segments.

BATHYMETRINÆ, p. 244.

c<sup>2</sup> P<sub>2</sub> does not bear a genital gland.

d<sup>1</sup> cirri long, compressed, deciduous, the distal segments slightly or not at all shorter than the proximal; there are no dorsal spines; opposing spine absent, more rarely feebly developed; P<sub>1</sub> is composed of numerous squarish or rounded segments, or much reduced.

THYSANOMETRINÆ, p. 242.

d<sup>2</sup> cirri few, short, with few segments, which are shorter distally than proximally, irregularly disposed on a low hemispherical centrodorsal; an opposing spine is present on the penultimate, but there are no dorsal spines.

ANTEDONINÆ, p. 227.

d<sup>3</sup> cirri numerous, long, composed of numerous segments which are much shorter distally than proximally, with the distal segments spinous or strongly carinate, and evenly distributed over and closely crowded on a large hemispherical or rounded conical centrodorsal

HELIOMETRINÆ, p. 238.

#### 20.—KEY TO THE GENERA OF ANTEDONIDÆ.

a<sup>1</sup> P<sub>α</sub> absent.

b<sup>1</sup> cirri in ten well-separated columns on a long conical centrodorsal; P<sub>1</sub> also absent.

BALANOMETRA, p. 238.

b<sup>2</sup> cirri closely crowded on a rounded conical or hemispherical centrodorsal; P<sub>1</sub> present.

c<sup>1</sup> interradial areas with two or more columns of perisomic plates; IBr series and lower brachials rounded and free laterally; synarthrial tubercles not developed; size very small.

ERYTHROMETRA, p. 233.

c<sup>2</sup> disk naked; IBr series and lower brachials in close apposition and strongly flattened laterally; synarthrial tubercles very prominent; size medium.

PEROMETRA, p. 232.

a<sup>2</sup> P<sub>α</sub> present.

b<sup>1</sup> P<sub>2</sub> bears a genital gland; size usually very small.

c<sup>1</sup> P<sub>1</sub> as long as, or slightly longer than, P<sub>2</sub>.

THAUMATOMETRA, p. 245.

c<sup>2</sup> P<sub>1</sub> shorter than P<sub>2</sub>.

BATHYMETRA, p. 244.

b<sup>2</sup> P<sub>2</sub> without a genital gland.

e<sup>1</sup> centrodorsal large, conical or more or less columnar, the cirrus sockets in definite columns.

d<sup>1</sup> two columns of cirrus sockets in each radial area; cirri with short segments distally, bearing dorsal spines; size small.

ADELOMETRA, p. 238.

d<sup>2</sup> three or more columns of cirrus sockets in each radial area.

e<sup>1</sup> three or more columns of cirrus sockets in each radial area; cirri smooth, all the segments elongated; calyx and arm bases smooth; size usually medium or large.

PSATHYROMETRA, p. 234.

e<sup>2</sup> three columns of cirrus sockets in each radial area; cirri long, with long segments proximally, short and spiny segments distally; calyx and arm bases very spiny; size medium or large.

ZENOMETRA, p. 234.

c<sup>2</sup> centrodorsal moderate or small, hemispherical or more or less discoidal, the cirri irregularly arranged and closely crowded.

d<sup>1</sup> cirri slender, much compressed, smooth, all the segments greatly elongated; no opposing spine; terminal claw nearly straight.

e<sup>1</sup> all the lower pinnules subequal, much elongated; P<sub>1</sub> composed of very numerous short segments, P<sub>2</sub> and following of elongated segments.

THYSANOMETRA, p. 244.

e<sup>2</sup> P<sub>1</sub> much shorter than P<sub>2</sub>, but, like it, composed of elongated segments; P<sub>2</sub> or P<sub>3</sub>, or both, enlarged and stiffened.

EUMETRA, p. 242.

d<sup>2</sup> distal cirrus segments shorter than the proximal (the latter centrally constricted), rarely longer than broad; opposing spine always present.

e<sup>1</sup> 25 or more cirrus segments.

f<sup>1</sup> P<sub>1</sub> very much longer than P<sub>2</sub>, excessively elongated, with more than 20 segments which are greatly elongated distally.

TRICHOMETRA, p. 239.

f<sup>2</sup> P<sub>1</sub> less than one third longer than P<sub>2</sub>, the distal segments not especially elongated.

g<sup>1</sup> P<sub>1</sub> only slightly longer than P<sub>2</sub>, with ten segments; size small.

NANOMETRA, p. 241.

g<sup>2</sup> P<sub>1</sub> about one third longer than P<sub>2</sub>, with 30—45 segments which are short proximally, and never more than twice as long as broad distally; size medium or large.

CYCLOMETRA, p. 238.

f<sup>2</sup> P<sub>1</sub> shorter than P<sub>2</sub>, which is more or less enlarged and stiffened.

PEROMETRA, p. 232.

e<sup>2</sup> 16 or less cirrus segments.

f<sup>1</sup> P<sub>1</sub> shorter than the succeeding pinnules.

g<sup>1</sup> P<sub>2</sub> bears a genital gland, and is stouter than P<sub>1</sub>.

BATHYMETRA, p. 244.

g<sup>2</sup> P<sub>2</sub> without a genital gland, resembling P<sub>1</sub>.

h<sup>1</sup> elements of the division series and brachials with very strongly produced and serrate distal ends.

TOXOMETRA, p. 232.

h<sup>2</sup> elements of the division series smooth; brachials with the distal ends slightly, if at all, produced.

IRIDOMETRA, p. 230.

f<sup>2</sup> P<sub>1</sub> much the longest pinnule.

g<sup>1</sup> P<sub>1</sub> about twice as long as P<sub>2</sub>; segments of the lower pinnules strongly overlapping.

COMPSOMETRA, p. 229.

g<sup>2</sup> P<sub>1</sub> about one third longer than P<sub>2</sub>, which, in turn, is about one third longer than P<sub>3</sub>; segments of the lower pinnules smooth.

MASTIGOMETRA, p. 227.

#### 21.—KEY TO THE GENERA OF PENTAMETROCRINIDÆ.

a<sup>1</sup> five arms.

PENTAMETROCRINUS, p. 250.

a<sup>2</sup> ten arms.

DECAMETROCRINUS, p. 247.

#### 22.—FAMILY ATELECRINIDÆ.

The family Atelecrinidæ includes only the genus *Atelecrinus*.

#### 23.—KEY TO THE GENERA OF PENTACRINITIDÆ.

a<sup>1</sup> The arms do not divide before the fourth post-radial ossicle; one or more pinnules precede the first axillary.

METACRINUS, p. 264.

a<sup>2</sup> the arms divide on the second post-radial ossicle; no pinnules before the first axillary.

b<sup>1</sup> ten arms; stem slender, smooth, nearly circular in cross-section.

HYPALOCRINUS, p. 261.

b<sup>2</sup> more than ten arms.

c<sup>1</sup> all the division series of two ossicles, united by pseudo-syzygy; the second brachial of the free undivided arms bears the first pinnule; the third and

fourth brachials are united by syzygy; stem stout, pentagonal, or more or less stellate; the pinnules continue to the arm tips; cirrus segments smooth.

ENDOXOCRINUS, p. 263.

c<sup>2</sup> IBr series of two ossicles, but the further division as in the comasterid genus *Capillaster*, more rarely as in *Comatella*; the first brachial of the free undivided arm, unless springing from a IBr axillary, bears a pinnule, and the second and third are united by syzygy; stem slender, nearly circular in section; the arm tips for a considerable distance bear only rudimentary pinnules, as in *Metacrinus*; the distal cirrus segments bear small dorsal spines.

COMASTROCRINUS, p. 252.

#### 24.—KEY TO THE GENERA OF APIOCRINIDÆ.

a<sup>1</sup> Pentagonal columnars in proximal portion of stem without markings on the articular faces; no nodals or cirri; elements of the IBr series narrow and widely separated.

CARPENTEROCRINUS, p. 272.

a<sup>2</sup> pentagonal columnars in proximal portion of stem with petaloid markings on the articular faces; proximal portion of stem with regularly spaced nodals bearing short cirri; elements of the IBr series very broad and in lateral apposition.

PROISOCRINUS, p. 272.

#### 25.—KEY TO THE GENERA OF HYOCRINIDÆ.

a<sup>1</sup> Five basals; the arms branch several times.

CALAMOCRINUS, p. 272.

a<sup>2</sup> three basals, sometimes completely fused; the arms do not branch.

b<sup>1</sup> each brachial, except the most proximal, bears a pinnule; syzygies very infrequent; pinnules not especially long.

PTILOCRINUS, p. 272.

b<sup>2</sup> one half or fewer of the brachials bear pinnules; brachials united in syzygial groups of two or three; pinnules extremely long, reaching to the arm tips.

c<sup>1</sup> brachials united in syzygial groups of three.

HYOCRINUS, p. 273.

c<sup>2</sup> brachials united in syzygial pairs.

d<sup>1</sup> upper part of stem hexagonal; first brachial occupying only about one third of the distal border of the radial.

THALASSOCRINUS, p. 273.

d<sup>2</sup> upper part of stem pentagonal; first brachial occupying about two-thirds of the distal border of the radial.

(GEPHYROCRINUS.)

#### 26.—FAMILY PHRYNOCRINIDÆ.

The family Phrynocrinidæ includes only the single genus *Phrynocrinus*.

#### 27.—KEY TO THE GENERA OF BOURGUETICRINIDÆ.

a<sup>1</sup> three or more of the topmost columnars are over twice as broad as long; ten arms; root scanty, but coarse.

BATHYCRINUS, p. 274.

a<sup>2</sup> only one of the topmost columnars is over twice as broad as long; usually 5 arms; root thick and fine.

RHIZOCRINUS, p. 279.

### 10. SPECIMENS LABELLED "INDIA."

Many of the specimens in the collection are labelled simply "India" which in some cases is questioned. I suspect that all these were taken in Ceylon as they all properly belong to the fauna of that island.

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## SYSTEMATIC PART.

### Phylum ECHINODERMATA.

*Echinodermata* 1734. KLEIN, Nat. Dispositio Echinod.

#### Subphylum ECHINODERMATA HETERORADIATA.

*Echinodermata Heteroradiata* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 184.—1909. American Naturalist, vol. 43, No. 515, p. 686.

#### Superclass PELMATOZOA.

*Pelmatozoa* 1848. LEUCKART, Morphologie der wirbellosen Thieren.

#### Class CRINOIDEA.

*Crinoidea* 1821. MILLER, A Natural History of the Crinoidea, p. 1.

## I.—THE UNSTALKED CRINOIDS.

## Order COMATULIDA

*Comatulida* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 209.

## Suborder COMATULIDA OLIGOPHREATA.

*Comatulida Oligophreata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 174.

## Family COMASTERIDÆ.

*Comasterida* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 210.

## Subfamily CAPILLASTERINÆ.

*Capillasterinae* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 175.

## Genus COMATELLA.

*Comatella* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 207 (*Actinometra nigra* P. H. Carpenter, 1888).

## COMATELLA NIGRA.

*Actinometra nigra* 1876. W. B. CARPENTER, Proc. Roy. Soc., vol. **24**, p. 451 (*nomen nudum*).—1876. P. H. CARPENTER, Journ. Anat. and Physiol., vol. **10**, p. 583 (*nomen nudum*).—1884. VON GRAFF, "Challenger" Reports, vol. **10**, Zoölogy, pp. 16, 20 (*nomen nudum*).—1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 96 (*nomen nudum*).—1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 304.

*Comatula nigra* 1877. VON GRAFF, Das Genus Myzostoma, pp. 17, 23, 72, 79 (*nomen nudum*).

*Comatella nigra* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 208.

LOCALITY.—*Southern portion of Malacca Strait*.—One specimen, resembling others from the Philippine Islands.

OTHER RECORDS.—Ternate, Moluccas; Bohol; Philippine Islands.

DEPTH.—Littoral, and down to 58 fathoms.

## COMATELLA STELLIGERA.

*Actinometra tenax* 1874. LÜTKEN, Cat. Mus. Godeffr., vol. **5**, p. 190 (*nomen nudum*).

*Actinometra stelligera* 1880. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. **15**, p. 198, pl. 12, fig. 26.—1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 308, pl. v, figs. 5, *a-d*; pl. lviii, figs. 1, 2.

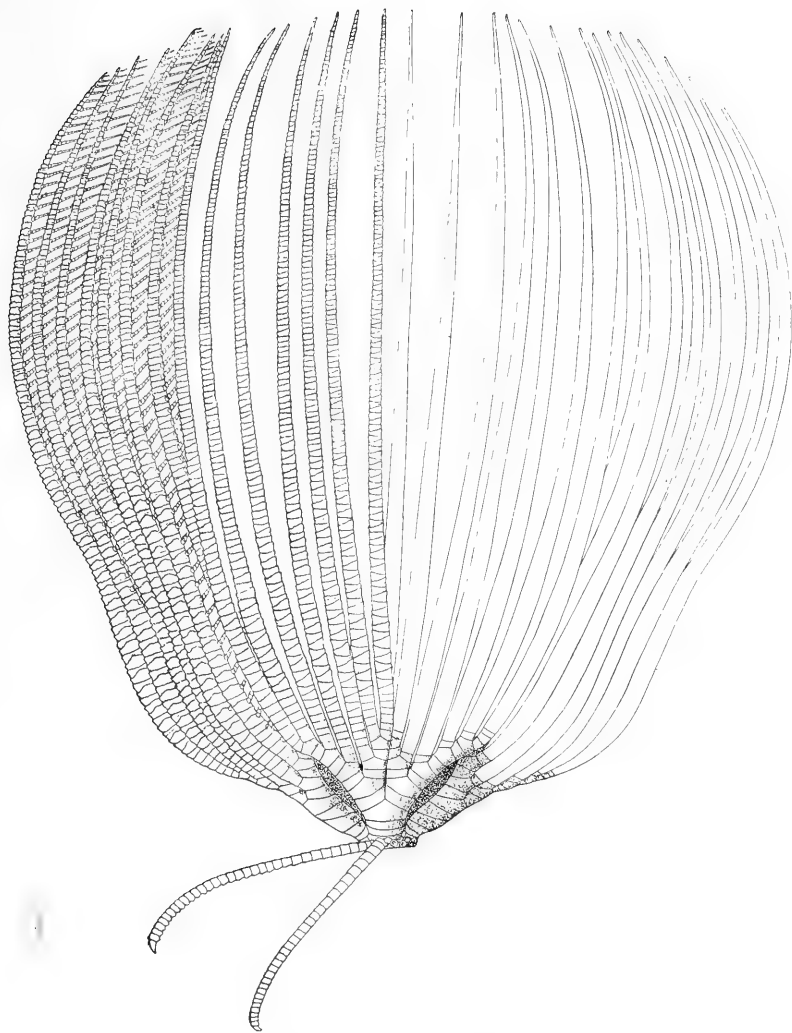


FIG. 1.—*Comatella nigra*.  
Lateral view of a typical specimen.

- Actinometra* sp. 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 291, line 3 from top.
- Actinometra notata* 1888. BELL, P. Z. S., 1888, p. 389 (footnote) (*nomen nudum*).—1889. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 21, p. 312, pl. xxi, figs. 6—10.
- Antedon bassett-smithi* 1894. BELL, P. Z. S., 1894, p. 399, pl. 24.
- Actinometra maculata* 1894. BELL, P. Z. S., 1894, p. 396.
- Comatella stelligera* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 207.

LOCALITIES.—*Padaw, Mergui Archipelago*.—One specimen with thirty-four arms, agreeing with the type of *Actinometra notata* which was found at King Island in the Mergui Archipelago.

? *India*.—A beautiful specimen with thirty-one arms 110 mm long, and cirri 25 mm. long; four interior and seven exterior HIBr series are present.

OTHER RECORDS.—Samoa; Fiji; Ovalau; Tonga; Reef of Atagor; Cebu; Philippine Islands; Macclesfield Bank; New Guinea; Amboina; Mergui Archipelago (King Island); Ceylon; Australia, south to Port Jackson; Salomon; Coin Peros; Parry's Shoal.

DEPTH.—Littoral, and down to 36 (? 40) fathoms.

REMARKS.—I have examined the type of Bell's *Antedon bassett-smithi*, preserved in the British Museum, and find it to be, as I deduced from the description some time ago, a typical example of *Comatella stelligera*.

#### COMATELLA MACULATA.

- Actinometra fuscata* 1877. LÜTKEN, Mus. Godefr. Cat., vol. 5, p. 100 (*nomen nudum*).—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 306 (*nomen nudum*).
- Actinometra maculata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 307, pl. v, figs. 1, *a-d*; pl. iv, fig. 2.
- Actinometra simplex* 1894. BELL, P. Z. S., 1894, p. 396.
- Actinometra* sp. 1898. BELL, P. Z. S., 1898, p. 849.
- Comatella maculata* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 138.—1911. Proc. U. S. Nat. Mus., vol. 40, p. 16.
- Actinometra multiradiata* 1909. BELL, Trans. Linn. Soc. (Zool.) (2), vol. 13, part 1, p. 29.

HABITAT.—Port Denison and Bowen, Queensland; Prince of Wales Channel; Parry's Shoal; New Caledonia; Ruk and Mortlock Island, Carolines; Macclesfield Bank; Rotuma; west Java; west reef of Hulule, Maldive Archipelago; Salomon; Coin Peros.

DEPTH.—Littoral, and down to 13 fathoms.

REMARKS.—The "*Actinometra pulchella*" recorded by Hartlaub from Ruk.

in the Carolines, appears to be a young example of this species. I have examined his specimen at Hamburg.

#### COMATELLA DECORA.

? *Actinometra difficilis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 93, pl. lii, fig. 2.

? *Actinometra pulchella* (part) 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 304, pl. lii, fig. 2.

*Comatula paucicirra* 1908. A. H. CLARK, Proc. U.S. Nat. Mus., vol. 34, p. 317.

DESCRIPTION.—Centrodorsal large, thick-discoidal, the large bare polar area flat, obscurely pitted about the periphery.

Cirri XX, 12-13, 15 mm. long; first segment very short, second half again as long as broad, third twice as long as broad, fourth and fifth rather over twice as long as broad (the fifth slightly longer than the fourth), sixth about twice as long as broad, the following decreasing gradually in length, the last two or three before the penultimate being about as long as broad, and the penultimate about half again as broad as long; from the sixth onward the distal dorsal edge of the segments is slightly everted, forming a low crescent-shaped or shallow V-shaped ridge across the distal end of the segment, appearing as a low subterminal spine in lateral view; dorsal surface of seventh and following segments with a slight median carination; opposing spine triangular, blunt, arising from the entire surface of the penultimate segment, the apex subterminal to subcentral, low, equal to about one third of the distal diameter of the penultimate segment in height; terminal claw twice as long as the penultimate segment, strongly curved basally, but becoming straighter distally.

Ends of the basal rays visible as rather large flattened rhombic tubercles in the angles of the calyx; radials concealed in the median line, but interradially forming a triangle over the ends of the basal rays, slightly separated distally;  $IBr_1$  trapezoidal, short, over three times as broad as long, strongly rounded dorsally, separated basally by the distal divergence of the radials, the sides of adjacent  $IBr_1$  diverging at a very obtuse angle;  $IBr_2$  (axillary) broadly pentagonal, about half again as broad as long, the lateral edges about as long as those of the  $IBr_1$ , forming with them an obtuse angle, the lateral edges of the  $IBr_2$  on adjacent rays being practically parallel; a broad strip of perisome, in width about equal to one third of the diameter of the  $IBr$  series, is visible between them (and similarly between the  $IIBr$  series), but it does not extend dorsally beyond their ventral edge.  $IIBr$  series 2 (eight are present and two absent in the type), the  $IIBr_1$  united for their proximal two thirds, from that point diverging in practically a straight line;  $IIIBr$  series 2, only present in one instance, on the exterior side of a derivative from a  $IBr$  series.

Nineteen arms (in the type) about 90 mm. long; first two brachials similar, rather small, wedge-shaped, about twice as broad as long exteriorly, the first united interiorly in the proximal half, diverging widely in the distal; third to

seventh or eighth brachials oblong or slightly wedge-shaped, about twice as broad as long, then becoming triangular, about as broad as long, and in the distal portion of the arm wedge-shaped again and longer than broad, reaching a length of about twice the breadth in the terminal portion. First syzygy between the second and third brachials except on arms arising direct from a IBr axillary, and on the exterior arms of each ray, where it is between the third and fourth; on the interior arms a syzygy between the second and third brachials is often immediately followed by another between the fourth and fifth; the distal intersyzygial interval is from three to five oblique muscular articulations.

Mouth central; anal tube small and inconspicuous, the anal area being no larger than the other interpalmar areas. Two of the ambulacral grooves divide at the mouth, as in *Decametrocrinus*, but in one of these the two branches join again just before branching to the arms, forming a sort of perisomic island.

P<sub>1</sub> long and slender, slightly stouter basally than P<sub>2</sub>, 15 mm. long, with about forty segments, of which the first is very short, the next eight or ten about as long as broad, then becoming half again as long as broad, and about as long as broad again distally; distal comb beginning abruptly, with about twelve large, long, bluntly triangular teeth, which are about as long as the lateral diameter of the segments which bear them, rather strongly incurved; the tooth-bearing segments maintain the same general direction as the segments preceding; P<sub>2</sub> similar, but shorter, about 11 mm. long; P<sub>3</sub> similar, but shorter, 8 mm. long, with twenty-six segments; its comb is similar to that of P<sub>1</sub> and P<sub>2</sub>; P<sub>4</sub> and P<sub>5</sub> similar to P<sub>3</sub>; P<sub>6</sub> similar to P<sub>5</sub>, with a similar comb, but stouter basally and bearing a small gonad on the third-fifth segments; following pinnules stouter throughout, but of the same length, composed of squarish segments, without combs; distal pinnules slender, about 11 mm. long.

The colour in life was bright yellow, the perisome slightly brownish.

HABITAT.—Southern Japan. ? Ki Islands.

DEPTH.—95-106 (?140) fathoms.

REMARKS.—In my paper on the crinoid fauna of Japan I listed the type specimen of this species as *Comatula paucicirra* (i.e., *rotalaria*); exactly the same mistake was made by Carpenter when he described his *Actinometra notata* in the "Paucicirra group," in spite of the fact that it was the same thing as his earlier *Act. stelligera*.

Species of the genus *Comatella* always possess cirri, and the outer cirrus segments always have dorsal processes; the multibrachiate species of *Comatula* rarely possess cirri except when very small; if they do, the outer segments are always perfectly smooth dorsally, without a trace of dorsal processes.

Carpenter depended upon the supposed presence of syzygies between the ossicles of the IBr and subsequent division series to differentiate the species of *Comatula* from those of *Comatella*; but these joints are not true syzygies, but pseudosyzygies, and are very commonly undeveloped so that the union of the elements of the IBr series in no way differs from that usually found among the

comatulids. Moreover the joints between the ossicles of the division series in the species of *Comatella* though never pseudosyzygies, are often so close as to be distinguishable externally.

#### Genus CAPILLASTER.

*Capillaster* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 87  
(*Actinometra sentosa* P. H. Carpenter, 1888).

#### CAPILLASTER MACROBRACHIUS.

*Actinometra macrobrachius* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 186.—1891. Nova Acta Acad. German., vol. **58**, No. 1, p. 101.

*Actinometra monobrachius* 1891. MINCHIN, Zoölogical Record for 1891, Echinoderms, p. 80.

HABITAT.—China Sea.

REMARKS.—In appearance this curious animal resembles such species as *Comantheria briareus*, but the arm structure is that of a typical *Capillaster*.

#### CAPILLASTER SENTOSA.

*Comatula multiradiata* (part) 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. **2**, p. 533.

*Comatula (Alecto) multiradiata* (part) 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss. (1847), p. 261.

*Actinometra sentosa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 325, pl. lxvi, figs. 4-6.

LOCALITIES.—*East of the Terribles*; 13 fathoms.—One rather small, though apparently mature, specimen.

*Off Colombo Light House*; 26½ fathoms.—Four medium-sized and small examples, each with about sixty-five arms.

*Off the north-eastern coast of Ceylon* (8° 51' 30" N. lat., 81° 11' 52" E. long.); 28 fathoms.—Two rather small specimens.

OTHER RECORDS.—Philippine Islands; Cebu; Moluccas; Banda; Sunda Islands; Singapore; North Male, Maldives.

DEPTH.—Littoral, and down to 74 fathoms.

REMARKS.—A large series of specimens of this species from Singapore and the Philippine Islands was available for comparison with the above recorded examples; there appear to be no constant differences correlated with locality; though usually perfectly smooth, in some of the Philippine examples the elements of the division series have somewhat projecting distal ends as in the specimen from Banda figured by Carpenter. This seems to be a rather uncommon condition in this form, though characteristic of the other species of the genus. Super-

ficially, *Capillaster sentosa* might much more readily be mistaken for *Comatella nigra* than for any other species of *Capillaster*.

#### CAPILLASTER MARIÆ.

?*Actinometra fimbriata* (part) 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 102.

*Comatula marie* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 153.

LOCALITY.—Andaman Islands.—One broken medium-sized specimen with twelve arms; the cirri are 28-35, 25 mm. long; the two IBr series are 4 (3-4).

OTHER RECORDS.—Southern Japan; Ruk, Caroline Islands.

DEPTH.—Littoral, and down to 59 fathoms.

#### CAPILLASTER MULTIRADIATA.

*Stella Chinensis perlegens* 1714. PETIVER, Gazophylacium, vol. 1, pl. iv, fig. 6.

Τρισκαϊδεκάκνηρος 1733. LINCK, De Stellis Marinis, p. 53.

*Triscadecacnimos* 1760. SCHULZE, Betrachtung der versteinerten Seesterne, p. 17.

*Asterias pectinata* (part) 1758. LINNÆUS, Syst. Nat., ed. x, p. 663 (reference to PETIVER).

*Asterias multiradiata* 1758. LINNÆUS, Syst. Nat., ed. x, p. 663 (type specimen, but not references cited).

*Comatula fimbriata* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 535.

*Comatula brevicirra* (part) TROSCHEL, MS.

*Comatula (Alecto) fimbriata* 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, p. 258.

*Actinometra gracilis* 1874. LÜTKEN, Mus. Godefr. Cat., vol. 5, p. 190.

*Comatula (Actinometra) borneensis* 1875. GRUBE, Jahresber. schl. Ges. vaterl. Cultur, 1875, p. 75.

*Actinometra coppingeri* 1884. BELL, Report Zoöl. Coll. H.M.S. "Alert," p. 168, pl. xvi, fig. B.—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 320, pl. lx, figs. 1, 2.

*Actinometra fimbriata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 317, pl. lxii, figs. 2-4.

*Actinometra stewarti* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 321.

*Actinometra multiradiata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 322, pl. lxvi, figs. 1-3.

*Actinometra parvicirra* (part) 1887. BELL, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645.—1888. BELL, P. Z. S., 1888, p. 384.—1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28.

*Actinometra multifida* BRIT. MUS., MS.

*Antedon anceps* BRIT. MUS., MS.



*Capillaster multiradiata* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist.

Forening i København, 1909, p. 134.

LOCALITIES.—*Off Colombo Light House, Ceylon*; 26½ fathoms.—Two specimens; one of these has eighteen arms about 90 mm. long, gradually increasing in diameter to about the twelfth brachial, and gradually tapering from that point onward, composed of very short discoidal brachials.

*East of the Terribles*; 13 fathoms.—One specimen.

*Arrakan coast, Burma*.—Two specimens, one with nineteen, the other with twenty-six arms.

*Two miles off Great West Torres Island, Merqui Archipelago*.—One small specimen.

*Andaman Islands*.—Nine specimens. Four of these are small; of the others one has thirteen arms, one fifteen, one seventeen, one nineteen, and one twenty-one; the arms of the fifteen-armed specimen are 100 mm. long with short discoidal brachials which overlap very strongly; the thirteen-armed specimen is of full size with the short discoidal brachials of the fully adult.

*Off Rutland Island, Andamans*; 35 fathoms.—One specimen with twelve arms 85 mm. long composed of short discoidal brachials; the eversion of the distal ends of the brachials is more marked than usual; the eversion of the distal ends of the cirrus segments is exceedingly strong and continues all around except on the middle of the ventral side, not being confined to the middle of the dorsal side as usual; the central spines on the dorsal side of the cirrus segments are correspondingly enlarged.

? *India*.—Five specimens, all small or medium sized.

*Southern portion of the Straits of Malacca*.—Five specimens with from seventeen to twenty-one arms.

*Malay Archipelago*; 100 fathoms.—One specimen with forty arms about 70 mm. long.

*Malay Archipelago*; 160 fathoms.—Two specimens, each with about forty arms 70 mm. long.

*West of South Andaman Island* (11° 49' 30" N. lat., 92° 55' 00" E. long.); 55 fathoms; bottom, sand and stones.—Four specimens, two with eleven, one with twelve, and one with thirteen arms.

*Eight miles west of Interview Island, Andamans*; 45 fathoms.—One specimen with eleven arms 85 mm. long.

OTHER RECORDS.—“*Indian Seas*”; “*Australia*”; Prince of Wales Channel; Torres Strait; Dampier Archipelago; north-western Australia; Flinders, Clairmont; Dirk Hartog Island; Tizaid Reef; Blanche Bay, New Britain; Straits of Sunda; Sunda Islands; Amboina; Java; Java Sea; Sumatra; Banda; Singapore; Ternate; Zamboanga; Bohol; Philippines; North Borneo; Macclesfield Bank; Nicobar Islands; Tuticorin, Madras; Ceylon; Trinquemale, Ceylon; Maldive Archipelago; Male, Maldives; China Sea; Formosa (Taiwan); Ruk Island, Carolines; Kagoshima, Japan; southern Japan; St. Mathias Island.

DEPTH.—Littoral, and down to 160 fathoms.

REMARKS.—The occurrence of this species at depths of 100 and 160 fathoms in the East Indian archipelago is a fact of very great interest, and it is to be regretted that the precise localities in these two cases were not recorded. Littoral species very rarely reach the 100-fathom line, and still more rarely pass it. The occurrence of *Antedon bifida* on the Rockall Bank below 100 fathoms, while scarcely reaching that depth anywhere else, has been thought possibly to be due to a subsidence of that bank which carried the animals down much deeper than they would ever have descended voluntarily. If these specimens of *Capillaster multiradiata* could be shown to have been obtained close to islands which can be proved geologically to have subsided, then a great degree of probability would be conferred upon the supposition regarding Rockall.

Among the West Indies we meet with a somewhat similar case; *Tropiometra picta* and *Nemaster lineata* are common littoral species along the Brazilian coast but both in the West Indies inhabit water 150 fathoms or more in depth. I have explained this by supposing that, creeping northward from Brazil, these two species found it necessary to descend to a considerable depth in order to pass under the mouths of the Amazon and the Orinoco, and, having reached a depth at which such passage was possible, they continued northward at that depth instead of again rising toward the surface, a process which, on account of the peculiar larval conditions pertaining to the crinoids (as we understand them), would be exceedingly slow.

Any theory of land subsidence based upon *Capillaster multiradiata*, however, would have to be supported by especially strong proof, for the sub-family Capillasterinae to which this species belongs has, when compared with the other sub-families of the Comasteridæ, an enormous bathymetric range, from the low tide mark (or even between tides) to nearly 500 fathoms, and it may well be that the individual species comprising this family, a number of which we now know only as littoral or sub-littoral, will prove to have a bathymetric range of an extent hitherto entirely unsuspected.

#### CAPILLASTER MULTIRADIATA var. COCCODISTOMA.

*Comatula coccolistoma* 1862. DUJARDIN and HUPE, Hist. nat. des Zoophytes.

Échinodermes, p. 208 (*nomen nudum*).

*Actinometra coccolistoma* 1883. P. H. CARPENTER, P. Z. S., 1882, p. 747 (*nomen nudum*).—1888. "Challenger" Reports, vol. 26, Zoölogy, p. 320 (*nomen nudum*).

*Capillaster multiradiata* var. *coccolistoma* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 16.

HABITAT.—Madagascar.

DEPTH.—Littoral, and down to 30 meters.

## Genus COMISSIA.

*Comissia* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 501 (*Clomissia lütkeni*, sp. nov.).

## COMISSIA PEREGRINA.

*Actinometra peregrina* 1894. BELL, P. Z. S., 1894, p. 402.

HABITAT.—Macclesfield Bank.

DEPTH.—55–60 fathoms.

REMARKS.—The cirri are XII, 25–30 (usually nearer the latter). 20 mm. long; the fifth is a transition segment.

The mouth and the anal tube are equally excentric.

The ten arms are 120 mm. long, resembling those of *Comissia lütkeni*; the synarthrial tubercles are only slightly evident; the distal edges of the brachials are moderately produced. The distal intersyzygial interval is three oblique muscular articulations.

This species appears to be nearest to *C. lütkeni*, but is readily distinguished by the more numerous cirrus segments.

## COMISSIA DUMETUM.

*Comissia dumetum* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 531.

HABITAT.—Philippine Islands.

DEPTH.—58 fathoms.

## COMISSIA LÜTKENI.

*Comissia lütkeni* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 502.

HABITAT.—Philippine Islands.

DEPTH.—49–74 fathoms.

## COMISSIA HISPIDA.

*Comissia hispida* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 531.

HABITAT.—Philippine Islands.

DEPTH.—51 fathoms.

## COMISSIA HORRIDUS.

*Comaster* (?) *horridus* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 533.

HABITAT.—Philippine Islands.

DEPTH.—58 fathoms.

## COMISSIA SCITULUS.

*Comaster* (?) *scitulus* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 534.

HABITAT.—Philippine Islands.

DEPTH.—58 fathoms.

COMISSIA IGNOTA.

*Comissia ignota* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 17.

HABITAT.—Amirante Islands (north-east of Madagascar).

DEPTH.—Littoral, and down to 17 fathoms.

COMISSIA PECTINIFER, sp. nov.

DESCRIPTION.—Centrodorsal moderately large, with a moderately large flat dorsal pole and three closely crowded marginal rows of cirrus sockets.

Cirri XXXIV, 14–16 (usually 16), 14 mm. long; the eighth is a transition segment; the longer proximal segments are nearly or quite twice as long as broad, slightly constricted centrally; the two segments preceding the penultimate are squarish to one-third broader than long; the outer segments (beyond the transition segment) are very highly polished, and bear small dorsal tubercles.

The ten arms are about 90 mm. long; the elements of the IBr series appear in external view to be united by syzygy, and are well separated laterally; the arms resemble those of *Comissia lütkeni*; the brachials overlap rather strongly. The distal intersyzygial interval is usually three oblique muscular articulations.

$P_1$  to  $P_4$  provided with combs;  $P_1$  is about 12 mm. long, and has a comb with about twenty-five exceptionally long teeth; the comb of  $P_4$  has fifteen or sixteen teeth, beyond which extends a toothless tip; only nine segments of  $P_4$  are not supplied with teeth.

HABITAT.—Christmas Island; the type is in the British Museum.

COMISSIA, sp.

*Actinometra parvicirra* 1904. CHADWICK, in HERDMAN, Report Ceylon Pearl Oyster Fisheries, part 2, Supplementary Report xi, p. 158 (part), plate, figs. 13, 14.

Mr. Chadwick has recorded, as a ten-armed specimen of *Comanthus parvicirra*, a specimen of an apparently new species of *Comissia* which was taken on the south coast of Ceylon in about 100 fathoms.

Subfamily COMACTINIINÆ.

*Comactiniine* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 175.

Genus COMATULA.

*Comatula* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. **2**, p. 530 (*Comatula solaris*, sp. nov.).

## COMATULA ROTALARIA.

*Comatula rotalaria* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 534.

*Actinometra jukesii* 1879. P. H. CARPENTER, Proc. Roy. Soc., vol. 28, p. 390.

*Actinometra paucicirra* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 169, pl. xvii, figs. A, Aa.—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 291, pl. iv, fig. 6; pl. v, fig 3; pl. liv.

*Actinometra aruensis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 292, pl. iv, fig. 6.

HABITAT.—Northern and north-western Australia; Reef of Atagor; Aru Islands.

DEPTH.—Littoral, and down to 15 fathoms.

REMARKS.—The "*Actinometra rotalaria*" from the Philippine Islands described and figured by Carpenter in the "Challenger" report is obviously the same thing as Müller's *Alecto parvicirra* and, on the strength of this, I have heretofore employed the Lamarckian name for that species. Upon examining the Lamarckian types at Paris, however, I discovered that *Comatula rotalaria* is in reality the form which was called by Carpenter *jukesii* and later (adopting Bell's name) *paucicirra*, an entirely different thing, belonging to an entirely distinct genus.

## COMATULA ETHERIDGEI.

*Comatula etheridgei* 1910. A. H. CLARK, Australian Museum Memoirs.

HABITAT.—Holothuria Bank, north-western Australia; Baudin Island.

DEPTH.—38 fathoms.

## COMATULA BRACHIOLATA.

*Comatula brachiolata* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 535.

*Alecto rosea* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 143.

HABITAT.—Southern coast of Australia.

REMARKS.—I have examined the types both of Lamarck's *Comatula brachiolata* (at Paris) and of Müller's *Alecto rosea* (at Berlin) and find them to be specimens of the same species. A fine specimen in the British Museum was taken at Port Phillip, South Australia; this is the first definite record for the species; Lamarck's specimens probably came from King George's Sound.

## COMATULA SOLARIS.

*Comatula solaris* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 533.

*Actinometra imperialis* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 140.

- Comatula (Actinometra?) hamata* 1869. HERKLOTS, Bijdragen tot de Dierkunde, vol. 9, p. 10, pl. ix.
- Actinometra albonotata* 1882. BELL, P. Z. S., 1882, p. 535.
- Actinometra robusta* ("Lütken, MS.") 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 517.
- Actinometra intermedia* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 166, pl. xvi, figs A, B.
- Actinometra strotata* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 167.

HABITAT.—Northern Australia, and northward to Singapore, the Philippine Islands, Cape Bantano, Java; the Moluccas, Billiton, the China Sea, and Hong Kong.

DEPTH.—Littoral, and down to 12 fathoms.

REMARKS.—The specimens of *Comatula solaris* from Singapore and Hong Kong which I examined at the Hamburg Museum resemble the slender form of *Comatula pectinata* found in the same localities, except for the much greater size and the larger number of cirrus segments (21). They have not the broadly expanded arms and stout cirri of the Australian form (the *robusta* of Lütken and Carpenter) nor are the arms so flat dorsally. Both the specimens are light brown with a narrow median dorsal line and borders to the arms of white. The Hong Kong specimen has three cirri and the Singapore specimen two, and two stumps. In both the centrodorsal is undergoing reduction.

Von Martens has recorded this species from Zanzibar, but his record appears to have been based upon a specimen of *Tropiometra carinata*.

#### COMATULA PECTINATA.

- Asterias pectinata* 1758. LINNÆUS, Syst. Nat., ed. x, p. 663 (type specimen, but not references cited).
- Comatula cumingii* 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, p. 255.
- Actinometra affinis* (Lütken, MS.) 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 517.
- Actinometra purpurea* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 170.
- Actinometra brachiolata* 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 107.
- Actinometra parvicirra* (Part) 1894. BELL, P. Z. S., 1894, p. 394.
- Actinometra echinoptera* BRIT. MUS., MS.
- Comatula rosularis* BRIT. MUS., MS.

LOCALITIES.—"India."—One small specimen.

*Malay Archipelago*.—One fine specimen with ten arms 150 mm. long and cirri XI, 13–14, 10 mm. long. The arms are slightly swollen in the proximal portion.

*Malay Archipelago*; 160 fathoms.—One specimen with ten arms 90 mm. long, rather strongly swollen basally.

*Southern portion of the Straits of Malacca*.—Two specimens; the larger has the cirri 15 mm. long with 15–17 segments; neither have the arms swollen basally.

All of these examples agree with others at hand from Singapore, Java and the Philippine Islands.

OTHER RECORDS.—“Indian Seas”; “Australia”; Arafura Sea; Prince of Wales Channel; Fitzroy Island, Port Molle, Port Curtis and Cooktown, Queensland; Port Jackson; Cape York; Dundas Strait; Torres Strait; Thursday Island; north Celebes; Banka; Banka Strait; Billiton; Java; Singapore; Malacca; Sunda Islands; Amboina; Ternate; Moluccas; Zamboanga; Bohol; Philippine Islands; 14° 50' S. lat., 125° 40' E. long.; north-western Australia; Baudin Island; Holothuria Bank; Bassett-Smith Bank.

DEPTH.—Littoral, and down to 160 fathoms.

REMARKS.—A critical examination of the type of Müller's *Comatula cumingii*, preserved in the Museum für Naturkunde at Berlin, has shown that it is nothing more than a small and immature specimen of *Comatula pectinata*.

The specimen of *Actinometra brachiolata* in the collection of the Leyden Museum described by Hartlaub is in reality an example of this species.

#### COMATULA PURPUREA.

*Alecto purpurea* 1843. J. MÜLLER, Archiv für Naturgesch., 1843, i, p. 132.

*Comatula purpurea* 1910. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 23, pp. 95–98, fig. p. 97.

HABITAT.—Dundas Strait, north-western Australia; Northern Australia; Port Molle and Port Denison, Queensland; Dimes Island, New Guinea.

DEPTH.—Littoral, and down to 36 fathoms.

#### COMATULA MICRASTER.

*Comatula micraster* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 143.

DESCRIPTION.—Centrodorsal rounded pentagonal, flush with, or very slightly raised above, the dorsal surface of the radials, without cirri.

Radials short, trapezoidal, four or five times as broad as long;  $IBr_1$  and  $IBr_2$  united by pseudosyzygy,<sup>1</sup> the pseudosyzygial pair being about twice as broad as long;  $IBr_1$  almost entirely, or quite, united laterally;  $IBr_2$  free laterally.

Ten arms 50 mm. to 65 mm. long, resembling, with the pinnules, those of *C. pectinata*.

The colour in spirits is white or light purple.

<sup>1</sup> cf. Proc. Biol. Soc. Washington, vol. 22, p. 173.

LOCALITIES.—*Andaman Islands*; 60 fathoms † (type locality).—Forty-five specimens, all with arms about 50 mm. long; three or four of these have from one to four (rarely more than one) cirri remaining; these are very delicate, 4 mm. long, with eleven segments, resembling those of *C. pectinata* but more slender with more elongated segments.

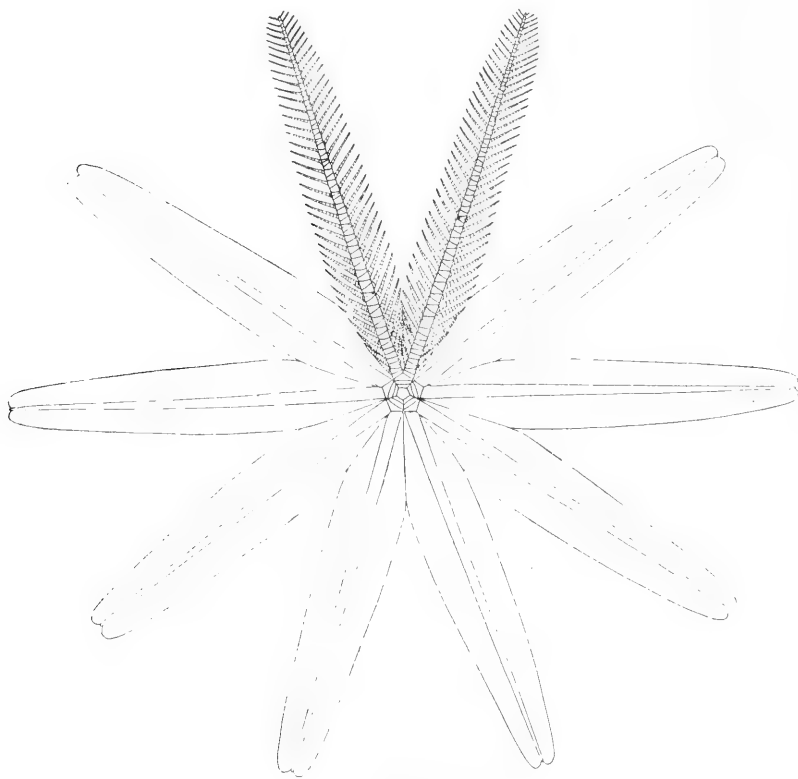


FIG. 2.—*Comatulula micraster*.

Dorsal view, showing one ray in detail and the remainder in outline.

*Two miles off Great West Torres Island*.—Three typical specimens.

*West of South Andaman Island* ( $11^{\circ} 49' 30''$  N. lat.,  $92^{\circ} 55' 00''$  E. long.); 55 fathoms; bottom, sand and stones.—Six specimens.

REMARKS.—The very small size of this species, together with the presence of only ten arms and the absence of cirri, make it a very easy one to recognize. The



difference in length between the anterior and posterior arms is often very great. In some specimens only four of the arms are supplied with ambulacra.

## Genus COMINIA.

*Cominia* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 497 (*Comanthus decameros*, A. H. Clark, 1908).

## COMINIA DECAMEROS.

*Comanthus decameros* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 221.

*Cominia decameros* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 150.

HABITAT.—Off the Goto Islands, near Nagasaki, Japan.

DEPTH.—170 fathoms.

## Subfamily COMASTERINAE.

*Comasterinae* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 175.

## Genus COMASTER.

*Comaster* 1836. L. AGASSIZ, Mém. de soc. de sci. nat. de Neuchâtel, vol. **1**, p. 193 (*Comatula multiradiata* Lamarck (= *Alecto multifida* J. Müller, 1841)).

*Phanogenia* 1866. LOVÉN, Öfversigt k. Vetensk.-Akad. Förhandl., 1866, No. 9, p. 231 (*Phanogenia typica*, sp. nov.).

## COMASTER TYPICA.

*Phanogenia typica* 1866. LOVÉN, Öfversigt k. Vetensk.-Akad. Förhandl., 1866, No. 9, p. 231, fig. p. 220 *a-h*.

*Actinometra stellata* 1874. LÜTKEN, Mus. Godefr. Cat., vol. **5**, p. 190 (*nomen nudum*).—1879. P. H. CARPENTER, Proc. Roy. Soc., vol. **28**, p. 390.

*Actinometra multifida* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 169 (part).

*Actinometra variabilis* (part) 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 169.

*Comaster typica* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 686.

HABITAT.—Fiji; Jobie; Singapore; New Harbour, near Singapore; Amboina; Malacca; Blanche Bay, New Britain; Cebu; Gilbert (Kingsmill) Islands; Philippine Islands; Prince of Wales Channel, Torres Strait; Thursday Island; Percy Island; Port Walcott and Port Headland, Western Australia.

DEPTH.—Littoral, and down to 50 fathoms.

REMARKS.—The specimen in the Leyden Museum examined by Carpenter

resembles the one from Fiji in the Copenhagen collection described by myself ; it has from four to six post-radial axillaries ; four of the IBr series are 2 and six are 4 (3+4).

## COMASTER GRACILIS.

*Actinometra stellata* (part) LÜTKEN, MS.

*Actinometra gracilis* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 187.—  
1891. Nova Acta Acad. German., vol. 58, No. 1, p. 111, pl. v, fig. 55.

*Actinometra tridistichata* BELL, MS.

*Actinometra* sp. 1894. BELL, P. Z. S., 1894, p. 402.

*Actinometra typica* 1899. BELL, Willey's Zoological Results, part ii, p. 134—  
1902. In GARDINER, Fauna and Geography of the Maldive and Laccadive  
Archipelagoes, vol. 1, part 3, p. 225.

*Antedon indica* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive  
and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

*Comaster gracilis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 686.

LOCALITY.—Port Blair, Andaman Islands.—One small specimen, resembling  
others at hand from Singapore and the Philippine Islands.

OTHER RECORDS.—Pulo Edam, China Sea ; Singapore ; Philippine Islands ;  
Cebu ; Macclesfield Bank ; Fiji ; Blanche Bay, New Britain ; Hulule, Maldives.

DEPTH.—Littoral, and down to 30 fathoms.

## COMASTER FRUTICOSUS.

*Comaster fruticosus* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 532.

HABITAT.—Philippine Islands.

DEPTH.—58 fathoms.

## COMASTER MULTIFIDA.

*Comatula multiradiata* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres,  
vol. 2, p. 533.

*Alecto multifida* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 147 (based  
upon one of Lamarck's specimens).

*Actinometra variabilis* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 169, pl.  
xvii, figs. B, Ba.

*Comaster carpenteri* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 686.

HABITAT.—Northern Australia ; Thursday Island.

DEPTH.—Littoral, and down to 38 fathoms.

REMARKS.—An examination of the type of this species, preserved in the  
Paris Museum, and of the types of *Actinometra variabilis* in the British Museum,  
shows that they are in reality representatives of the same species.

Professor Döderlein in his paper upon a collection of comatulids from Am-  
boina and Thursday Island has confused this species with *Comanthina belli* ; in

his figures of specimens supposedly of that species fig. 4 obviously represents *Comaster multifida*.

COMASTER TAVLIANA, sp. nov.

DESCRIPTION.—Centrodorsal discoidal, broad, the polar area flat, 5 mm. in diameter; cirrus sockets arranged in a single crowded, somewhat irregular, marginal row.

Cirri XX–XXII, 16–18, moderately slender, 13 mm. to 15 mm. long; first two segments about twice as broad as long, third slightly longer than broad, fourth, seventh or eighth half again as long as broad, the following gradually decreasing in length, the terminal seven or eight being about one third again as broad as long; ninth a transition segment, rounded in cross section and with a dull surface like the preceding in the proximal three-fourths, polished like the succeeding in the distal fourth; following the transition segment the segments become rather strongly compressed laterally, so that in a lateral view the cirrus appears to thicken from this point onward; transition and following segments with the distal dorsal edge produced, this production rapidly becoming more sharply rounded, and soon  $\Lambda$ -shaped, the segments at the same time becoming distally more carinate dorsally, so that the later segments are provided with a small but sharp sub-terminal tubercle; in addition, the segments from the eleventh or twelfth onward have, just before their middle, a second, more rounded median dorsal tubercle, not quite so high as that in the distal portion, presenting, therefore, the same appearance as the cirrus segments of *Oligometra adeonae*: opposing spine represented by a small median tubercle arising from the entire dorsal surface of the penultimate segment, the apex usually forming in lateral view slightly more than a right angle, though occasionally more sharp; terminal claw somewhat longer than the penultimate segment, stout basally but becoming more slender distally, moderately curved.

Ends of the basal rays visible as small tubercles in the angles of the calyx; radials only slightly visible in the angles of the calyx, over the ends of the basal rays; IBr<sub>1</sub> very short and broad, more or less (sometimes wholly) concealed by the centrodorsal, just in contact basally but diverging distally; IBr<sub>2</sub> broadly pentagonal, almost triangular, twice as broad as long, or even somewhat broader; IIBr 4 (3+4); IIIBr 2; IVBr 2, but irregular in occurrence; division series free laterally though not widely separated, rounded dorsally, but not especially convex.

Thirty-six arms about 100 mm. long; first brachial short, wedge-shaped, almost entirely united interiorly, twice as broad as its interior length or slightly broader; second brachial similar, but slightly larger; third and fourth (syzygial pair) not quite so long as broad; next two brachials oblong, about twice as broad as long, then becoming triangular, about half again as broad as long, after the end of the proximal third of the arm gradually becoming wedge-shaped, and in the terminal portion wedge-shaped, about as long as broad; fourth and follow-

ing brachials with strongly produced and finely spinous distal ends. The arm increases gradually in diameter up to the tenth brachial, then tapers away very gradually distally. Syzygies occur between the third and fourth brachials, again usually between the thirteenth and fourteenth, and distally at intervals of four (more rarely five) oblique muscular articulations.

Disk covered with rather coarse papillæ; mouth sub-marginal, anus sub-central.

$P_1$  10 mm. long, slender, with thirty-five segments, of which the first is short, oblong, about two and one-half times as broad as long, and the following are rhombic, at first nearly twice as broad as long, gradually becoming longer and about as long as broad after the sixth; second and following segments with the corners cut away, this gradually decreasing distally and disappearing entirely after about the twelfth segment; second to tenth or eleventh segments with long single or double spines projecting vertically from the dorsal surface, at first about equal to half the diameter of the joint in height, but slowly decreasing in length distally; terminal comb short, very prominent, rising abruptly, with six or seven teeth which are subequal, triangular, slightly longer than broad, rather longer than the diameter of the segments which bear them, the bases in apposition, rather strongly recurved;  $P_2$  5 mm. long, with twenty segments, resembling  $P_1$  but weaker and more slender;  $P_3$  3.5 mm. long with fifteen segments, resembling  $P_2$ ;  $P_4$  and following pinnules stouter than the preceding, 6 mm. long, with about twenty segments, the first two short, the remainder squarish, becoming longer than broad distally; the distal ends of the segments are spinous and strongly overlapping, and the more proximal segments are usually furnished with more or less prominent dorsal spines in addition; distally the pinnules gradually become shorter and more slender, the distal pinnules being 6 mm. long, very slender, with about twenty segments, the first two short, the third longer than broad, the remainder elongated, with slightly expanded ends, becoming about twice as long as broad distally; terminal combs occur usually on most of the genital pinnules, and at intervals on those in the distal part of the arm.

The colour is chrome yellow, the skeleton yellowish white.

HABITAT.—Philippine Islands (Tawi Tawi group).

DEPTH.—49 fathoms.

#### COMASTER MULTIBRACHIATA.

*Actinometra novæ-quinæ* 1879. P. H. CARPENTER, Proc. Roy. Soc., vol. 28, p. 386.

*Actinometra multibrachiata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 299, pl. lvi, figs. 3, 4.

*Actinometra regalis* 1894. BELL, P. Z. S., 1894, p. 396 (part).

*Comaster multibrachiata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 686.

LOCALITY.—*Andaman Islands*.—One rather small example with about one hundred and sixty arms 90 mm. long. It agrees with specimens at hand from the Philippine Islands.

OTHER RECORDS.—Banda, Moluccas; Philippine Islands; Macclesfield Bank.

DEPTH.—17—30 fathoms.

#### COMASTER DELICATA.

*Phanogenia delicata* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 393.

HABITAT.—Philippine Islands.

DEPTH.—49 fathoms.

#### COMASTER NOVÆGUINEÆ.

*Alecto novæ-guineæ* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 146.

*Comaster novæ-guineæ* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 686.

*Actinometra regalis* 1894. BELL, P. Z. S., 1894, p. 396.

HABITAT.—Eidouma, New Guinea; Ternate; east coast of China; Macclesfield Bank; Philippine Islands.

DEPTH.—Littoral, and down to 49 fathoms.

REMARKS.—In the type at Leyden there are fifteen cirrus sockets, and one segment of a single cirrus remains. This specimen has the same smooth appearance as the specimen of Lütken's *Actinometra stellata* from Fiji in the Copenhagen Museum. Compared with the specimens of *typica* at Leyden (described by Carpenter) the only differences to be found are the lesser numbers of arms and the thinly discoidal centrodorsal on which are cirrus sockets. It almost entirely lacks the rough and spinous character of the Philippine specimens which heretofore I had regarded as representing true *novæguineæ*. There is a strong possibility that it may turn out to be synonymous with *typica*, in which case the Philippine form would require a new name; it might be appropriately called *philippinensis*.

#### COMASTER DISTINCTA.

*Actinometra distincta* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 295, pl. iv, fig. 1.

*Actinometra parvicirra* (part) 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 338.—1894. BELL, P. Z. S., 1894, p. 396.

*Antedon brevicirra* 1894. BELL, P. Z. S., 1894, p. 400.

*Comaster distincta* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 686.

HABITAT.—Philippine Islands; Macclesfield Bank; Zamboanga.

DEPTH.—10—58 fathoms.

REMARKS.—One of the specimens recorded by Carpenter as "*Actinometra parvicirra*" in the "Challenger" report is in reality a specimen of *Comaster distincta*; the two species have also been confused by Professor Bell; an

examination of the type of Bell's "*Antedon brevicirra*" shows that it is the same thing as Carpenter's *Actinometru distincta*.

#### COMASTER PARVUS.

*Comaster parvus* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 144.

DESCRIPTION.—Cirri XIII–XVIII, 10–11, 8 mm. long, arranged in a single or partially double row on a rather thick discoidal centrodorsal.

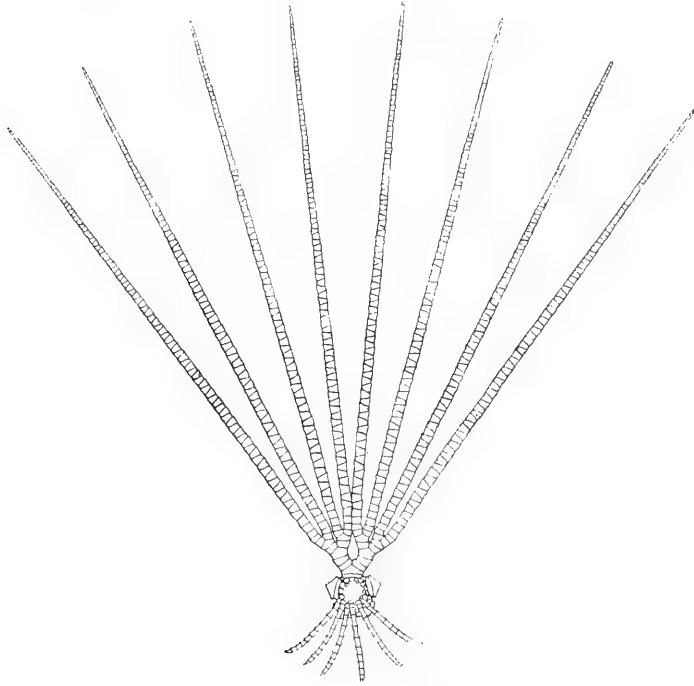


FIG. 3.—*Comaster parvus*.

Dorsal view, showing one ray in detail, and the cirri on about one-third of the periphery of the centrodorsal.

Ends of the basal rays visible as prominent tubercles in the angles of the calyx; radials projecting slightly beyond the edge of the centrodorsal;  $IBr_1$  very short and band-like, just in contact basally but widely diverging so that their lateral edges are separated by a broad shallow U-shaped gap;  $IBr_2$  triangular, twice as broad as long, the anterior angle very acute;  $IIBr$  4 (3+4), widely separated;  $IIIBr$  2 (1+2);  $IVBr$  2 (1+2), developed interiorly in reference to the  $IIBr$  series, but seldom present.

Forty arms 60 mm. to 70 mm. long resembling, with the pinnules, those of the other small species of the genus.

Mouth central or sub-central; anal tube small, sub-central or marginal; disk naked.

The colour in spirits is yellowish brown.

LOCALITY.—*Andaman Islands*.—Twelve specimens.

DEPTH.—53 fathoms.

#### COMASTER SERRATA.

*Comatula serrata* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 154.

*Comaster serrata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 686.

*Comaster parvicirra* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 306.

HABITAT.—Southern part of the Sea of Japan; Southern Japan.

DEPTH.—55–95 fathoms.

REMARKS.—The small comasterids in the Alan Owston collection which I originally determined as *Comanthus parvicirra* I find on re-examination to belong to this species.

#### COMASTER MINIMA.

*Phanogenia minima* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 392.

HABITAT.—Philippine Islands.

DEPTH.—16 fathoms.

#### COMASTER sp.

REMARKS.—The collection contains numerous unidentifiable arm fragments of some species of this genus from off Little Coco Island.

#### Genus COMANTHUS.

*Goldfussia* 1891. NORMAN, Ann. and Mag. Nat. Hist. (6), vol. **7**, p. 387 (preoccupied).

*Comanthus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 220 (*Comanthus intricata*, sp. nov.).—Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 203.—1909. Vidensk. Medd. fra den naturhist. Forening i Köbenhavn, 1909, p. 141.

#### Subgenus *Comantheria*.

*Comantheria* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i Köbenhavn, 1909, p. 142 (*Antedon briareus* Bell, 1884).

#### COMANTHERIA POLYCNEMIS.

*Comanthus polycnemis* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 396.

HABITAT.—Philippine Islands.

DEPTH.—18–28 fathoms.

## COMANTHERIA ALTERNANS.

*Actinometra alternans* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 208.

HABITAT.—Port Molle, Queensland; Philippine Islands.

DEPTH.—Littoral, and down to 28 fathoms.

REMARKS.—The type at Leyden has about ninety arms; the division series are regularly alternating, the IBr series being 4 (3+4), the IIIBr 2, the IVBr 4 (3+4), the VBr 2, etc.; there are almost no exceptions to this regular alternation. The centrodorsal is in shape like an *Hippasteria*, not yet having become stellate.

## COMANTHERIA BRIAREUS.

*Antedon briareus* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 163, pl. xiv.

*Actinometra divaricata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 332, pl. lxiii, figs. 6-8.

*Actinometra duplex* BRIT. MUS., MS.

*Actinometra parvicirra* BRIT. MUS., MS.—1894. BELL, P. Z. S., 1894, p. 394.

*Actinometra typica* BRIT. MUS., MS.

HABITAT.—Port Denison, Queensland; Port Walcott, northwest Australia; Baudin Island; Banda; Amboina; Billiton; Sunda Islands; West Java; Bassett-Smith Bank; Philippine Islands.

DEPTH.—Littoral, and down to 50 fathoms.

## COMANTHERIA MAGNIFICA.

*Actinometra magnifica* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, pp. 330, 333.

HABITAT.—Philippine Islands.

## COMANTHERIA GRANDICALYX.

*Actinometra grandicalyx* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 520.

HABITAT.—Canton, China.

REMARKS.—In general appearance this animal resembles *Comanthus pinguis*; there is the same large centrodorsal; the brachials imbricate slightly; the sides of the division series and of the arms are brown; there is a median line of dirty white on each.

There are three cirri still remaining on the centrodorsal, with 22, 24, and 25 segments respectively, the last seven or eight with dorsal processes, small blunt tubercles becoming sharper outwardly, but never prominent.

The first cirrus segment is short, the following gradually increasing in length,



becoming squarish on the fifth and on the eighth or ninth somewhat longer than broad, then gradually decreasing in length again so that the last ten are twice as broad as long; the earlier of these ten are bluntly carinate, this carination on the last three becoming a low sharp median tubercle.

The rays are concealed as far as the axillaries; the axillaries are free laterally; the division series are broad, nearly in lateral contact.

The second to the fifth pinnule segments have more or less developed dorsal processes, suggesting the condition seen in *Comanthina belli*; the terminal comb has fourteen teeth which are low, well separated, and have a more or less serrate border.

#### COMANTHERIA IMBRICATA.

*Comaster imbricata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 306.

HABITAT.—Southern Japan; off the Goto Islands; Futschau (Province of Fokien), China.

DEPTH.—Littoral, and down to 50 fathoms.

#### Subgenus *Comanthina*.

*Comanthina* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (*Actinomerta nobilis* P. H. Carpenter, 1888 (= *Actinometra schlegelii* P. H. Carpenter, 1881)).

#### COMANTHINA BELLI.

*Actinometra belli* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 334, pl. lxiv, figs. 1, 2.

*Actinometra multifida* 1894. BELL, P. Z. S., 1894, p. 394.

*Actinometra nobilis* 1894. BELL, P. Z. S., 1894, p. 394.

HABITAT.—Prince of Wales Channel; Thursday Island; Torres Straits; northwestern Australia; Mermaidsk, Port Hedland and Shark Bay, western Australia.

DEPTH.—Littoral, and down to 65 fathoms.

REMARKS.—Professor Bell's records of *Comanthina nobilis* and of *Comaster multifida* in western and northwestern Australia were based upon specimens of this species wrongly identified, as I discovered during my visit to the British Museum.

#### COMANTHINA SCHLEGELII.

*Actinometra schlegelii* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 210.

*Actinometra multifida* (part) 1884. BELL, Report Zoöl. Coll. H.M.S. "Alert," p. 169.

*Actinometra duplex* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 335, pl. xlv, fig. 3.

- Actinometra nobilis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 336, pl. lxxv.
- Actinometra dissimilis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 337.
- Actinometra regalis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 347, pl. lxxviii.—1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 99.
- Actinometra parvicirra* (part) 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 96.
- Actinometra? duplex* 1894 BELL, P. Z. S., 1894, p. 396.
- Actinometra typica* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225.

LOCALITIES.—*Off Tobu Island*; 35 fathoms.—One small specimen with about seventy arms, many of which are arising by multiplicative regeneration from broken IIBr series, showing that the specimen is just passing into the adult stage. The division is perfectly regular, all the division series being 4 (3+4) except the exterior IIIBr series which are 2. The dorsal perisome is plated as in the adults. The centrodorsal is thin discoidal with a few rudimentary cirri and one fully developed cirrus on the periphery, the latter being 10 mm. long and consisting of 14 segments.

*Southern portion of the Malacca Straits*.—One specimen with about one hundred and forty arms, being slightly smaller and with slightly fewer arms than the average from the Philippine Islands. The centrodorsal is rounded pentagonal, flush with the surface of the radials, and bears a single cirrus 13 mm. long with 14 segments. The interradial areas are covered with a uniform fine calcareous deposit which is not broken up into interradial plates. The synarthrial tubercles are rather prominent. The dorsal surface of the animal as a whole is nearly flat.

*Invisible Bank*.—One specimen with about one hundred and twenty arms 130 mm. long.

OTHER RECORDS.—Mortlock Island, Carolines; Philippine Islands; Zamboanga; Cebu; Bassett-Smith Bank; Macclesfield Bank; Sunda Islands; Blanche Bay, New Britain; Solomon Islands; Banda; Amboina; Malacca; Singapore; Suvadiva, Maldives; Percy Island, Queensland.

DEPTH.—Littoral, and down to 42 fathoms.

REMARKS.—The presence of one or two cirri in the adults of this species is not at all unusual; in fact about half the specimens I have examined exhibit this condition.

An examination of the type of Carpenter's *Actinometra schlegelii* at Leyden has shown me that it is the same thing as his *Actinometra nobilis* and *Act. regalis* described seven years later. Carpenter overlooked the curious characteristic arm structure in the Leyden specimen, just as he did in the type of *Act. regalis*, though it is clearly depicted in his figure of the latter.

The type specimen at Leyden appears to have had four cirri, of which the

first segments still remain; there are numerous obsolete cirrus sockets. Of the III Br series those on two rays are typical, 2 exteriorly, 4 (3+4) interiorly; on a third ray one of the outer series is 2, but the other three series are 4 (3+4); on the remaining two rays all the series are 4 (3+4). All the other division series are 4 (3+4) as usual. This specimen may be exactly matched by others from the Philippine Islands.

The type of Carpenter's *Actinometra duplex*, which was obtained by the "Challenger" at Banda, proves to be only a young specimen of *schlegelii*.

#### Subgenus *Comanthus*.

*Comanthus* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (*Comanthus intricata* A. H. Clark, 1909).

#### Specific Group *Bennettia*.

*Goldfussia* 1891. NORMAN, Ann. and Mag. Nat. Hist. (6), vol. 7, p. 387 (preoccupied).

*Bennettia* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (*Alecto bennetti* J. Müller, 1841).

#### COMANTHUS BENNETTI.

*Comatula multiradiata* (part) 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 533.

*Comatula multiradiata* 1832. GOLDFUSS, Petrefacta Germaniæ, vol. 1, p. 202, pl. lxi, fig. 2, a-s.

*Alecto bennetti* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 146.

*Actinometra peronii* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 214.

*Actinometra brachymera* (Lütken, MS.) 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 95.

*Actinometra robustipinna* 1895. KIEHLER, Rev. suisse zool., vol. 3, p. 290.

*Actinometra grandicalyx* 1899. BELL, Willey's Zoological Results, part 2, p. 134.

*Comanthus* (*Comanthus*) *bennetti* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 147.

LOCALITIES.—*Table Island, Andaman Sea*; 15-35 fathoms.—Three magnificent specimens; one has seventy-eight arms 160 mm. long and cirri XX, 32-35, 40 mm. to 50 mm. long; the centrodorsal is large and hemispherical, 11 mm. in diameter, the bare dorsal pole being 5 mm. in diameter, strongly concave; the disk is 40 mm. in diameter, and bears calcareous nodules about the anal tube; the mouth is marginal and radial; the anal area is very large; the anal tube is central. A similar specimen has seventy-six arms 140 mm. long, and cirri XXX, 29-31, 40 mm. long; the disk is 30 mm. in diameter, with an interradiar mouth; the anal tube is covered with calcareous concretions. The third specimen has

seventy-eight arms 120 mm. long and cirri XXVII, 27—33, 33 mm. to 40 mm. long; it is similar to the two preceding.

Every division series in all these specimens is 4 (3+4).

OTHER RECORDS.—“South Seas”; “Indian Ocean”; Port Denison, Queensland; Amboina; Ceram; Moluccas; Loyalty Islands; Pelew Islands; Uca, Solomon Islands; New Britain; Sulu Sea; Macclesfield Bank; Singapore; St. Mathias Island; Lelti; Philippine Islands.

REMARKS.—A specimen from the Pelew Islands identified by Lütken as “*Actinometra brachymera*” belonging to the Copenhagen Museum was at hand for comparison with those listed above, and no differences were detected.

Professor Kœhler records *Actinometra robustipinna* from Amboina, but his specimen was undoubtedly an example of this species. The type of *Actinometra robustipinna*, which I examined at Leyden, is a much mutilated example of some species of *Himerometra*, possibly *H. crassipinna*, and is not an “*Actinometra*” at all!

Carpenter’s *Actinometra peronii*, the type of which I also examined at Leyden, is the same thing as Müller’s *Alecto bennetti*.

#### COMANTHUS PINGUIS.

*Actinometra* sp. 1906. McCLENDON, Bull. American Mus. Nat. Hist., vol. **22**, p. 123.

*Comanthus (Comanthus) pinguis* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **37**, p. 29.

HABITAT.—Southern Japan.

DEPTH.—21–125 fathoms

#### COMANTHUS JAPONICA.

*Alecto japonica* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 145.

*Actinometra* sp. 1881. P. H. CARPENTER, Bull. Mus. Comp. Zool., vol. **9**, No. 16, p. 169.

*Actinometra morsei* 1888. P. H. CARPENTER, “Challenger” Reports, vol. **26**, Zoölogy, p. 346.

HABITAT.—Southern Japan.

DEPTH.—Littoral, and down to 140 fathoms.

#### COMANTHUS SOLASTER.

*Comatula solaster* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 153.

*Comanthus (Comanthus) solaster* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 147.

HABITAT.—Southwestern Japan, and southward to Formosa (Taiwan).

DEPTH.—35–108 fathoms.

## COMANTHUS TRICHOPTERA.

*Comatula trichoptera* 1846. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178.

HABITAT.—Southern coasts of Australia, and Tasmania.

DEPTH.—Littoral, and down to 12 fathoms.

## COMANTHUS WAHLBERGII.

*Alecto wahlbergii* 1843. J. MÜLLER, Archiv für Naturgesch., 1843, i, p. 131.

*Comatula coccolistoma* (part) 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Echinodermes, p. 208 (*nomen nudum*).

*Comanthus (Bennettia) wahlbergii* 1911. A. H. CLARK, Proc. U. S. Nat., Mus., vol. 40, p. 17.

*Actinometra paucicirra* BRIT. MUS., MS.

HABITAT.—South Africa, to Natal.

DEPTH.—Littoral, and down to 25 fathoms.

## COMANTHUS SAMOANA.

*Actinometra trachygaster* (part) LÜTKEN, MS.

*Actinometra parvicirra* (part) 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 338.

*Comanthus samoana* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, p. 30.

LOCALITIES.—*Invisible Bank*.—One specimen, slightly larger than any of those at hand from Samoa, with twenty arms 70 mm. long and cirri XXV, 13—14, 9 mm. long, in a crowded and irregular marginal row; the polar area of the centrodorsal is 3 mm. in diameter.

OTHER RECORDS.—Samoa; Sulu; Tonga; Fiji; New Caledonia; Ruk, Carolines; ? Australia.

REMARKS.—I can find no differences whatever between the specimen listed above and those of the type series in the U. S. National Museum from Samoa: the development of spines on the brachials and pinnulars is excessive, just as in the originals. This species, on account of the similarity in shape and size, has heretofore apparently always been confused with *C. parvicirra*; its more numerous, stouter, stronger, and more curved cirri, the almost invariable occurrence of division series of 4 (3+4), and the excessive development of minute spines on all the post-radial ossicles, however, render it easy of recognition; no one who has handled the two species would mistake it for the very "soft" *C. parvicirra*.

Specific Group **Vania**, nov.

*Validia* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (*Comatula rotalaria* Lamarek, 1816).

TYPE SPECIES.—*Alecto parvicirra* J. Müller, 1841.

REMARKS.—The specific group *Vanía* covers exactly the same ground as was intended by the specific group *Validia* established by myself in 1909. The type of *Validia* is *Comatula rotalaria* Lamarck, chosen on the basis of the description of *Actinometra rotalaria* given by Carpenter in the "Challenger" Report. Examination of the types of *Comatula rotalaria* at Paris, however, has shown that it is in reality the same species as the *Actinometra jukesii* and *Act. paucicirra* described many years later; therefore the name *Validia* lapses into the synonymy of *Comatula*, though it will become available if it should ever become advisable to separate the twenty-armed from the ten-armed species assigned to that genus.

#### COMANTHUS ANNULATA.

*Actinometra gracilis* (part) LÜTKEN, MS.

*Actinometra intricata* (part) 1874. LÜTKEN, Cat. Mus. Godefr., vol. 5, p. 190.

*Actinometra annulata* 1882. BELL, P. Z. S., 1882, p. 535, pl. xxxv.

*Actinometra meyeri* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, p. 525.

*Actinometra valida* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 314, pl. lix, fig. 3.

*Actinometra littoralis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 346, pl. lxxvii, figs. 1, 2.

*Actinometra parvicirra* (part) 1887. BELL, Sci. Trans. Roy. Dublin Soc., (2), vol. 3, p. 645.—1888. BELL, P. Z. S., 1888, p. 384.—1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 98.—1894. BELL, P. Z. S., 1894, p. 396.—1904. CHADWICK, in HERDMAN, Report Ceylon Pearl Oyster Fisheries, part 2, Supplementary Report xi, p. 158.—1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28.

*Comanthus intricata* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 220.

LOCALITY.—*Southern portion of Malacca Straits*.—One specimen with fifty-one arms 140 mm. long, agreeing perfectly with the type of *Comanthus intricata* in the Copenhagen Museum, with which it was directly compared. Eleven IVBr series are present; four of the IIBr series are 2, as are three or four of the outer division series. One cirrus 10 mm. long, slender, with 14 segments, and three very rudimentary cirri, remain.

OTHER RECORDS.—Atjeh, Burma: Tuticorin, Madras; Banda; Cebu; Philippine Islands; Macclesfield Bank; Sulu; Ternate; Tonga; Fiji; Solomon Islands; Ceylon; St. Mathias Island; Friedrichwilhelmshaven, New Guinea; Cape York; Prince of Wales Channel; Thursday Island; Torres Straits; Bowen, Queensland; northwestern Australia; Holothuria Bank.

DEPTH.—Littoral, and down to 30 fathoms.

REMARKS.—AN examination of the type of Professor Bell's *Actinometra*

*annulata* shows that it is the same thing as the *Actinometra valida* described by Carpenter six years later, and the *Comanthus intricata* described by myself in 1908.

The type has thirty-nine arms, and cirri XII, 16—17; all the division series, except one of the IIBr series, are 4 (3+4).

## COMANTHUS PARVICIRRA.

- Alecto parvicirra* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 145.  
*Alecto timorensis* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 145.  
*Comatula simplex* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208.  
*Comatula brevicirra* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208.  
*Actinometra trachygaster* (part) 1869. LÜTKEN, Cat. Mus. Godefr., vol. 4, p. 125.  
*Actinometra intricata* (part) 1874. LÜTKEN, Cat. Mus. Godefr., vol. 5, p. 190.  
*Comatula mertensi* 1875. GRUBE, Jahresber. der schls. Gesellsch. für vaterland. Cultur, 1875, p. 74.  
*Actinometra armata* (Semper, MS.) 1876. W. B. CARPENTER, Proc. Roy. Soc., vol. 24, p. 451.  
*Actinometra polymorpha* 1877. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 13, p. 440.—1879. Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 1.  
*Antedon mertensi* 1882. BELL, P. Z. S., 1882, p. 535.  
*Actinometra mutabilis* (Lütken, MS.) 1884. VON GRAFF, "Challenger" Reports, vol. 10, Zoölogy, part 27, p. 13.  
*Actinometra cumingi* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 167.—1887. BELL, Sci. Trans. Roy. Dublin Soc., (2), vol. 3, p. 645.  
*Actinometra annotea* 1887. BELL, Sci. Trans. Roy. Dublin Soc., (2), vol. 3, p. 645.  
*Actinometra elongata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 311, pl. lvii, figs. 2-4.  
*Actinometra simplex* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 312.  
*Actinometra quadrata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 331, pl. lxii, fig. 1.  
*Actinometra parvicirra*, (part) 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 338.  
*Actinometra rotalaria*, 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 313.  
*Actinometra guttata* (Lütken, MS.) 1891. HARTLAUB, Nova Acta Acad. German., vol. 85, No. 1, p. 96.  
*Actinometra variabilis* (part) 1894. BELL, P. Z. S., 1894, p. 394.  
*Comatula orientalis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 155.

- Comatula helianthus* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 440.  
*Comanthus rotalaria*, 1909. A. H. CLARK, Smiths, Miscell. Coll. (Quarterly Issue),  
 vol. **52**, part 2, p. 205.  
*Comanthus (Comanthus) rotalaria*, 1909. A. H. CLARK, Vidensk. Medd. fra den  
 naturhist. Forening i København, 1909, p. 144.  
*Comanthus (Validia) parvicirra*, 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol.  
**40**, p. 18.

LOCALITIES.—*Gwada, Baluchistan*.—Two specimens; one has twenty-five arms  
 60 mm. long; the other is smaller with twenty-one arms.

*Galle, Ceylon*.—Ten specimens; one has twenty arms 75 mm. long, one IIBr  
 series being absent and one IIIBr 4 (3+4) series being present; one has thirty-  
 five arms 100 mm. long, the IIIBr series being all present on three of the rays:  
 two are present, developed exteriorly, on one, and one, developed interiorly, on  
 the fifth; one specimen with twenty-two arms 75 mm. long; one medium-sized  
 specimen with twenty arms; one small specimen with twenty-two arms 70 mm.  
 long; one specimen with twenty-one arms 75 mm. long, three IIIBr series being  
 present and two IIBr series absent; one specimen with thirty-five arms; one  
 specimen with twenty arms 60 mm. long; one specimen with thirty-one arms  
 75 mm. long; and one small eighteen-armed example.

*Off Table Island; 15-35 fathoms*.—One specimen with eight IIIBr 4 (3+4)  
 series developed, and two IIBr series lacking; two of the IIBr series are 2.

*Port Blair, Andaman Islands*.—One example with thirty-four arms 110 mm.  
 long; all the IIBr and fourteen IIIBr series are developed, the latter in 1,2,2,1  
 order, except where there are four on a ray. One of the IIIBr series is 2, the  
 remaining thirteen being 4 (3+4).

*Andamans; surf line*.—One specimen with twenty-eight arms 110 mm. long.

*Andamans*.—Three small and medium-sized examples.

*Off Contor's Island (12° 12' N. lat., 98° 15' E. long.)*; 8 fathoms.—One  
 specimen with several IIIBr series developed.

? *India*.—One specimen with twenty arms 150 mm. long; the calyx and arm  
 bases are no larger than in specimens with half the arm length of this individual,  
 but the arms are greatly attenuated and elongated. I have previously shown  
 that the excessive attenuation and elongation of the arms is a somewhat frequent  
 variation in *Comatula pectinata*,<sup>1</sup> but it has not previously been reported in the  
 genus *Comanthus*. This is a variation in the direction of the permanent condi-  
 tion found in *Uintacrinus*.

OTHER RECORDS.—“Australia”; northwest Australia; Prince of Wales  
 Channel; Torres Straits; Thursday Island; Port Molle and Port Denison, Queens-  
 land; Warrior Reef; Cape Baudin; Bassett-Smith Bank; Fremantle, western  
 Australia; Samoa; Fiji; Tonga; Vavao, Friendly Islands; Pelew Islands;  
 Gilbert Islands; Timor; New Caledonia; Mortlock Island, Carolines; Batjan;

<sup>1</sup> Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 149.



Panopé and Friedrichwilhelmshaven, New Guinea; Amboina; Lombok Strait; Moreton Bay; Ovalao; Sandal Bay, Lifu; North Borneo; Kupang; Solor; Bohoi; Ubay; south coast of Ceram; Admiralty Islands; Moluccas; Banda; Tongatabu Reefs; Ternate; Zamboanga; Cebu; Cabulan; Philippine Islands; Sulu; Macclesfield Bank; Madras; Tuticorin, Madras; Bay of Bengal; Nicobar Islands; Ceylon; Gulf of Manaar; Singapore; China Sea; Amoy; Formosa (Taiwan); Tokyo Bay; southern Japan; Seychelles; ? Red Sea; ? Madagascar; ? Mauritius.

DEPTH.—Littoral, and down to 42 (? 55) fathoms.

REMARKS.—This species has been recorded from Peru on the strength of several specimens collected by Vierau labelled "Peru" in the collection of the Hamburg Museum. I have elsewhere suggested<sup>1</sup> that the "Peru" intended might possibly be the island Peru in the Gilbert group. These specimens form part of a very old collection, and Professor Pfeffer and Dr. Michaelsen tell me that the localities as given are unreliable.

#### COMANTHUS sp.

*Comanthus* sp. 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 19.

An undetermined species of *Comanthus*, apparently related to *C. parvicirra*, which was dredged by Dr. P. R. Joly in about 30 meters at Cape St. André, Madagascar, is here recorded.

#### COMANTHUS sp.

*Comanthus* sp. 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 20.

Two small comasterids close to, if not, *Comanthus parvicirra*, are here recorded from Mauritius.

#### Family ZYGOMETRIDÆ.

*Zygotetrada* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 211.

#### Genus EUDIOCRINUS.

*Ophiocrinus* 1868. SEMPER, Archiv für Naturgesch., 1868, I, p. 68 (**Ophiocrinus indivisus**, sp. nov.; preoccupied by *Ophiocrinus* Salter, 1856).

*Eudiocrinus* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, p. 488 (new name for *Ophiocrinus* Semper, 1868, not *Ophiocrinus* Salter, 1856; **Ophiocrinus indivisus** Semper, 1868).

#### EUDIOCRINUS ORNATUS.

*Eudiocrinus ornatus* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 663.

DESCRIPTION.—Centrodorsal a thin disk, the bare polar area flat, 2.5 mm in diameter; cirri arranged in a single marginal row.

<sup>1</sup> Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 127 (footnote).

Cirri XVIII, 17-18, 20 mm. long; first segment twice as broad as long, second nearly or quite as long as broad, third to fifth twice as long as the proximal diameter, sixth slightly shorter, a more or less marked transition segment; following segments gradually decreasing in length, the terminal segments being only slightly longer than broad; penultimate segment about as long as broad; the third to the sixth segments are very strongly "dice-box" shaped, with the distal edge all around produced, except on the dorsal side; from the seventh onward both these features become less marked, and the cirrus becomes somewhat compressed

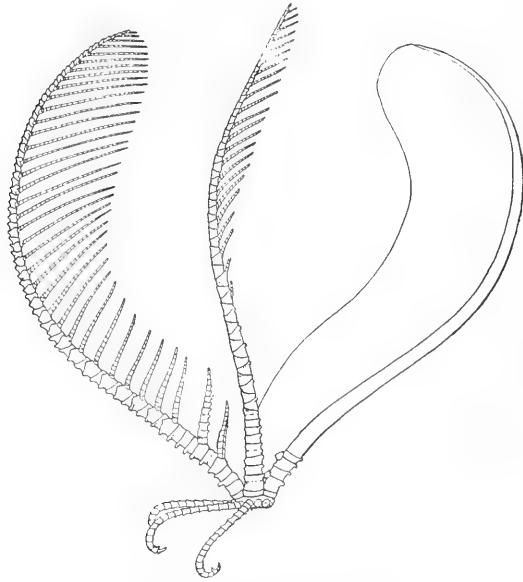


FIG. 4.—*Eudiocirrus ornatus*.  
Lateral view of a typical specimen

laterally; there are no dorsal spines; opposing spine sharp, prominent, arising from the entire dorsal surface of the penultimate segment, equal to about one half of the lateral diameter of that segment in height; terminal claw equal in length to the penultimate segment, stout and strongly curved.

Disk with a few rather large plates along the ambulacra, and well plated in the anal area.

Ends of the basal rays visible as small tubercles in the angles of the calyx; radials projecting slightly beyond the centrodorsal, slightly concave distally;  $IBr_1$  and  $IBr_2$  united by pseudosyzygy, forming an oblong pseudosyzygial pair

from one third to one half again as broad as long, the lateral edges straight, barely in apposition basally, the ventrolateral border slightly produced.

Five arms 85 mm. long; first brachial oblong, about three times as broad as long; second slightly wedge-shaped, about the same size; third and fourth (syzygial pair) slightly longer on one side than on the other, half again as broad as the median length; next three brachials approximately oblong, two and one half times as broad as long, the following becoming triangular, as broad as long, and after the proximal fourth of the arm wedge-shaped, as long as broad, and in the terminal portion somewhat longer. The lower brachials have on either side, as far as the lowest pinnule on the side, a slightly produced ventrolateral edge, corresponding with that on the IBr series; the brachials have a somewhat concave dorsal surface and very prominent distal ends, everted on the proximal, strongly overlapping on the distal, which gives the animal a curiously ornate appearance. Syzygies occur between the third and fourth brachials (the fifth and sixth post-radial ossicles), again between the eighth and ninth, and distally at intervals of three, more rarely four, oblique muscular articulations.

Pe 5.5 mm. long, moderately stout basally, tapering evenly to the tip, rather strongly prismatic, with twelve segments, the first short, the second not quite so long as broad, the third and fourth squarish, the following gradually increasing in length, becoming nearly or quite twice as long as broad as long terminally; P<sub>1</sub> similar to Pe, with the same number of segments, but somewhat stouter and not tapering so rapidly; P<sub>2</sub> 8.5 mm. long, much stouter than Pe, gradually tapering from the base to the tip, with twelve or fifteen segments, the first three about as long as broad, the following very gradually becoming elongated and about twice as long as broad distally; the pinnule is rounded prismatic; P<sub>2</sub> similar to P<sub>2</sub>; P<sub>6</sub> 6 mm. long, slender, cylindrical, less stout basally than Pe, gradually tapering and becoming very delicate in the terminal portion, with fifteen or sixteen segments, the first short, the second and third about as long as broad, the following gradually increasing in length and becoming nearly or quite three times as long as broad in the terminal portion; P<sub>3</sub> similar to P<sub>6</sub>; following pinnules similar, gradually decreasing in length to 5 mm., then very slowly increasing, reaching a length of 10 mm. distally. The distal ends of the segments of the lower pinnules are more or less produced and spinous.

The colour in spirits is chrome-yellow, the brachials to the second or third beyond the second syzygy violet; there are indistinct blotches of violet at intervals along the arms and pinnules; the arms have a median narrow zigzag light band, bordered on each side with dark.

LOCALITIES.—Near the Andaman Islands (14° 04' 30" N. lat., 93° 51' 00" E. long.) 41 fathoms; (*Type Locality*).—Six specimens.

Eight miles west of Interview Island, Andamans; 270—45 fathoms.—One specimen.

## EUDIOCRINUS SERRIPINNA.

*Eudiocrinus serripinna* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 211.

HABITAT.—Philippine Islands.

DEPTH.—22 fathoms.

## EUDIOCRINUS INDIVISUS.

*Ophiocrinus indivisus* 1868. SEMPER, Archiv für Naturgesch., 1868, i, p. 68.

*Eudiocrinus indivisus* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 495.

*Eudiocrinus granulatus* 1894. BELL, P. Z. S., 1894, p. 397, pl. xxiii.

HABITAT.—Pandanon, near Bohol; Philippine Islands; Macclesfield Bank; Ternate.

DEPTH.—30-58 fathoms.

REMARKS.—I have examined the type of Professor Bell's *Eudiocrinus granulatus* from the Macclesfield Bank, and I cannot see that it differs in any way from *E. indivisus*.

## EUDIOCRINUS VARIEGATUS.

*Eudiocrinus variegatus* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 278, figs. 9, 10, 11.

HABITAT.—Southern Japan.

DEPTH.—60 fathoms.

## EUDIOCRINUS MINOR.

*Eudiocrinus minor* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 75.

DESCRIPTION.—Centrodorsal a thin disk, the bare flat dorsal pole 1 mm. in diameter; cirrus sockets arranged in a single marginal row.

Cirri XII, 12, 5 mm. long; first two segments twice as broad as long, third half again as broad as long, fourth twice as long as broad; following segments very gradually decreasing in length, the antepenultimate being about one third again as long as broad; third and fourth segments strongly "dice-box" shaped, fifth and sixth slightly so, the following with practically straight edges; cirri proximally almost circular in cross-section, after the fifth segment becoming laterally compressed and therefore broader in lateral view; no dorsal spines or projections; opposing spine median, small, scarcely equalling one fourth the diameter of the penultimate segment in height.

Arms and pinnules as in *Eudiocrinus indivisus*, the overlapping of the brahials and pinnulars being moderately marked; the arms are 15 mm. long.

The colour in spirits is white.

LOCALITY.—*Andaman Islands*.—One specimen.

REMARKS.—Although the single specimen upon which this species is founded is small, yet the overlapping of the distal ends of the brachials and the structure of the cirri seem to indicate that it is in reality a small species, and not the young of a larger one. The small number of cirrus segments separates *E. minor* from all the other species of the genus except *E. variegatus*, but in the last they are all subequal and about as broad as long.



FIG. 5.—*Eudiocrinus minor*.  
Lateral view of the type.

#### Genus ZYGOMETRA.

*Hyponome* 1868. LOVÉN, Förhandl. Skand. Naturf. Christiania, vol. 10, p. liv  
(*Hyponome sarsii*, sp. nov., a detached visceral mass, not with certainty determinable).

*Zygometa* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50,  
part 3, p. 347 (*Antedon microdiscus* Bell, 1884).

#### ZYGOMETRA MICRODISCUS.

*Comatula* sp. (part) 1879. P. H. CARPENTER, Trans. Linn. Soc. (Zool.), (2), vol.  
2, p. 23 (footnote).

*Antedon microdiscus* 1884. BELL, Rep. Zool. Coll. H.M.S. "Alert," p. 163, pl. xv.

*Antedon macronema* BRIT. MUS., MS.

*Zygometa microdiscus* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 348.

HABITAT.—Northern and northwestern Australia; Torres Strait.

DEPTH.—Littoral, and down to 12 fathoms.

#### ZYGOMETRA MULTIRADIATA.

*Comatula* sp. (part) 1879. P. H. CARPENTER, Trans. Linn. Soc. (Zool.), (2), vol. 2, p. 23 (footnote).

? *Hyponome sarsii* 1868. LOVÉN, Förhandl. Skand. Naturf. Christiania, vol. 10, p. liv.

*Antedon multiradiata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 96, pl. ix.

*Zygometa multiradiata* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 348.

*Antedon variipinna* BRIT. MUS., MS.

HABITAT.—Torres Strait; northwestern Australia; Albany Island; Somerset Passage; Holothuria Bank; Dampier Archipelago; Cape York.

DEPTH.—5-9 fathoms.

#### ZYGOMETRA ELEGANS.

*Comatula* sp. (part) 1879. P. H. CARPENTER, Trans. Linn. Soc. (Zool.), (2), vol. 2, p. 23 (footnote).

*Antedon elegans* 1884. BELL, Rep. Zool. Coll. H.M.S. "Alert," p. 162, pl. xiii, figs. B, Ba.

*Antedon fluctuans* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 94, pl. viii.

*Zygometa elegans* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 348.

HABITAT.—Northern and northwestern Australia; Arafura Sea; Torres Strait; Baudin Island.

DEPTH.—Littoral, and down to 49 fathoms.

#### ZYGOMETRA COMATA.

*Antedon comata* (P. H. Carpenter, MS.) 1887. VON GRAFF, "Challenger" Reports, vol. 20, Zoölogy, part 61, p. 2 (*nomen nudum*).

*Antedon elegans* 1889. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 21, p. 305.

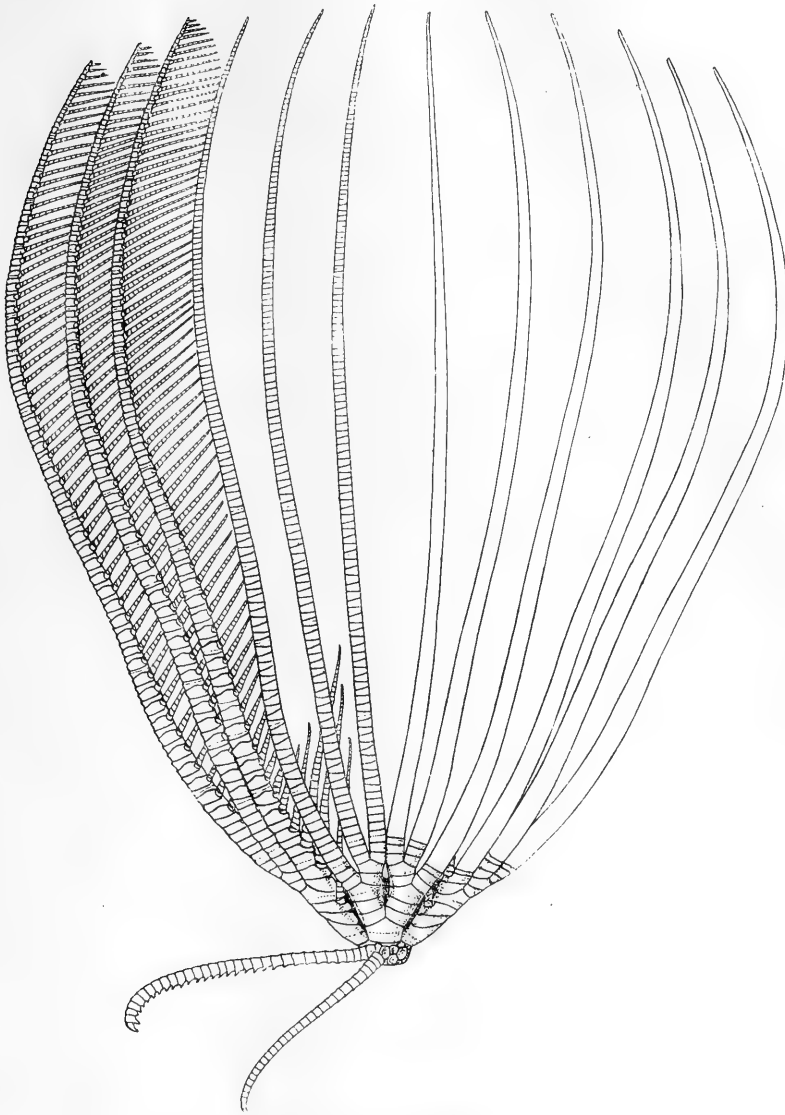


FIG. 6.—*Zygometra comata*.  
Lateral view of a typical specimen.

- Zygometa elegans* (part) 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 212.
- Zygometa fluctuans* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 151.
- Zygometa comata* 1910. A. H. CLARK, Memoirs of the Australian Museum.  
 HABITAT.—Singapore; Hong Kong; Mergui Archipelago; Philippine Islands.  
 DEPTH.—Littoral, and down to 49 fathoms.

## ZYGOMETRA PRISTINA.

- Zygometa pristina* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 537.  
 HABITAT.—Philippine Islands.  
 DEPTH.—18 fathoms.

## Genus CATOPTOMETRA.

- Catoptometra* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 317 (**Antedon hartlaubi** A. H. Clark, 1907).

## CATOPTOMETRA MAGNIFICA.

- Catoptometra magnifica* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 208.  
 HABITAT.—Philippine Islands.  
 DEPTH.—20 fathoms.

## CATOPTOMETRA OPHIURA.

- Catoptometra ophiura* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 539.  
 HABITAT.—Philippine Islands.  
 DEPTH.—58 fathoms.

## CATOPTOMETRA HARTLAUBI.

- Antedon hartlaubi* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 72.
- Catoptometra hartlaubi* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 317.  
 HABITAT.—Southern Japan.  
 DEPTH.—152–153 fathoms.

## CATOPTOMETRA RUBROFLAVA.

- Antedon rubroflava* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 150.
- Catoptometra rubroflava* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 317.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 153.



HABITAT.—Southern Japan.

DEPTH.—36–100 fathoms.

#### CATOPTOMETRA KÖHLERI.

? *Antedon rara* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 72.

*Zygometra köhleri* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 339.

*Catoptometra köhleri* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 317.

HABITAT.—Southern Japan.

DEPTH.—63–100 fathoms.

#### Family HIMEROMETRIDÆ.

*Himerometrida* (part) 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 211.

*Himerometrina* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 175.

#### Genus AMPHIMETRA.

*Amphimetra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 6  
(*Comatula* (*Alecto*) *milberti* J. Müller, 1846).

#### AMPHIMETRA PHILIBERTI.

*Comatula philiberti* 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, p. 259.

*Amphimetra mortenseni* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 635.

DESCRIPTION.—Centrodorsal thick discoidal, the bare polar area flat, 4 mm. or 5 mm. in diameter; cirrus sockets arranged in two closely crowded alternating marginal rows.

Cirri XVIII–XX, 30–42 (usually about 35), 25 mm. to 30 mm. long; first segment short, about three times as broad as long, second and third about twice as broad as long, the following gradually increasing in length to the ninth or tenth, which is nearly, though never quite, as long as broad; next five to seven segments similar, the following gradually decreasing in length, in almost the whole of the terminal half of the cirrus being about one half again as broad as long; from the twelfth or fourteenth onward sharp median tubercles or small spines are developed on the dorsal side of each segment, those on the last few segments occupying a position slightly proximal to median; opposing spine much larger than the processes on the preceding segments, triangular, the apex median, arising from very nearly the whole dorsal surface of the penultimate segment, equal to about half the lateral diameter of that segment in height; terminal claw longer than the penultimate segment, moderately stout basally but gradually becoming slender distally, moderately curved.

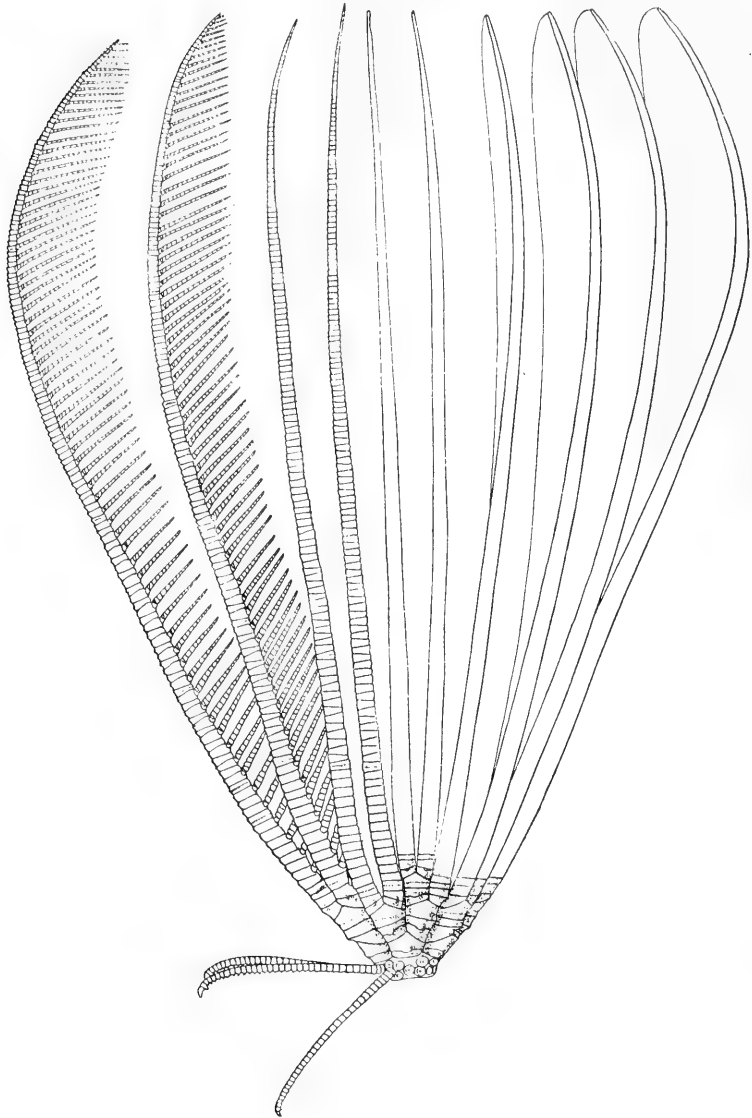


FIG. 7.—*Amphimetra philiberti*.  
Lateral view of a typical specimen.

Radials concealed, or just visible beyond the centrodorsal;  $IBr_1$  oblong, very short, in close lateral apposition;  $IBr_2$  very broadly pentagonal, almost triangular, the lateral edges not quite so long as those of the  $IBr_1$ , about two and one half times as broad as long;  $IIBr$  4 (3+4);  $IIIBr$  4 (3+4); division series and first two brachials in close lateral apposition and laterally flattened, the dorsal carination of  $P_D$  only being visible exteriorly; synarthrial tubercles usually prominent.

Twenty to twenty-five arms 150 mm. long; first brachial slightly wedge-shaped, short, about three times as broad as its exterior length, almost entirely united interiorly; second about the same size, but more pronouncedly wedge-shaped; third and fourth (syzygial pair) oblong, half again as broad as long; next five or six brachials oblong, nearly or quite four times as broad as long, then slowly becoming wedge-shaped and then almost triangular, four times as broad as long, soon becoming wedge-shaped again and, in the outer half of the arm, oblong and very short, though somewhat longer again terminally. The proximal discoidal brachials are somewhat swollen, and most of the brachials have slightly overlapping distal ends. Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth to thirty-first and thirty-second (usually somewhere between the sixteenth and twenty-fifth, with sometimes an extra one from two to four or five brachials beyond the first), and distally at intervals of from two to thirteen (usually eight to twelve) oblique muscular articulations.

$P_D$  7 mm. long, moderately stout basally but tapering rapidly and becoming slender in its distal half, with about twenty-five segments, which are at first three times as broad as long, becoming twice as broad as long at the sixth, and squarish in the terminal portion; some of the lower segments are bluntly carinate;  $P_1$  10 mm. long with thirty segments, slightly less stout basally than  $P_D$  and tapering somewhat less rapidly; the segments are at first about twice as broad as long, becoming as long as broad at about the eighth, and somewhat longer than broad terminally;  $P_2$  15 mm. long, stouter than  $P_1$ , tapering evenly to a delicate tip, with thirty segments, at first about half again as broad as long, becoming squarish at the eighth or ninth, and about twice as long as broad at the tip;  $P_3$  22 mm. long, stouter than the preceding, with thirty segments, at first broader than long, becoming squarish at the tenth and longer than broad terminally; the pinnule is more or less carinate in its proximal half and has a moderate supplementary ridge on the distal half of the outer side;  $P_4$  resembling  $P_3$ , but very slightly longer, and proportionately stouter and more carinate;  $P_5$  like  $P_3$ ;  $P_6$  10 mm. long, resembling  $P_1$ , but somewhat more strongly carinate proximally; following pinnules gradually decreasing to 7 mm. in length and losing the basal carination, then increasing to 12 mm. distally. On some arms  $P_5$  is small as described for  $P_6$ , and again  $P_4$  may also be small, while occasionally  $P_2$  and  $P_4$  are similar and  $P_3$  is greatly enlarged; sometimes  $PP_{2, 3}$ , and  $4$  are as described for  $PP_{2, 4}$ , and  $6$ . On one or more of the inner arms of each ray

$P_2$  is often much larger than on the outer, while the adjacent pinnules are reduced.

The colour in spirits is flesh colour, the cirri violet; or, cirri and division series violet, the arms flesh colour, more or less clouded with violet; or, entirely deep violet.

LOCALITIES.—*Port Blair, Andaman Islands* (Type Locality).—One specimen. *Andaman Islands*.—Four specimens.

OTHER RECORDS.—Java; Kwala Cassam, Malay Peninsula.

REMARKS.—Examination of the type of Müller's *Comatula philiberti*, preserved in the Paris Museum, has shown me that it is the same species as that which I described, from specimens in the Indian Museum collection, as *Amphimetra mortenseni*. Müller's description was not detailed, and the specimen had never been re-examined, so that there was no way of telling even to what genus it belonged until an opportunity offered of studying it.

#### AMPHIMETRA VARIIPINNA.

*Comatula dubia* 1877. VON GRAFF, Das Genus Myzostoma, p. 15 (*nomen nudum*).

*Antedon variipinna* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 506.

*Antedon crenulata* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 507.

*Antedon decipiens* 1882. BELL, P. Z. S., 1882, p. 534.—Rep. Zoöl. Coll. H.M.S. "Alert," p. 159, pl. xi, figs. B, Ba.

*Antedon irregularis* 1882. BELL, P. Z. S., 1882, p. 534.—Rep. Zoöl. Coll. H.M.S. "Alert," p. 161, pl. xiii, figs. A, Aa-c.

*Antedon bidentata* 1884. VON GRAFF, "Challenger" Reports, vol. 10, Zoölogy, part 27, pp. 15, 16, 17 (*nomen nudum*).—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 262 (*nomen nudum*).

*Antedon dubia* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 258, pl. xxxvi, figs. 1-6.

*Antedon philiberti* BRIT. MUS., MS.

*Amphimetra variipinna* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.

LOCALITIES.—*Pocock Island*; 20 fathoms.—One specimen with twenty arms 110 mm. long; three IIBr series are lacking, but the deficiency is compensated by the development of three IIIBr series. The seven IIBr series are extraordinarily irregular; one is 8 (3+4; 5+6; 7+8), one 2, one 4, the two outer elements united by synarthry, and four are 4 (3+4); the three IIIBr series are also irregular, one being 1, one 2, and one 4 (3+4), the last two being on a single post-radial series, 2 externally, 4 (3+4) externally.

This example agrees with others from Singapore in the collection of the Copenhagen Museum, and with others from Australia in the collection of the Australian Museum.

OTHER RECORDS.—Canton, China; Borneo; Philippine Islands; Singapore; Arafura Sea; Aru Islands; Sunda Islands; Baudin Island; Albany Island; Port Curtis; Holothuria Bank; Torres Strait; Dundas Strait; Prince of Wales Channel; northwestern Australia.

DEPTH.—Littoral, and down to 61 fathoms.

#### AMPHIMETRA PRODUCTA.

*Antedon laevissima* (part) 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, p. 224.

*Himerometra producta* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 224.

*Amphimetra producta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 157.

HABITAT.—Singapore; Fadiffolu, Maldives.

#### AMPHIMETRA SCHLEGELII.

*Alecto schlegelii* LÜTKEN, MS.

*Actinometra intricata* BRIT. MUS., MS.

*Himerometra schlegelii* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 223.

*Amphimetra schlegelii* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 158.

HABITAT.—Japan, and southward to New Guinea, Tonga, and Fiji.

#### AMPHIMETRA AFRICANA.

*Amphimetra africana* 1911. A. H. CLARK, Proc. U.S. Nat. Mus., vol. 40, p. 20.

HABITAT.—Bagamoyo, German East Africa; Zanzibar; Wazin, British East Africa.

#### AMPHIMETRA MILBERTI.

*Comatula (Alecto) milberti* 1846. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178.

*Comatula jacquinoti* 1846. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178.

*Comatula laevissima* (part) 1875. GRUBE, Jahresber. d. schlesisch. Gesellsch. für vaterl. Cultur, 1875, p. 74.

*Antedon laevipinna* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, p. 502.

*Amphimetra milberti* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.

HABITAT.—Canton, China; Prince of Wales Channel, Torres Strait; Amboina; Panay; Zamboanga; Philippine Islands; Padan Bay, Mergui Archipelago; North Borneo; Ceram; Ceylon; Port Molle, Queensland.

DEPTH.—Littoral, and down to 35 (? 36) fathoms.

#### AMPHIMETRA LAEVISSIMA.

*Comatula laevisissima* 1875. GRUBE, Jahresber. d. schlesisch. Gesellsch. für vaterl. Cultur., 1875, p. 74.

HABITAT.—North Borneo.

#### AMPHIMETRA MOLLERI.

*Antedon laevisissima* (part) 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, p. 224.

*Antedon milberti* (part) 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 81.

*Himerometra molleri* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 222.

*Amphimetra molleri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 156.

*Antedon milberti* BRIT. MUS. MS.

HABITAT.—“ Indian Ocean ”; “ East Indies ”; Maldives; Singapore; Malacca; Atjeh, Burma; Java Sea.

#### AMPHIMETRA PARILIS.

*Amphimetra parilis* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, p. 32.

HABITAT.—Philippine Islands.

DEPTH.—21 fathoms.

#### AMPHIMETRA DISCOIDEA.

*Comatula carinata* 1828–1837. GUÉRIN-MÉNEVILLE, Iconographie du regne animal, zoophytes, pl. i, fig. 2a.

*Comatula dibrachiata* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).

*Comatula* (*Antedon*) *milberti* var. *dibrachiata* P. H. CARPENTER, MS.

*Antedon milberti* (part) 1894. BELL, P. Z. S., 1894, p. 394.

*Actinometra brachiolata* BRIT. MUS., MS.

*Himerometra discoidea* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 215.

*Amphimetra formosa* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37,

p. 32.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 157.

*Amphimetra discoidea* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, p. 32.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 158.

HABITAT.—Northwestern, northern, and northeastern Australia, and northward to Singapore, Formosa (Taiwan), and the Philippine Islands.

DEPTH.—Littoral, and down to 20 fathoms.

#### AMPHIMETRA ENSIFER.

*Himerometra ensifer* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 225.

*Amphimetra ensiformis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 7.

*Amphimetra ensifer* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 158.

HABITAT.—Singapore.

#### AMPHIMETRA DENTICULATA.

*Antedon denticulata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 130, pl. xxii, figs. 1, 2.

HABITAT.—Arafura Sea.

DEPTH.—49 fathoms.

REMARKS.—An examination of the type of this species at the British Museum has shown that it belongs to the genus *Amphimetra* instead of to *Nanometra* as I had previously supposed.

#### AMPHIMETRA PINNIFORMIS.

*Antedon pinniformis* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 180.

HABITAT.—Andai, New Guinea.

REMARKS.—This is a small species of *Amphimetra*, belonging to the *milberti* division of the genus, though heretofore on the basis of Carpenter's description it has always been assigned to the genus *Oligometra*. The cirri are moderately stout, tapering slightly in the distal half, with all the segments subequal, all about twice as broad as long, those in the proximal half slightly longer, those in the distal half slightly shorter. The synarthrial tubercles are small but rather prominent, resembling those in specimens of *Amphimetra discoidea* from Port Mølle.  $P_2$  is long and stout, much larger than the small and weak  $P_1$ ;  $P_3$  is similar to  $P_2$  and nearly as long and stout; the following pinnules are small and weak. The cirri are XII, 25; the dorsal spines are sharp and moderately long.

## Genus HIMEROMETRA.

*Himerometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 355 (*Antedon crassipinna* Hartlaub, 1890).

## HIMEROMETRA BARTSCHI.

*Himerometra bartschi* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 212.

HABITAT.—Philippine Islands.

DEPTH.—21-24 fathoms.

## HIMEROMETRA MAGNIPINNA.

*Himerometra magnipinna* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 214.

HABITAT.—Philippine Islands; St. Mathias Island.

DEPTH.—Littoral, and down to 21 fathoms.

## HIMEROMETRA PULCHER, nom. nov.

*Himerometra robustipinna* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 213.

HABITAT.—Philippine Islands.

DEPTH.—9 fathoms.

REMARKS.—The entirely unexpected discovery that Carpenter's *Actinometra robustipinna* really belongs to the genus *Himerometra* has necessitated a change in the name of the present species.

## HIMEROMETRA INOPINATA.

*Antedon inopinata* 1894. BELL, P. Z. S., 1894, p. 398.

DESCRIPTION.—Centrodorsal as in the other species of the genus.

Cirri XXX, 26-34, stout, 30 mm. to 35 mm. long; the sixth or seventh segments are the longest, slightly broader than long to half again as broad as long; the outer segments are slightly carinate, the carination on the last six or seven ending distally in a small spine.

The forty-six arms are 140 mm. long; nine of the IBr series are 4 (3+4) and two are 2; the IIIBr series are all 4 (3+4) except one (internal); the remaining division series are all 4 (3+4) except two IVBr series which are 2. The division series are strongly convex and well separated as is usual in the genus.

The proximal pinnules are very stout, but nearly smooth, the distal edges of the segments being only very slightly swollen; all the segments are short, about twice as broad as long in the proximal half, becoming squarish toward the



tip; the proximal pinnules are about 20 mm. long with from seventeen to twenty segments.

HABITAT.—Macclesfield Bank.

DEPTH.—13-36 fathoms.

REMARKS.—Professor Bell assigned this species to the "Granulifera group" of Carpenter instead of to the "Savignyi group" where it belongs. In the original description no characters of other than generic or family importance are mentioned.

The depth is given as "31-36 fms." but the label with the specimen reads "13-36 fms."

This species is very similar to *Himerometra sol* which was found by Mr. J. Stanley Gardiner in the Maldive Islands (the *Antedon palmata* of Professor Bell) but the cirri are larger and rather stouter and the proximal pinnules are shorter, about as stout in the proximal part, but tapering more rapidly, and without the flagellate tip. The segments in the outer part also do not possess the strongly everted distal edges seen in *H. sol*. The cirri of *H. inopinata* are much the same as those of *H. sol*, but for the presence of a distinct, though small, spine on the last five or six segments; that on the antepenultimate segment is nearly as large as the opposing spine.

#### HIMEROMETRA SOL, sp. nov.

*Antedon palmata* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

DESCRIPTION.—Centrodorsal thick discoidal, with a strongly concave dorsal pole 4 mm. in diameter.

Cirri XXI, 25, 27, 28 and 30, 25 mm. to 30 mm. long; the longest segments, in the basal third, are nearly or quite as long as broad; the distal segments are slightly broader than long, sometimes as much as one third broader than long; the terminal ten or twelve have a small and low median dorsal tubercle, sometimes scarcely noticeable until near the end of the cirrus; opposing spine well developed and conspicuous. The cirri as a whole are stout, stouter than in the other species of the genus, with approximately subequal segments.

The forty-one arms are 140 mm. long; the IIBr series are 4 (3+4); the IIIBr series are 4 (3+4) externally, 2 internally; the IVBr series when present are 4 (3+4).

P<sub>5</sub> is 18 mm. long with from 30 to 32 segments which are nearly twice as broad as long in the proximal half, becoming squarish in the distal third and terminally twice as long as broad; after the fourth or fifth the segments develop strongly everted and produced distal edges, this character gradually dying away in the distal third; this eversion is smooth and not serrate. These proximal pinnules are very stout, but also very long, and taper distally to a flagellate tip as in *H. magnipinna*; but the eversion of the distal ends of the segments is much greater than in that species, and the cirri are much stouter.

Another specimen has the cirri XXXV, 27-29; there are fifty-one arms; only one of the division series (a IIIBr series) is 2; the division series as in the other are strongly convex and well separated; the proximal pinnules are exactly as in the other, 18 mm. to 21 mm. long.

HABITAT.—Kolumaduli, Maldives.

DEPTH.—38 fathoms.

#### HIMEROMETRA CRASSIPINNA.

? *Actinometra robustipinna* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. , p. 201.

*Antedon crassipinna* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 185.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 32, pl. i, figs. 1, 5, 10.

*Himerometra crassipinna* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 356.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 155.

HABITAT.—Amboina; Singapore; Pulau Ubin, Singapore; ? Cochin China.

REMARKS.—The type of *Actinometra robustipinna* preserved at Leyden proves to be a specimen of some species of *Himerometra*, and is not an "*Actinometra*" at all; in appearance it is exactly like the specimens of *H. crassipinna* which I have examined from Singapore; the IIIBr series throughout are 4(3+4), a rather unusual, though not at all an unknown condition. The proximal pinnules are very large and stout, the tip ending bluntly after a considerable recurve. So far as they are preserved the segments are all broader than long; the distal ends are not thickened or produced, though appearing slightly prominent and a trifle swollen. One  $P_1$  with eighteen segments seems to be complete. This appears to be the same thing as Hartlaub's *Antedon crassipinna*, but the identification cannot be certain because of the absence of all the cirri and of the pinnule tips.

Hartlaub's specimen from Cochin China, which I examined at Hamburg, appears to belong to a different species, but no material was available for critical comparison.

#### HIMEROMETRA KRAEPELINI.

*Antedon kraepelini* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 183.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 22, pl. ii, figs. 15, 21.

HABITAT.—Akyab, Burma.

#### HIMEROMETRA PERSICA.

*Himerometra persica* 1908. A. H. CLARK, Bull. Mus. Comp. Zoöl., vol. 51, No. 8, p. 243.—Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 214.

HABITAT.—Philippine Islands; Persian Gulf.

DEPTH.—Littoral, and down to 28 fathoms.

## HIMEROMETRA sp.

*Actinometra robustipinna* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 201.

The type of Carpenter's *Actinometra robustipinna*, which was brought from the Moluccas by H. C. Macklot, proves to be a specimen of a typical species of *Himerometra*, possibly *H. crassipinna*.

## Genus CRASPEDOMETRA.

*Craspedometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 8. (*Antedon acuticirra* P. H. Carpenter, 1882).

## CRASPEDOMETRA ACUTICIRRA.

*Antedon acuticirra* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 509.

*Antedon ludovici* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 510.

*Antedon australis* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 510.

*Antedon bipartipinna* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 512.

*Craspedometra acuticirra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 9.

LOCALITIES.—*Andaman Islands*.—One specimen with twenty-two arms 120 mm. long, and cirri X, 43+, 50 mm. long; all the IIBr series are present; the two IIIBr series are 2, developed internally; the colour is whitish, the articulations purple, the arms crossed by regular broad deep purple bands; the cirri are white, each segment with a saddle of purple ventrally, becoming rusty brown at the tip.

*Gregory Island, Mergui Archipelago*.—One example with thirty-one arms 120 mm. long; the IIBr series are all present, 4 (3+4); the IIIBr series are all present, developed internally, and there is an additional external one; two of them are 4 (3+4), the others being 2; the cirri are XIII, 43—44, 40 mm. long. In coloration it resembles the following.

*Yé, Burma*.—One especially fine specimen with thirty-six arms 90 mm. long; the IIBr series are all 4 (3+4), the IIIBr series all 2, all present internally, and six present externally; the synarthrial tubercles are prominent; the cirri are XII, 42+, 43+, and 44+.

In coloration this specimen is yellowish white, the pinnules with occasional small irregular blotches of light purple; the cirri are white, becoming rusty brown at the tip, each segment with a saddle of dull purplish.

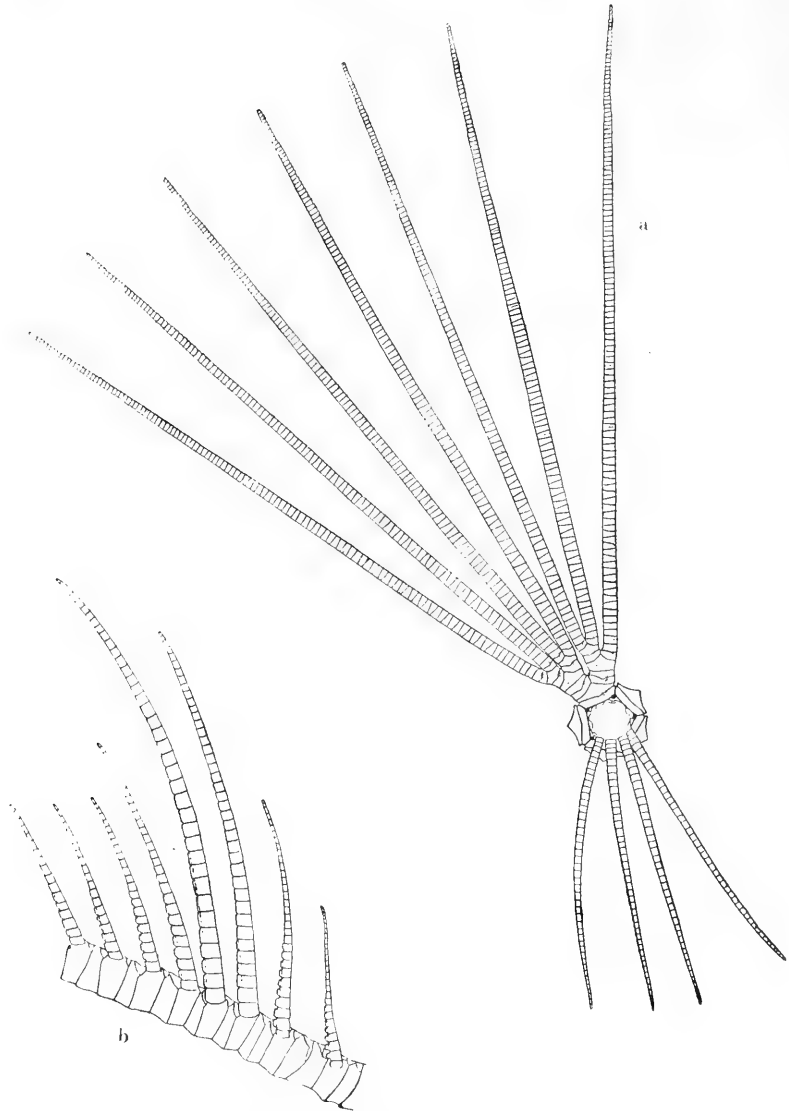


FIG. 8.—*Craspedometra acuticirra*.

- (a) Dorsal view of a typical specimen; one ray is shown in detail, and the cirri on about one third of the periphery of the centrodorsal.  
(b) The proximal pinnules.

OTHER RECORDS.—Hong Kong ; Singapore ; Sydney, New South Wales ; Amboina.

CRASPEDOMETRA ATER.

*Craspedometra ater* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 21.

HABITAT.—Red Sea.

CRASPEDOMETRA MADAGASCARENSIS.

*Craspedometra madagascarensis* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 23.

HABITAT.—Madagascar.

CRASPEDOMETRA AMBOINÆ, sp. nov.

*Antedon ludovici* 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 29, pl. 1, figs. 7, 8.

DESCRIPTION.—Centrodorsal large, slightly convex, the dorsal pole often finely pitted ; cirrus sockets arranged in two irregular rows.

Cirri about XXV, 35–40, about 35 mm. long ; none of the cirrus segments are longer than broad ; the outer bear small dorsal tubercles, and the terminal sometimes prominent spines.

Radials plainly visible in the angles of the calyx, or entirely concealed ;  $IBr_1$  entirely united laterally ;  $IBr_2$  short, pentagonal ;  $IIBr$  series usually 4 (3+4), more rarely 2 ;  $IIIBr$  series developed usually only interiorly, 2, but 4 (3+4) when following a  $IIBr$  2 series ; synarthrial tubercles moderately developed ; rays laterally free, though sometimes very close together.

Sixteen to twenty-two long arms, some of them arising direct from the  $IBr$  axillary ; the brachials are only slightly overlapping ; the bases of the arms are rugose. Brachials short ; the first is shorter than the second ; third and fourth (syzygial pair) very short ; following this there is a series of discoidal brachials, and then a series of wedge-shaped, the latter becoming progressively shorter, and short oblong after the middle of the arm. Syzygies occur between the third and fourth brachials, again somewhere between the eleventh and nineteenth brachials, and distally at intervals of from seven to eleven oblique muscular articulations. In the arms arising directly from a  $IBr$  axillary the second syzygy is between the ninth and tenth brachials, more rarely between the sixteenth and seventeenth ; the distal intersyzygial interval is usually seven or eight oblique muscular articulations.

$P_1$  or  $P_D$  8 mm. or 9 mm. long ;  $P_2$  usually much longer, almost as long as  $P_3$ , 18 mm. ;  $P_4$  variable, but usually smaller ; following pinnules decreasing in length to  $P_5$ , which is 7 mm. or 8 mm. long ; distal pinnules 14 mm. long. Proximal segments of the pinnules in the basal third of the arm strongly carinate ; the enlarged lower pinnules are moderately stiffened ;  $P_2$  is composed of about

twenty sharply carinate segments, none of which are longer than broad.  $P_2$  and  $P_1$  are very slender and flagellate after the first few segments.

The colour in spirits is uniform black, in dry specimens somewhat reddish brown.

HABITAT.—Amboina.

DEPTH.—Littoral.

REMARKS.—The above description is taken from Hartlaub's account of the type specimens, which were collected at Amboina by Dr. J. Brock; Hartlaub referred them to *C. acuticirra*, but they evidently represent a new species.

#### CRASPEDOMETRA ANCEPS.

*Antedon* sp. 1880. P. H. CARPENTER, Quart. Journ. Geol. Soc. (February, 1880, p. 41 (footnote).

*Antedon anceps* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 254, pl. xxxv, figs. 1-3.

*Antedon clemens* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 229, pl. xxxix, fig. 5.

*Craspedometra aliena* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, p. 31.

HABITAT.—Celebes Sea; Sunda Islands; Philippine Islands.

DEPTH.—10-44 fathoms.

REMARKS.—An examination of the "Challenger" material in London has shown me that my *Craspedometra aliena* is merely a very large form of the species which Carpenter called *anceps*, and, furthermore, that his *clemens* is also the same thing as his *anceps*. The earlier pinnules of this species sometimes have the curious production of the distal corners of the segments which Carpenter described in *Amphimetra variipinna* and in *Oligometra serripinna*.

#### Genus HETEROMETRA.

*Heterometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11 (*Antedon quinduplicava* P. H. Carpenter, 1888).

#### HETEROMETRA NEMATODON.

*Antedon nematodon* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 185.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 27, pl. i, fig. 9.

*Heterometra nematodon* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

HABITAT.—Bowen and Port Mollé, Queensland.

DEPTH.—Littoral, and down to 20 fathoms.

REMARKS.—At the British Museum I found, in a large jar full of specimens of *Amphimetra discoidea* (labelled *Antedon milberti*), a small example of this species which had been dredged by the "Alert" at Port Mollé in from 12 to 20 fathoms of water.

## HETEROMETRA REYNAUDII.

*Comatula (Alecto) reynaudii* 1846. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178.

*Antedon variipinna* 1904. CHADWICK, Report Pearl Oyster Fisheries Ceylon, part 2, Supplementary Report xi, p. 157.

*Heterometra reynaudii* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

LOCALITIES.—*South of Ceylon* ( $6^{\circ} 01' N.$  lat.,  $81^{\circ} 16' E.$  long.); 34 fathoms.—Four specimens, one small and two medium sized, the cirrus segments numbering 31–36. The fourth specimen is one of the most interesting crinoids I have ever seen. The centrodorsal and division series are of normal size and shape; one cirrus remains, which tapers to a point at the seventeenth segment; no dorsal spines are developed; the nineteen arms are only 17 mm. long, of normal size basally but rapidly tapering to a point beyond which they are continued for a short distance in a slender soft uncalcified process. The lower pinnules taper very rapidly for the first five or six segments, from that point onward being very hair-like and slender with little or no lime in their composition. Beyond the arm bases the pinnules are exceedingly slender, with never more than the first or first two segments of normal size, and usually with none, usually with traces of calcareous deposits showing segmentation, though often quite without any. With the reduction of the calcareous matter in the pinnules comes a reduction in the pinnule sockets, the non-calcareous pinnules on the outer part of the arm not being accompanied by any modification in the outer edge of the brachials whatever. Most of the arms of the specimen have been broken off and repaired at the syzygy between the third and fourth brachials.

The short, stout, rapidly tapering arms which, as it happens, are folded inward over the disk, are strongly suggestive of those of the fossil *Flexibilia Impinnata*, a similarity which is greatly enhanced by the almost complete absence of calcified pinnules, and the entire absence of pinnule sockets on the outer part of the arms. Had this specimen been found fossil it would probably have been referred to that group; as it is it leads one to suppose that the so-called *Impinnata* may not, after all, have been impinnate as commonly considered but may have been supplied with non-calcareous pinnules which were never preserved. The *Impinnata* all have a large visceral mass and short arms, just as in this specimen, and it is somewhat problematical how they managed to obtain sufficient food to maintain their existence; but if, on the analogy of this specimen, we increase their arm length by supplying a hypothetical non-calcareous continuation of the arms, and then supply the whole structure with soft pinnules, we can readily furnish the animals with an adequate food-collecting area.

Mr. Frank Springer is now completing his monograph upon the *Flexibilia*. I therefore referred the specimen to him for study in connection with his work,



FIG. 9.—*Heterometra reynaudii*.  
Lateral view of a typical specimen.



with a request that he furnish me with some notes upon it. These notes he was kind enough to prepare, and they are incorporated in this report in the form of an appendix. As Mr. Springer is the acknowledged leader in the study of the fossil crinoids his remarks upon this specimen are of peculiar interest.

Many months ago, when the United States government was preparing to undertake a detailed marine biological survey of the Philippine Islands, we indulged in some speculation as to what might be expected in the way of new crinoids. The discovery of *Phrynocrinus*, *Gephyrocrinus*, *Ptilocrinus* and *Calamocrinus* among the stalked forms, and of the dozens of comatulids inhabiting the north Pacific, had only recently been made, opening our eyes to the fact that what we did not know about the recent crinoids undoubtedly far exceeded what we did; and I remember that Mr. Springer remarked that it was not improbable that the "Albatross" would discover an impinnate form. Little did we suspect that we had already been anticipated and that a crinoid which to all intents and purposes is impinnate had been found some years before by a rival ship, the "Investigator."

*East of the Terribles; 13 fathoms.*—Three specimens; two of these have each twenty-five arms, five IIIBr2 series being present, developed internally in 1, 2, 2, 1 order; the third is smaller with only thirteen arms.

*Palk Strait, north-east coast of Ceylon.*—Four specimens; one of these has twenty arms about 110 mm. long and cirri XXV, 34-40, 25 mm. to 27 mm. long; another has twenty-one arms (one IIIBr series being present) and cirri XXI, 33-42; a third has twenty-two arms (with two IIIBr series developed internally); while the fourth has twenty arms, one IIBr series being absent, but its loss being compensated by the development of one IIIBr series which, however, is 4 (3+4) instead of 2 as usual.

*Off the Ganjam Coast (Madras Presidency), 8 miles E.S.E. of Kalingapatam Light-House; 28-30 fathoms.*—One medium-sized specimen.

*Ganjam Coast; 24-30 fathoms.*—One small twelve-armed specimen.

*Arrakan Coast, Burma.*—Two specimens, each with twenty-two arms, two IIIBr series being developed internally; one has 35-42 cirrus segments, the other 47.

? *Arrakan Coast.*—One medium-sized specimen.

*India.*—One medium-sized specimen.

? *India.*—Six medium-sized specimens.

REMARKS.—Two of the specimens from Palk Strait are parasitized by a small species of *Eulima*, but the specimens of it are too much eroded for definite determination. *Eulima* has previously been found parasitic on *Ptilocrinus pinnatus* (*E. ptilocrinicola*) from the Queen Charlotte Islands, off British Columbia, in 1,588 fathoms; on *Capillaster multiradiata* from Singapore, littoral (*E. capillastericola*), and on *Stenometra dorsata* from Japan. The first two species were described by Professor Paul Bartsch, while the specimens of the third have

been turned over to Dr. W. H. Dall for study in connection with the mollusca of the "Albatross" 1906 cruise.

OTHER RECORDS.—Ceylon; Gulf of Manaar, Pambán and Tuticorin, Madras Presidency.

DEPTH.—Littoral, and down to 7 (? 9) fathoms.

#### HETEROMETRA SAVIGNII.

*Comatula multiradiata* 1817. AUDOUIN, in SAVIGNY, Description de l'Égypte, Échinodermes, pl. i, figs. 1—6.

*Comatula adconæ* 1836. DE BLAINVILLE, Manuel d'Actinologie, 1834, pl. xxvi, figs. 1—5.

*Alecto savignii* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 144.

*Heterometra savignii* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

LOCALITIES.—*Kurrachi*.—One medium-sized specimen; there are 26 cirrus segments, the distal with strong dorsal spines.

*Straits of Ormuz, at the entrance to the Persian Gulf; 48–49 fathoms; muddy bottom*.—Seven specimens; one has twelve arms 80 mm. long and cirri XVI, 25–28, 15 mm. long; one of the two IBr series is 2, the other 4 (3+4); another has eleven arms 65 mm. long, the cirri being XV, 26–32, 15 mm. long; the single IBr series is 4 (3+4), another has twelve arms 75 mm. long the cirri being XX, 33–34, 20 mm. long; both division series are on the same ray, and both are 5 (3+4); another has thirteen arms 115 mm. long and cirri XIX, 31–33, 20 mm. long; IBr series are developed on three rays; another has ten arms 90 mm. long and cirri XVI, 26+, 20 mm. long; another has nineteen arms 90 mm. long and cirri XVII, 28–33, 20 mm. to 22 mm. long; the last has eighteen arms 75 mm. long.

OTHER RECORDS.—Red Sea; Gulf of Suez; Tor; Ul Shubuk; Khor Shinab; Salaka; Muscat; Kurraehi.

DEPTH.—Littoral, and down to 12 fathoms.

REMARKS.—Mr. Chadwick erroneously gives this species as ranging to Ceylon.

#### HETEROMETRA COMPTA.

*Heterometra compta* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 636.

DESCRIPTION.—Centrodorsal discoidal, the bare polar area flat, slightly convex, or slightly concave, about 5 mm. in diameter; cirrus sockets arranged in a single more or less irregular marginal row.

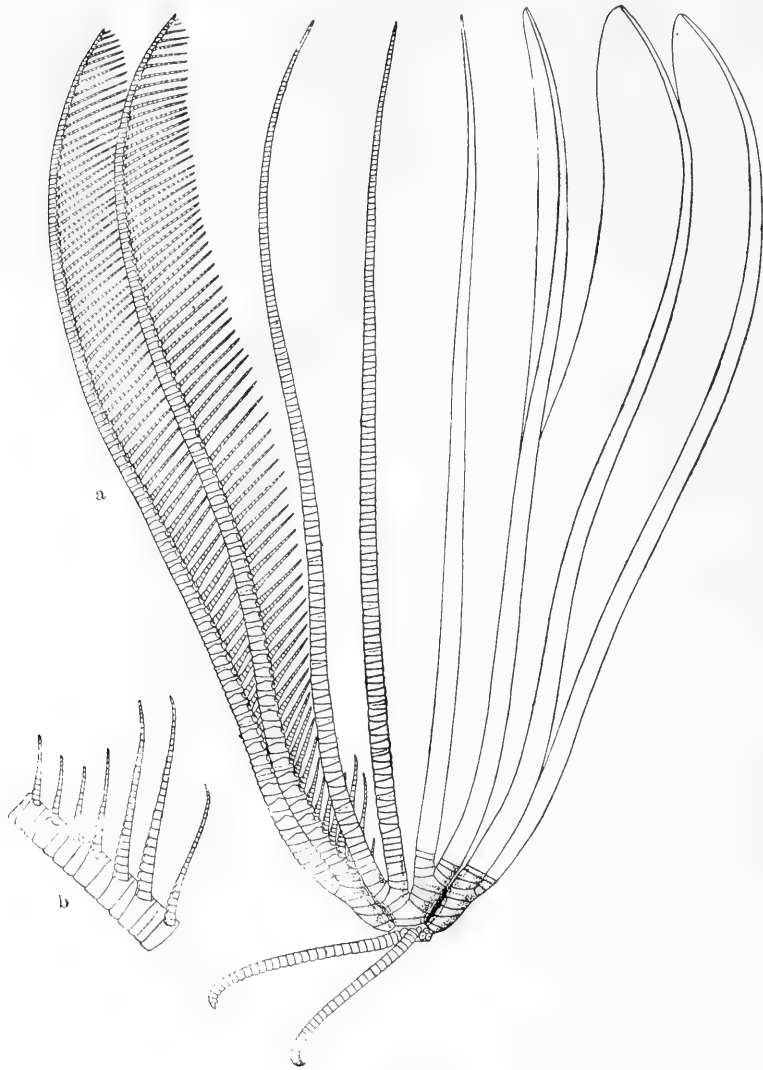
Cirri XVIII–XXIII, 31–35, 23 mm. to 25 mm. long; first segment very short, the next three nearly two and one half times as broad as long, the following gradually increasing in length to the sixth or seventh, which is about as long as broad; next five to seven segments usually slightly longer than broad (some-

times squarish), the following gradually decreasing in length, the terminal fifteen or rather more being half again to twice as broad as long; at about the fifteenth segment dorsal tubercles are developed, at first involving only the distal portion of the dorsal surface, later arising in a slightly convex line from near the proximal end, the apex being subterminal; these tubercles are narrow, laterally occupying only a small portion of the median part of each segment, and are slightly rounded dorsally; on the last three segments the tubercles become somewhat sharper, more erect, and move to a median position; opposing spine small (though larger than the tubercle on the preceding segment), blunt, arising from the entire dorsal surface of the segment, the apex median or sub-median in position, in height equal to about one third the lateral diameter of the penultimate segment; terminal claw somewhat longer than the penultimate segment, rather stout and strongly curved.

Ends of the basal rays and radials concealed;  $IBr_1$  very short and band like;  $IBr_2$  short, almost triangular, two and one half times as broad as long;  $IIBr_4$  (3+4), in apposition laterally, though not laterally flattened;  $IIBr_1$  entirely united interiorly;  $IIIBr_2$ , rarely 4 (3+4);  $IVBr_2$ , but rarely present.

Sixteen to twenty-five arms 110 mm. long; first two brachials wedge-shaped, three times as broad as long exteriorly, the first interiorly united; following four or five brachials oblong, about four times as broad as long, then gradually becoming wedge-shaped, almost triangular, about three times as broad as long, and less oblique and somewhat longer on the outer portion of the arms. The dorsal portion of the arms is perfectly smooth. Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth to twentieth and twenty-first (usually in the vicinity of the fifteenth) and distally at intervals of seven to eleven (most commonly eight or nine) oblique muscular articulations.

$P_D$  7.5 mm. long, moderately stout basally but tapering rather rapidly in the proximal half and becoming slender distally, with twenty-five segments, at first twice as broad as long, becoming squarish after the tenth; the first four segments are strongly carinate, this carination decreasing from this point onward and disappearing after the middle of the pinnule;  $P_1$  13 mm. long, slightly stouter than  $P_D$  basally, tapering gradually and becoming slender in its distal third, with twenty-six segments, at first twice as broad as long, becoming squarish after the ninth and somewhat longer than broad in the terminal portion; the first seven or eight segments are rather strongly carinate and in addition have a low sharp ridge running along their exterior surface at the base of the carinate processes;  $P_2$  similar to  $P_1$  and of the same length, but the low ridge just described may be traced to about the twelfth segment;  $P_3$  9 mm. long with nineteen segments, similar to the two preceding pinnules, but slightly less stout;  $P_4$  small, 6 mm. long, tapering rapidly in the proximal half and becoming very slender distally, with sixteen segments, which at first are twice as broad as long, becoming squarish about the ninth, and longer than broad distally; the

FIG. 10.—*Heterometra compta*

- (a) Lateral view of a typical specimen  
(b) The proximal pinnules.

first six segments are carinate like those of the preceding pinnules;  $P_6$  similar, 5.5 mm. or 5 mm. long;  $P_4$  and the following pinnules 6 mm. long with seventeen segments, at first twice as broad as long, becoming squarish about the eighth and twice as long as broad terminally; the pinnules are about as stout basally as the two preceding, tapering rapidly in the proximal half and becoming very slender distally; the carination of the proximal segments is slightly marked on the first four; this carination later becomes restricted to the second and third segment only, and disappears entirely in the outer half of the arm.

The colour in spirits is violet, darker at the articulations; the centro-dorsal and the cirri are bright yellow; sometimes the animal is entirely a light yellow brown.

LOCALITY.—*Pedro Shoal* (off the west coast of India).—Nine specimens.

#### HETEROMETRA AFFINIS.

*Antedon affinis* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 184.—  
1891. Nova Acta Acad. German., vol. 58, No. 1, p. 25, pl. v, figs. 18, 24.

*Heterometra affinis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

HABITAT.—Amboina.

#### HETEROMETRA BROCKII.

*Antedon brockii* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 183.—  
1891. Nova Acta Acad. German., vol. 58, No. 1, p. 23, pl. i, figs. 12, 13;  
pl. ii, fig. 17.

*Heterometra brockii* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

HABITAT.—Amboina.

#### HETEROMETRA MARTENSI.

*Antedon martensi* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 182.—  
1891. Nova Acta Acad. German., vol. 58, No. 1, p. 21, pl. i, figs. 3, 6.

*Heterometra martensi* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 164.

HABITAT.—Singapore.

#### HETEROMETRA JOUBINI.

*Heterometra joubini* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 25.

HABITAT.—Zanzibar.

#### HETEROMETRA GRAVIERI.

*Heterometra gravieri* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 25.

HABITAT.—Zanzibar.

## HETEROMETRA ASPERA.

*Heterometra aspera* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 162.

HABITAT.—Singapore.

## HETEROMETRA SINGULARIS.

*Heterometra singularis* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 638.

DESCRIPTION.—Centrodorsal discoidal, the bare polar area flat, 1.5 mm. in diameter; cirrus sockets arranged in a single crowded, more or less irregular marginal row.

Cirri XVII, 21–25, 12 mm. long; first segment short, second about twice as broad as long, third somewhat longer, fourth about as long as broad, next two slightly longer than broad, the following gradually decreasing in length, the terminal fifteen being one third or one half again as broad as long; at the seventh subterminal dorsal spines begin to develop which soon become long and prominent; opposing spine large and long, much larger than the spines on the preceding segments, triangular, the apex terminal, arising from the whole surface of the penultimate segment and about equal to the diameter of that segment in height; terminal claw nearly twice as long as the penultimate segment, slender, abruptly curved proximally, becoming nearly straight distally.

Disk with a few calcareous granules in the anal area, especially on the anal tube.

Radials short, oblong, the dorsal surface with numerous prominent rounded tubercles; IBr<sub>1</sub> short, oblong, slightly over four times as broad as long, in close lateral apposition; IBr<sub>2</sub> broadly pentagonal, almost triangular, twice as broad as long, the lateral edges shorter than those of the IBr<sub>1</sub>; IIBr 4 (3+4); segments up to and including the second brachial exteriorly and fourth interiorly, as well as the first two segments of the first three pinnules, in close apposition and sharply flattened, the lateral edges somewhat produced.

Eleven arms 40 mm. long; first two brachials subequal, wedge-shaped, about twice as broad as the exterior length, the first interiorly united; third and fourth (syzygial pair) slightly longer interiorly than exteriorly, nearly three times as broad as the interior length; next four brachials oblong, nearly four times as broad as long, then becoming almost triangular, about three times as broad as long, then gradually lengthening (though remaining almost triangular) to about twice as broad as long, and at a point somewhat beyond the proximal third rather quickly becoming wedge-shaped, almost oblong, about two and one half times as broad as long. From about the ninth onward the brachials have prominent distal ends, though they do not overlap the bases of the succeeding segments. Syzygies occur between the third and fourth, ninth and tenth, and

fifteenth and sixteenth brachials (the second sometimes omitted), and distally at intervals of from seven to ten oblique muscular articulations.

$P_D$  4.5 mm. long, moderately stout basally, but tapering rapidly in the proximal half and slender distally, with twenty segments, at first about twice as broad as long, becoming squarish after the eighth; the second to the seventh segments are rather strongly carinate;  $P_1$  similar, very slightly longer and stouter;

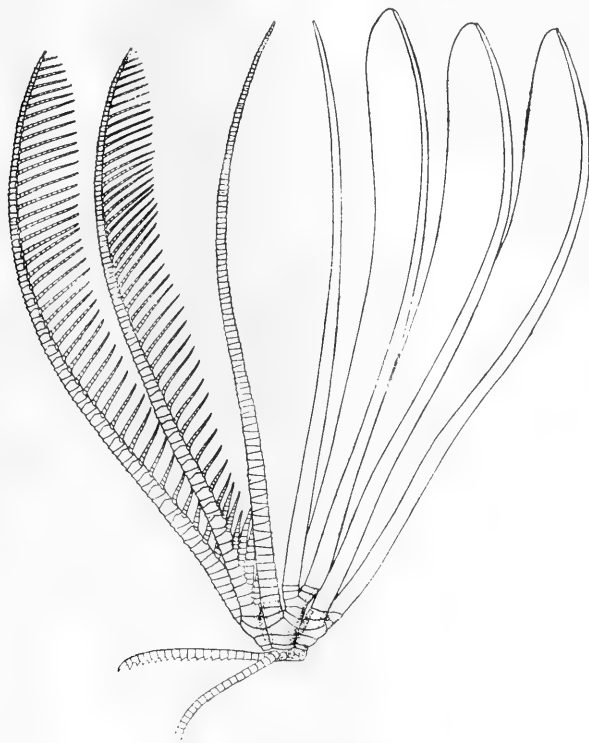


FIG. 11.—*Heterometra singularis*.  
Lateral view of the type.

$P_2$  6 mm. long, considerably stouter and stiffer than the preceding and rather more strongly carinate basally, with about twenty segments, the first seven (except for the carinate process) squarish, the remainder slightly longer than broad becoming about half again as long as broad distally; the ridge in the distal half of the outer side is but little marked;  $P_3$  3 mm. long, much smaller than any of the preceding, with about twelve segments, at first broad, becoming squarish about the fifth, and nearly twice as long as broad distally; the second-

fifth segments are carinate; following pinnules similar and about the same length, the segments becoming gradually longer and the basal carination gradually less; the distal pinnules are 5 mm. long. On the arms arising from a IBr axillary PP<sub>1, 2</sub>, and <sub>3</sub> are usually as described for P<sub>D</sub>, P<sub>1</sub>, and P<sub>2</sub>, and P<sub>4</sub> is much smaller, as described for P<sub>3</sub>; but occasionally P<sub>2</sub> is enlarged and similar to P<sub>3</sub>, as described, instead of being small like P<sub>1</sub>.

The colour in spirits is yellowish white, the proximal third of the pinnules purple.

LOCALITY.—*Southern part of Malacca Strait.*—One specimen.

OTHER RECORD.—Singapore.

REMARKS.—The specimen from Singapore which I described from the collection of the Copenhagen Museum has twelve arms 65 mm. long and cirri XV, 26–31 15 mm. to 18 mm. long.

#### HETEROMETRA BENGALENSIS.

*Antedon bengalensis* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 182.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 19, pl. i, fig. 2; pl. ii, fig. 16.

*Antedon anceps* 1904. CHADWICK, Report Pearl Oyster Fisheries Ceylon, part 2, Supplementary Report xi, p. 157.

*Heterometra bengalensis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

LOCALITIES.—*South of Ceylon* (6° 6' 5" N. lat., 81° 23' E. long.); 32 fathoms.—Two specimens, agreeing well with Hartlaub's original description; one has the cirri XIII, 24–28, the other, with twelve arms, has the cirri XII, 21–27.

*Andaman Islands.*—Two specimens, similar to the preceding; one has fourteen arms and 26 cirrus segments, the other fifteen arms and 22 or 23 cirrus segments.

OTHER RECORDS.—Bay of Bengal; Ceylon; Philippine Islands; Queensland; Holothuria Bank.

DEPTH.—Littoral, and down to 24 fathoms.

#### HETEROMETRA QUINDUPLICAVA.

*Antedon* sp. ("from Station 212") 1880. P. H. CARPENTER, Quart. Journ. Geol. Soc. (February), 1880, pp. 42, 43.

*Antedon quinduplicava* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 262, pl. iv, figs. 1 a-d; pl. xlvii, figs. 4, 5.

*Heterometra quinduplicava* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 11.

HABITAT.—Philippine Islands; Singapore.

DEPTH.—Littoral, and down to 20 fathoms.



Family **STEPHANOMETRIDÆ.**

*Stephanometrina* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 176.

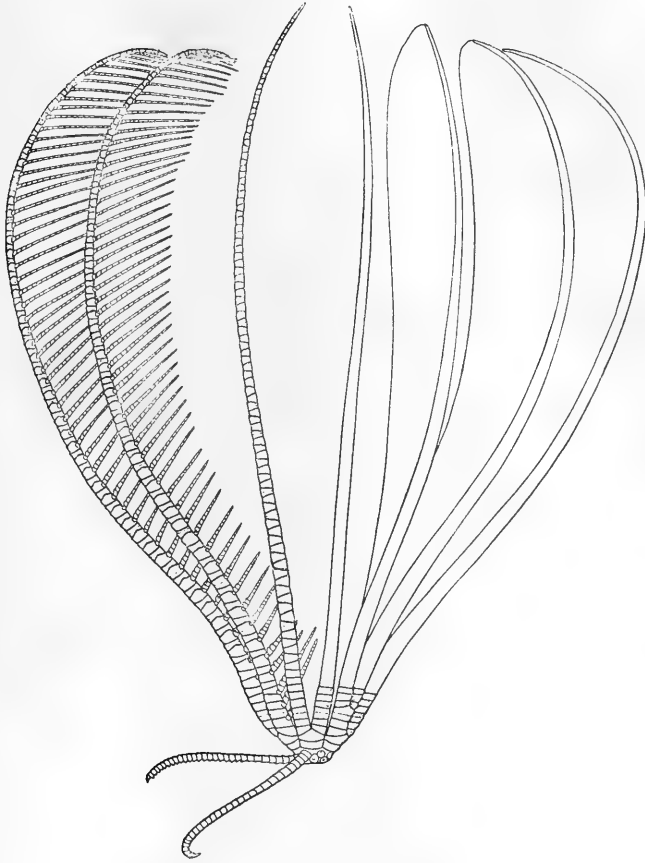


FIG. 12.—*Heterometra bengalensis*.  
Lateral view of a typical specimen.

Genus **OXYMETRA.**

*Oxymetra* 1909. A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, p. 13 (*Antedon erinacea* Hartlaub, 1890).

## OXYMETRA ERINACEA.

- Oxymetra erinacea* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 177.—  
1891. Nova Acta Acad. German., vol. **58**, No. 1, p. 52, pl. iii, fig. 29.  
HABITAT.—Cebu, Philippines.

## Genus STEPHANOMETRA.

- Stephanometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 9  
(*Antedon monacantha* Hartlaub, 1890).

## STEPHANOMETRA ECHINUS.

- Himerometra echinus* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
vol. **52**, part 2, p. 218.  
*Stephanometra echinus* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol.  
**22**, p. 10.  
HABITAT.—Philippine Islands.  
DEPTH.—21 fathoms.

## STEPHANOMETRA OXYACANTHA.

- Antedon oxyacantha* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p.  
178.—1891. Nova Acta Acad. German., vol. **58**, No. 1, p. 55, pl. iii, figs.  
35, 37.  
*Stephanometra oxyacantha* 1909. A. H. CLARK, Proc. Biol. Soc. Washington,  
vol. **22**, p. 10.  
HABITAT.—Amboina : Solomon Islands.

## STEPHANOMETRA SPINIPINNA.

- Antedon spinipinna* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 179.  
—1891. Nova Acta Acad. German., vol. **58**, No. 1, p. 61, pl. iv, figs. 42, 44.  
*Stephanometra spinipinna* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol.  
**22**, p. 10.  
HABITAT.—Amboina.

## STEPHANOMETRA SPICATA.

- Antedon spicata* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol.  
**3**, p. 190.  
*Stephanometra spicata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
p. 10.  
HABITAT.—Banda Sea ; Ugi, Solomon Islands.  
REMARKS.—The type at Leyden has the cirri XXIII, 22-25, rather slender,

resembling those of such species as *S. monacantha*; the longest segment is about twice as long as its median diameter; the longer proximal segments are somewhat constricted centrally; the IIIBr series are externally developed; the ventrolateral tubercles on the elements of the division series are well developed and thick.  $P_2$  is the largest, with 16, 16, 17 segments;  $P_3$  is similar, but not quite so long;  $P_4$  is much shorter than  $P_3$ , stiff, with eleven or twelve segments;  $P_5$  is slightly shorter than  $P_4$  and is like the succeeding pinnules instead of being stiff like the preceding, though it may be a trifle stiffer than its successors.

It is quite probable that this is in reality the same as the succeeding species, as the only tangible difference is the greater number of segments in the enlarged lower pinnules. So far as has been observed, however, this is a constant character, and, as exactly the same difference serves to distinguish *S. indica* from *S. monacantha*, it may be found always to hold good.

#### STEPHANOMETRA TUBERCULATA.

*Antedon tuberculata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 232, pl. xlv, figs. 2, 3.

*Antedon* ? *spicata* 1894. BELL, P. Z. S., 1894, p. 396.

*Stephanometra tuberculata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 10.

HABITAT.—Singapore; Pulau Ubin, Singapore; Macclesfield Bank; Cocos Island; Lifu, Loyalty Islands; ? Fiji.

DEPTH.—Littoral, and down to 35 fathoms.

REMARKS.—In the type of this species, preserved in the British Museum,  $P_1$  is slender and flexible, very slender distally;  $P_2$  is large and spine-like;  $P_3$  is spine-like, like  $P_2$ , but shorter;  $P_4$  is small and weak and very short, but somewhat stiffened.  $P_2$  has twelve segments, and is nearly half again as long as  $P_3$ .

#### STEPHANOMETRA CORONATA.

*Stephanometra coronata* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 639.

DESCRIPTION.—Cirri XXII-XXIII, 25-30, 22 mm. long, resembling those of *S. tenuipinna*; the longest segments are about one third longer than broad; the ninth, tenth, or eleventh is a well-marked transition segment.

Radials projecting slightly beyond the edge of the centrodorsal; IBr<sub>1</sub> oblong, short, about three and one half or four times as broad as long, not in lateral apposition, with a rounded ventrolateral process in the proximal half; IBr<sub>2</sub> broadly pentagonal, twice as broad as long, the lateral edges about half as long as those of the IBr<sub>1</sub>, produced into a rounded prominent ventrolateral process; synarthrial tubercles rather prominent; IIBr series, IIIBr series, and IVBr series (when present) 2; elements of the division series and first brachials with prominent rounded ventrolateral processes.

Thirty-three or thirty-four arms 120 mm. long, in general resembling those of *S. tenuipinna*.

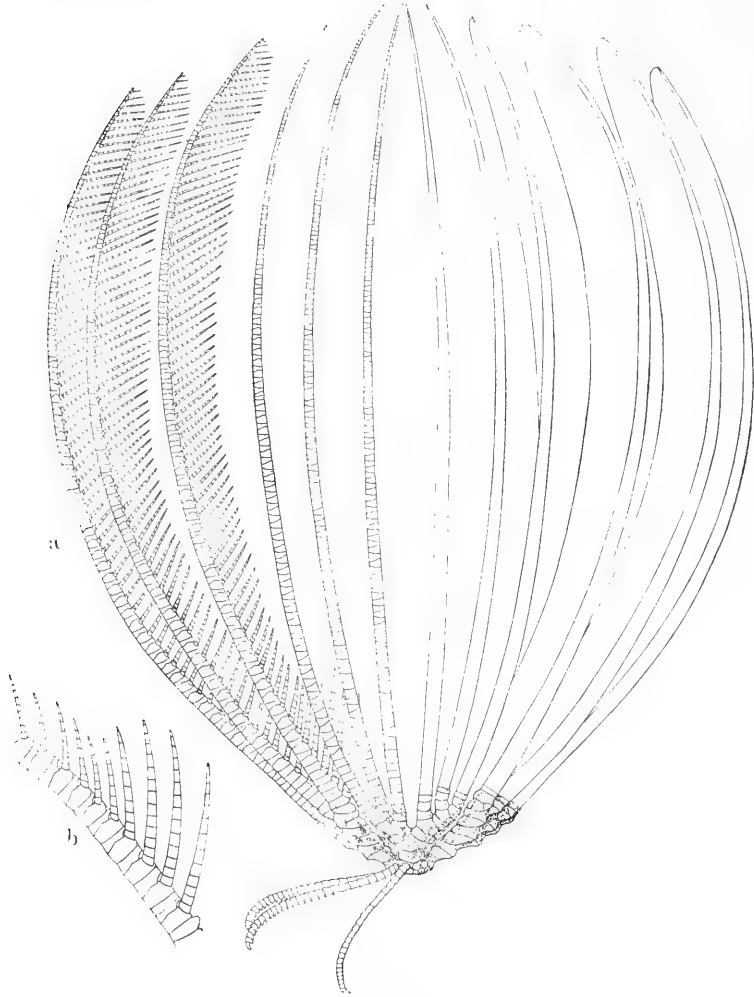


FIG. 13.—*Stephanometra coronata*.

- (a) Lateral view of the type.  
 (b) The proximal pinnules.

P<sub>1</sub> 14 mm. long, stout, stiff, and spine-like, with fourteen segments, the first two somewhat broader than long, the third to the fifth squarish, the remainder

becoming gradually elongated and twice as long as broad distally;  $PP_2$  and  $3$  exactly like  $P_1$ ;  $P_4$  10 mm. long with ten segments, resembling the preceding;  $P_5$  7 mm. long, spine-like as the preceding but somewhat more slender, with eight segments; following pinnules decreasing gradually in length,  $P_6$  being 5 mm. long with eight segments; subsequent pinnules remaining of similar length but decreasing in stiffness and increasing in the number of segments,  $P_{13}$  being 5 mm. long with twelve segments, the third squarish, the distal twice as long as broad, only stiffened proximally; distal pinnules slender, 9 mm. long.

The colour in spirits is light yellowish brown.

LOCALITY.—“India.”—Two specimens.

OTHER RECORD.—Philippine Islands.

DEPTH.—Littoral.

#### STEPHANOMETRA TENUIPINNA.

*Antedon tenuipinna* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 178.

—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 54, pl. iii, figs. 28, 30, 34.

*Stephanometra tenuipinna* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 10.

LOCALITY.—Off Colombo Light House, Ceylon; 26½ fathoms.—A single specimen with twenty-one arms 50 mm. long, agreeing well with Hartlaub's original description and with a specimen at hand from Singapore belonging to the Copenhagen Museum.  $P_1$  has twelve segments.

OTHER RECORDS.—Singapore; Matupi, New Britain; Philippine Islands.

DEPTH.—Littoral, and down to 26½ fathoms.

#### STEPHANOMETRA MARGINATA.

*Antedon marginata* 1888. P. H. CARPENTER, “Challenger” Reports, vol. 26, Zoölogy, p. 230, pl. xl.

*Stephanometra marginata* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 169.

HABITAT.—Philippine Islands; Ceylon; Singapore; ? Suez.

DEPTH.—Littoral, and down to 18 (? 30) fathoms.

REMARKS.— $P_3$ , though not especially enlarged and about the length of the succeeding pinnules, is more of the character of  $P_2$  and is somewhat stouter than those succeeding; it is flagellate distally.  $P_2$  is strongly recurved and not erect as it is in *S. monacantha*.

#### STEPHANOMETRA INDICA.

*Comatula indica* 1876. SMITH, Ann. and Mag. Nat. Hist. (4), vol. 17, p. 406.—1879. Phil. Trans. Roy. Soc. vol. 168, p. 564, pl. 51, figs. 3, 3a-b.

- Antedon palmata* (part) 1888. BELL, P. Z. S., 1888, pp. 384, 387.—1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28; No. 2, p. 114.—1909. BELL, Trans. Linn. Soc. (Zool.), (2), vol. 13, part 1, p. 20.
- Actinometra maculata* (part) 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225.
- Stephanometra indica* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 10.
- HABITAT.—Madagascar; Seychelles; Rodriguez; north reef, Farquhar Atoll; Mublas, Maldives; Male, Maldives; Hulule, Male, Maldives; Muhlos, Maldives; Ceylon; Tuticorin, Madras.
- DEPTH.—Littoral, and down to 34 (? 40) fathoms.

## STEPHANOMETRA MONACANTHA.

- Antedon protectus* 1874. LÜTKEN, Cat. Mus. Godefr., vol. 5, p. 190 (*nomen nudum*) (part).—1879. LÜTKEN, in CARPENTER, Trans. Linn. Soc. (Zool.) (2), vol. 2, p. 19.
- Antedon palmata* (part) 1888. BELL, P. Z. S., 1888, pp. 384, 387.—1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28; No. 2, p. 11.
- Antedon militaris* HARTLAUB, MS.
- Antedon spicata* BRIT. MUS., MS.
- Antedon monacantha* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 179.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 59, pl. iii, figs. 33, 38.
- Antedon flavomaculata* 1894. BELL, P. Z. S., 1894, p. 400.
- Himerometra acuta* 1890. A. H. CLARK, Bull. Mus. Comp. Zool., vol. 51, No. 8, p. 242.
- Stephanometra monacantha* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 10.—Vidensk. Medd. fra den naturhist. Forening i Köbenhavn, 1909, p. 168.

LOCALITIES.—Off north-eastern Ceylon ( $8^{\circ} 51' 30''$  N. lat.,  $81^{\circ} 11' 52''$  E. long); 28 fathoms.—Three small specimens; one has thirteen arms 70 mm. long, and  $P_2$  10 mm. long with fifteen or sixteen segments; another is similar, with sixteen arms; the third has twenty arms 50 mm. long,  $P_2$  having fourteen or fifteen segments.

Andaman Islands.—One specimen with nineteen arms 70 mm. long;  $P_2$  has eleven or twelve segments.

Port Blair, Andamans.—One specimen with thirty arms 90 mm. long;  $P_2$  is 12 mm. long with twelve or thirteen segments.

OTHER RECORDS.—Torres Straits; New Caledonia; Fiji; Tonga Islands; Mortlock Island, Carolines; Philippine Islands; Macclesfield Bank; Singapore; Tuticorin, Madras Presidency; Nicobar Islands; Hulule, Male, Maldives; Male, Maldives.

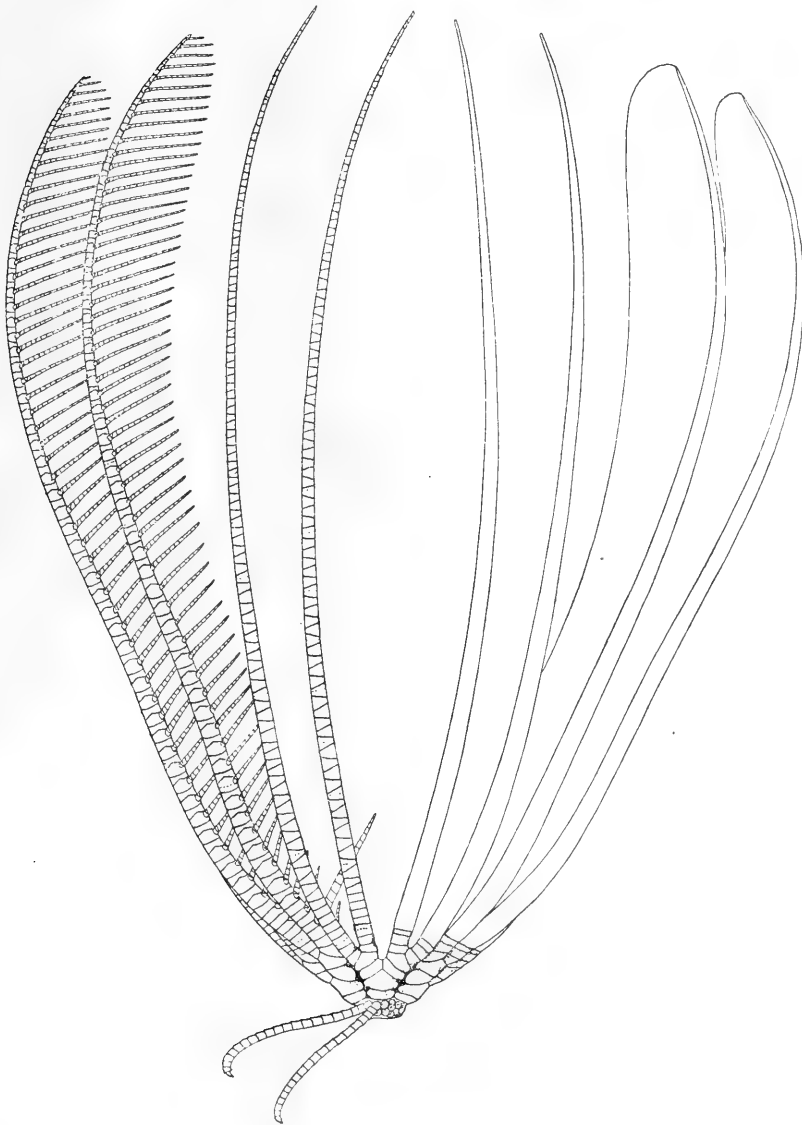


FIG. 14.—*Stephanometra monacantha*.  
Lateral view of a typical specimen.

DEPTH.—Littoral, and down to 21 fathoms.

REMARKS.—An examination of the type of Bell's *Antedon flavomaculata* shows that it is exactly the same thing as Hartlaub's *Antedon monacantha* described four years previously.

#### Family PONTIOMETRIDÆ.

*Pontiometridæ* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 175.

#### Genus PONTIOMETRA.

*Pontiometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, p. 354 (*Antedon andersoni* P. H. Carpenter, 1889).

#### PONTIOMETRA ANDERSONI.

*Antedon polyopus* 1879. LÜTKEN, Cat. Mus. Godeffr., vol. **7** (*nomen nudum*).

*Antedon* sp. 1887. BELL, P. Z. S., 1887, p. 140.

*Antedon andersoni* 1888. BELL, P. Z. S., 1888, p. 387 (footnote) (*nomen nudum*).—1889. P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. **21**, p. 306, pl. 26, figs. 1-5; pl. 27, fig. 8.—1891. HARTLAUB, Nova Acta Acad. German., vol. **58**, No. 1, p. 78.

*Pontiometra andersoni* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 354.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 165.

LOCALITY.—*Padaw, Mergui Archipelago*.—One broken specimen with about eighty-five arms.

OTHER RECORDS.—King Island, Mergui Archipelago; Andaman Islands; Amboina; Pelew Islands; Singapore; Sulu; Cebu; Philippine Islands; New Caledonia.

DEPTH.—Littoral, and down to 24 fathoms.

#### PONTIOMETRA INSPERATUS.

*Pontiometra insperatus* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 397.

HABITAT.—Philippine Islands.

DEPTH.—23 fathoms.

#### Genus EPIMETRA.

*Epimetra* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 542 (*Epimetra nympa* sp. nov.).

#### EPIMETRA NYMPHA.

*Epimetra nympa* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 542.

HABITAT.—Philippine Islands.

DEPTH.—58 fathoms.



Family **MARIAMETRIDÆ.**

*Mariametrince* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 176.

Genus **SELENEMETRA.**

*Selenemetra* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 541 (**Antedon finschii** Hartlaub, 1890).

**SELENEMETRA FINSCHII.**

*Antedon finschii* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 176.  
—1891. Nova Acta Acad. German., vol. **58**, No. 1, p. 47, pl. iii, fig. 32.

HABITAT.—New Britain.

**SELENEMETRA ARANEA.**

*Dichrometra aranea* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 76.

DESCRIPTION.—This species is nearest to *S. finschii* from New Britain; it differs from that form in having fewer cirrus segments (53–66), and in having  $P_3$  nearly or quite as long as  $P_2$ , while the segments in the distal portion of the proximal pinnules are much elongated instead of subequal, slightly longer than broad, as in *finschii*. The lower pinnules are comparatively slender, but slightly stiffened;  $P_2$  is about as stout as  $P_1$ , and 2 mm. longer.

The colour in spirits is light brownish yellow.

LOCALITY.—West of the Andamans ( $8^{\circ} 51' 30''$  N. lat.,  $81^{\circ} 11' 52''$  E. long.); 28 fathoms.—One specimen.

**SELENEMETRA GRACILIPES.**

*Himerometra gracilipes* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 219.

HABITAT.—Philippine Islands.

DEPTH.—28 fathoms.

**SELENEMETRA VIRIDIS.**

*Selenemetra viridis* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 541.

HABITAT.—Philippine Islands.

DEPTH.—42 fathoms.

Genus **MARIAMETRA.**

*Mariametra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 144.  
(**Himerometra subcarinata** A. H. Clark, 1908).

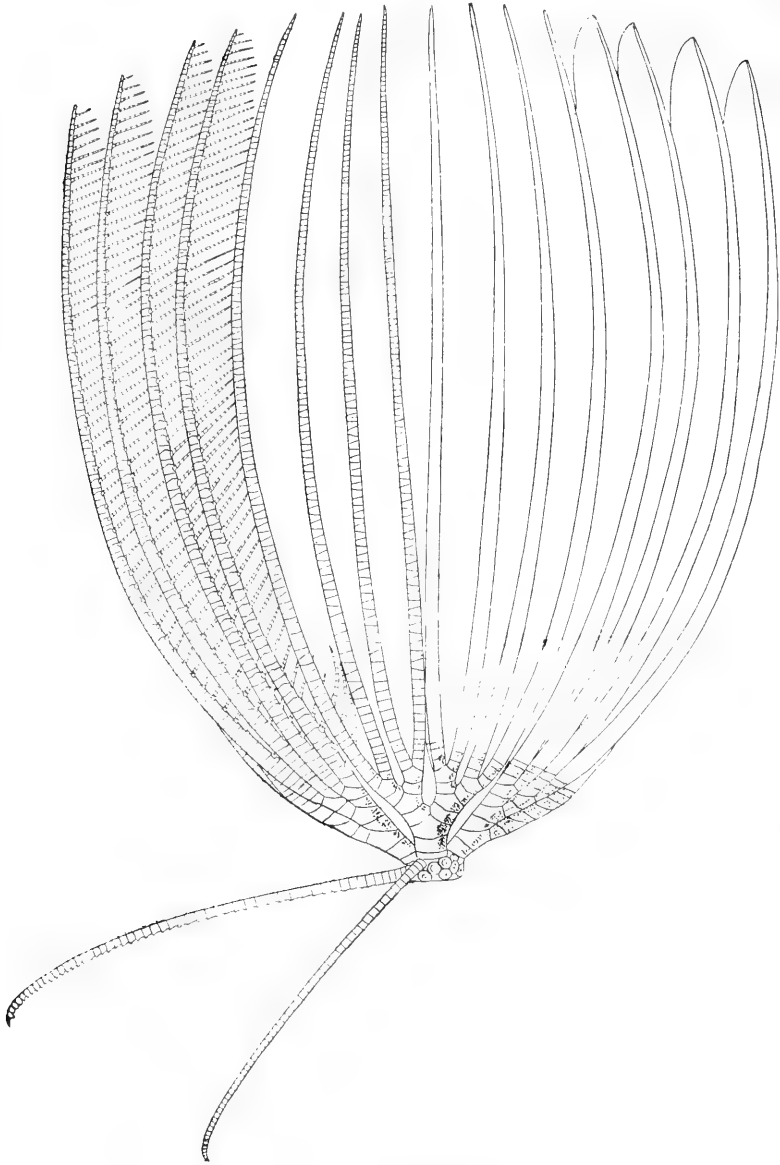


FIG. 15.—*Selenometra aranea*.  
Lateral view of the type.

## MARIAMETRA MARGARITIFERA.

*Mariametra margaritifera* 1909. A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, p. 145.

DESCRIPTION.—Centrodorsal rather small, discoidal.

Cirri XXI, 30–34, 15 mm. long, the outer segments with long dorsal spines.

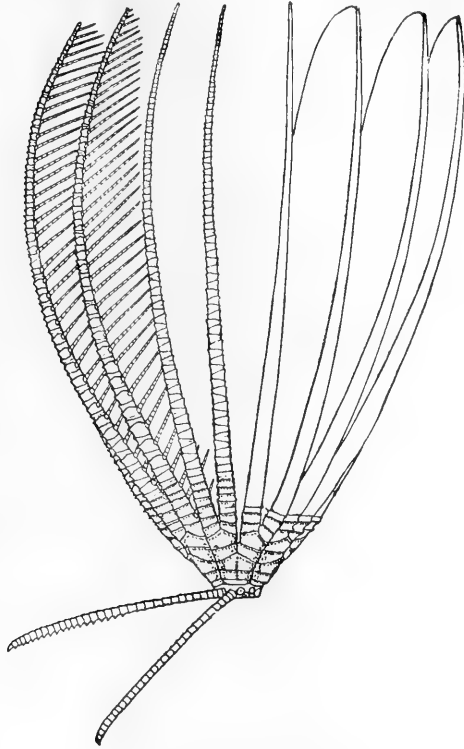


FIG. 16.—*Mariametra margaritifera*.  
Lateral view of the type.

Disk thickly studded with small calcareous plates along the ambulacra and on the anal tube, with scattering plates in the interambulacral areas; no plating after the last axillary.

Radials short, about six times as broad as long, gently convex proximally and correspondingly concave distally;  $IB_1$  short, oblong, somewhat over four times as broad as long, in lateral apposition and slightly flattened;  $IB_2$  short,

almost or quite triangular, two and one half or three times as broad as long, in apposition laterally; IIBr 2; radials and portion of centrodorsal above the proximal row of cirrus sockets evenly and thickly covered with high small tubercles resembling those on the dorsal pole of the centrodorsal, this tubercular modification of the dorsal surface of the segments extending distally in the interradial angles, occupying the lateral third of the IBr<sub>1</sub> and the IBr<sub>2</sub> and of the IIBr series, thence diminishing in width and disappearing on the second brachial; inner edges of the IIBr series similarly modified; IBr series with a low and narrow, but prominent, tubercular keel or row of tubercles; this is much less marked or absent altogether on the IIBr series and first two brachials, though sometimes traceable to the lowest of the triangular brachials; IBr and IIBr series and proximal oblong brachials with prominently everted dentate proximal and distal ends; as the brachials become wedge-shaped and triangular the everted dentate ends become gradually lower, transforming into a rather prominent finely spinous overlap which slowly dies away distally.

Eighteen arms (in the type) apparently 30 mm. to 35 mm. long, the proportions of the brachials being approximately as in *M. subcarinata*.

P<sub>1</sub> 4 mm. long, moderately stout basally but tapering rather rapidly in the proximal half and slender distally, with twelve segments, the first three squarish, the following increasing in length and becoming three or four times as long as broad distally; P<sub>2</sub> 6 mm. long, slender, but stouter than P<sub>1</sub> and somewhat stiffened, with about sixteen segments, at first squarish, but becoming three or four times as long as broad distally; P<sub>3</sub> similar to P<sub>2</sub> and about the same size; following pinnules 3 mm. long, small and weak; distal pinnules delicate, 5 mm. long.

The colour in spirits is white, the division series and arms with a narrow median dorsal line of deep purple.

LOCALITY.—*Two miles off Great West Torres Island.*—One broken specimen.

#### MARIAMETRA VICARIA.

*Antedon vicaria* 1894. BELL, P. Z. S., 1894, p. 400.

*Antedon? variispina* 1894. BELL, P. Z. S., 1894, p. 396.

DESCRIPTION.—Cirri XXIII; 29-31 (usually 29), slender, 20 mm. long; long sharp dorsal spines are developed from the ninth or tenth segment onward; the longest cirrus segment (just before the development of the spines) is about twice as long as broad.

The disk is covered with small calcareous plates.

The twenty-four arms are 60 mm. long. When IIBr series are developed they are always external; the ornamentation resembles that seen in *Mariametra subcarinata*, and occupies exactly the same areas, but it is much more prominent and more irregular; instead of having a finely tuberculated surface the sides of the rays are converted into a sort of spongy-looking mass, causing the edges of the segments to appear denticulate; the median keel on the division series and brachials is much higher than in *M. subcarinata*.

The arms and division series bear a narrow median deep purple line.

HABITAT.—Macclesfield Bank

DEPTH.—30–50 fathoms.

REMARKS.—In the original description this species was referred to Carpenter's "Spinifera group" and compared with *Ptilometra macronema*, with which it has not the remotest relation.

Another specimen of the same species (labelled "*Antedon variispina*") taken at 50 fathoms on the Macclesfield Bank has the cirri XXIII, 33–36, 23 mm. long; the cirrus segments are proportionately not quite so long as in the preceding (the type); dorsal spines are developed from the tenth segment onward; one cirrus is regenerating in the distal portion.

The ornamentation is essentially the same as in the type, but the tuberculous structure is represented by fine spines on the sides of the division series; these short fine thickly-set spines cover the radials and a small part of the proximal edge of the IBr<sub>1</sub>, and then extend up interradially. This lateral ornamentation extends somewhat dorsalsward at the articulations, running up the borders of the segments, and may narrowly bridge over the division series at the synarthry. This condition is slightly more developed than in the other specimen. As in the type the division series and lower brachials are sharply flattened laterally; the deep purple median line is the same in each, as is also the median carination.

#### MARIAMETRA SUBCARINATA.

*Himerometra subcarinata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 237.

*Mariametra subcarinata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 145.—Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 171.

HABITAT.—Formosa (Taiwan) to southern Japan.

DEPTH.—22–59 fathoms.

#### Genus DICHROMETRA.

*Dichrometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 12 (*Alecto flagellata* J. Müller, 1841).

#### DICHROMETRA PROTECTUS.

*Comatula (Alecto) palmata* (part) 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, p. 261.

*Comatula dividua* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).

*Comatula polyactinis* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).

- Antedon protectus* 1874. LÜTKEN, Cat. Mus. Godeffr., vol. 5, p. 190 (*nomen nudum*).—1879, in P. H. CARPENTER, Trans. Linn. Soc. (Zool.) (2), vol. 2, p. 19.
- Antedon brevicuneata* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 187.—1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 68, pl. 3, fig. 31; pl. 4, fig. 39.
- Antedon protecta* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 192.—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 225.—1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 180.
- Antedon equipinna* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 504.
- Antedon imparipinna* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.) vol. 16, p. 505.—1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 63.
- Antedon conjungens* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 233, pl. xlv, fig. 1.
- Antedon palmata* (part) 1888. BELL, P. Z. S., 1888, pp. 384, 387.—1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28; No. 2, p. 114.
- Antedon indica* 1889. BELL, Willey's Zoological Results, vol. 2, p. 133.
- Antedon amboinensis* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 181.
- Antedon okelli* 1904. CHADWICK, Report Ceylon Pearl Oyster Fisheries, part 2, Supplementary Report xi, p. 155, pl., figs. 3-5.
- Dichrometra prolectus* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 13.—Vidensk. Medd. fra den naturhist. Forening i Köbenhavn, 1909, p. 172.

LOCALITIES.—Colombo Breakwater, Ceylon.—Fourteen specimens.

Port Blair, Andaman Islands.—One fine specimen with forty arms; the proximal pinnules are much larger and stouter than usual.

Andaman Islands.—Twelve specimens, most of them with thirty, a few with forty, arms. This series exhibits great variation in the size of the proximal pinnules; so much difference is there between the two extremes that, were it not for the intergrades, they would certainly be considered as representing different species. A rather large specimen with thirty arms 90 mm. long represents the condition in which the cirri and lower pinnules are remarkably small and weak, the latter especially being unusually slender, with very little difference between those on the outside and on the inside of the rays, so that it might almost be taken for a specimen of *D. tenera*. A forty-armed example, on the other hand, has remarkably large and stout lower pinnules with the difference between those on the inside and the outside of the arms exceptionally pronounced. Most of the specimens are quite typical and agree with a very large series at hand from Singapore, the Philippine Islands, and other places in the East Indies.

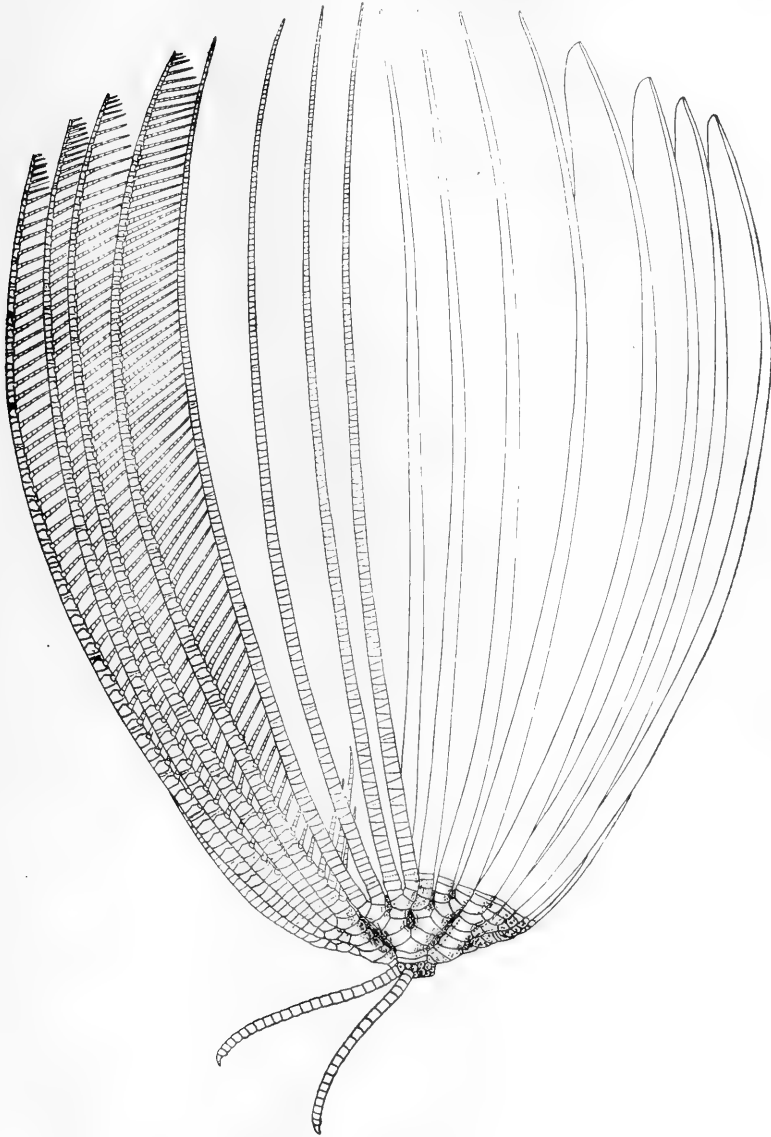
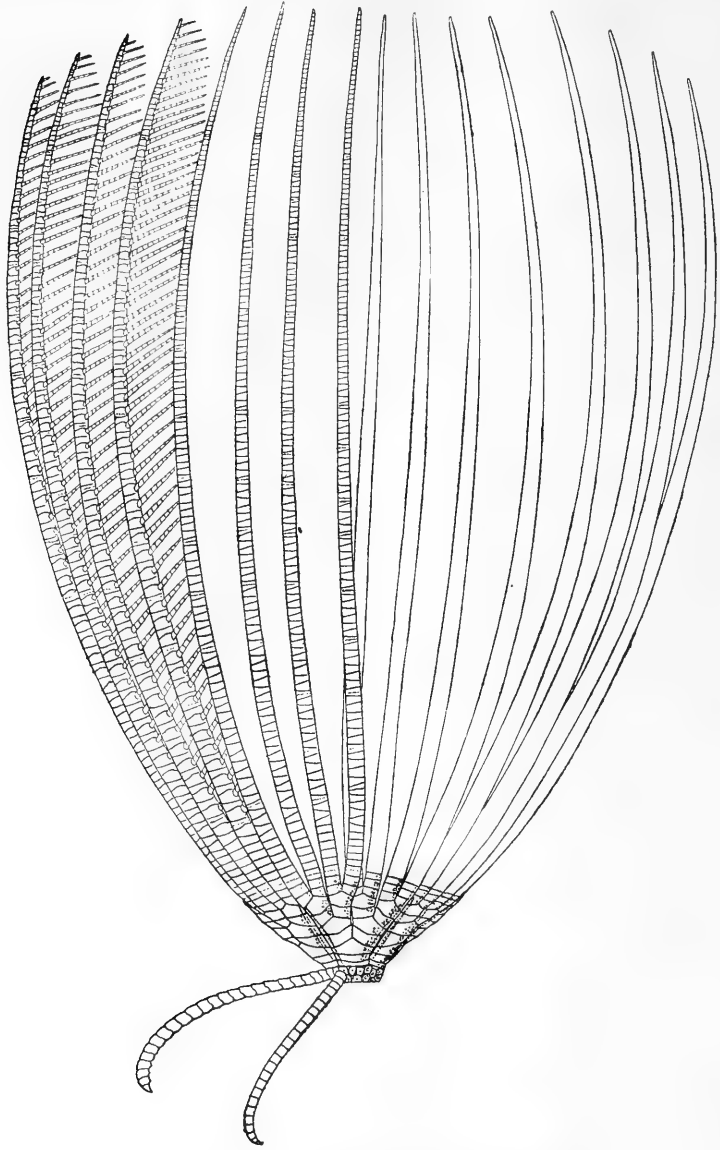


FIG. 17.—*Dichrometra protectus*.  
Lateral view of a specimen with well separated rays.

FIG. 18.—*Dichrometra protectus*.

Lateral view of a specimen with closely appressed rays.



? *India*.—Five small and medium-sized specimens.

OTHER RECORDS.—Fiji; Zamboanga; Cebu; Philippine Islands; Ovalau; Mortlock Island, Carolines; New Caledonia; Java; Johore Strait, Pulau Ubin; Bougainville Island; New Guinea; Salawatti; Nam-Zit Island; Amboina; Tonga; Blanche Bay, New Britain; Poulo Condor, Cochin China; Hong Kong; Singapore; Batjan; Andaman Islands; Ramesvaram, Gulf of Manaar; Ceylon; Red Sea; Suez Bay; Suakim Harbour.

DEPTH.—Littoral, and down to 12 (? 36) fathoms.

REMARKS.—An examination of the type of Carpenter's *Antedon brevicornata*, preserved at Leyden, of the type of his *Antedon æquipinna* preserved at Hamburg, and of the type of his *Antedon conjungens*, preserved in the British Museum, shows that they are identical with Lütken's *Antedon protectus*. Chadwick's *Antedon okelli* was founded on small specimens of this species.

The specimen of *Comatula palmata* recorded by Müller from Zamboanga, which was collected by M. Hombron on the famous expedition of the "Astrolabe," is in reality an example of this species, as I discovered upon examining it at the Paris Museum.

#### DICHROMETRA LAEVICIRRA.

*Antedon laevicirra* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 189.

HABITAT.—Aru Islands.

REMARKS.—In the type at Leyden the cirri are XXII, 24, 24, 25, 28; there are thirty-seven arms; the rays and division series are entirely free laterally, though close together; the dorsal pole of the centrodorsal is flat and rather broad. The eighth–eleventh cirrus segments are very slightly longer than broad; the last ten to twelve are rather sharply carinate, in dorsal view showing a dorsoventrally elongate tubercle. The proximal pinnules resemble those of the slender pinnuled form of *D. protectus*; the second and third segments of the lower pinnules are slightly carinate. The pinnules on the outer side of the outer arms of each distichium are, as in *D. protectus*, considerably larger than those on the inner side, and on the inner arms. The division series of this species resemble those of *D. protectus*; in fact the whole animal is so much like the slender pinnuled form of *D. protectus* that it would not be surprising if they should turn out to be in reality the same thing.

#### DICHROMETRA SIMILIS.

*Antedon similis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 235, pl. xlvii, figs. 1–3.

LOCALITY.—Near Kandavu, Fiji.

DEPTH.—?

REMARKS.—There is very little difference between this species and *D. protectus*, and I am inclined to believe that they will turn out to be identical. Bell's

*Antedon moorei* (p. 287) is apparently the same thing as this, but is a young specimen; the spines on the cirrus segments are a trifle more conspicuous, and the animal is all around more slender, as would be expected. In the type of *similis* the cirrus segments are never quite so long as broad, the earlier being longer than broad in *moorei*, probably due to the undeveloped condition of the latter.

#### DICHROMETRA TENERA.

- Antedon tener* 1877. LÜTKEN, Cat. Mus. Godeffr., vol. 5, p. 100 (*nomen nudum*).  
*Antedon tenera* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 180.—  
 1891. Nova Acta Acad. German., vol. 58, No. 1, p. 66.  
*Antedon articulata* BRIT. MUS., MS.  
*Dichrometra tenera* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22,  
 p. 13.

HABITAT.—Bowen, Port Denison, and Port Essington, Queensland; north of Cape Hillsboro'; Thursday Island; Torres Strait; Samoa; Marshall Islands.

#### DICHROMETRA PALMATA.

- ? *Caput Melusæ Cinereum* 1733. LINCK, De Stellis Marinis, p. 57, pl. 21, No. 33.  
*Comatula leucomelas* 1833. LEUCKART, Zeitschr. für organ. Physik, vol. 3, Heft 4, pp. 387, 390 (*nomen nudum*).  
*Alecto palmata* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 144.  
*Comatula scita* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).  
*Comatula palmata* 1869. VON MARTENS, in VON DER DECKEN, Reise in Ost-Africa vol. 3, p. 129.  
*Antedon lepida* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 176.  
*Antedon palmata* 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 49, pl. 3, fig. 27.  
*Dichrometra palmata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22,  
 p. 13.

LOCALITIES.—*Gwata, Baluchistan*.—One small specimen.

*Snod Island* (12° N. lat., 98½° E. long.).—One very small specimen with a minute parasitic *Eulima* on the ventral side of one of the arms.

? *Celebes*.—One specimen.

OTHER RECORDS.—“India”; Red Sea; Djeddah; coral reef of Misharif Island; between tide marks at Suez; Muscat; Ceylon; Java; Singapore; Bougainville Island; Tonga.

REMARKS.—The examples listed above agree well with an example collected by the German steamer “Gazelle” at Bougainville Island (north-west of the Solomons) and identified by the late P. H. Carpenter. They were compared directly with Professor Müller’s types, which are in the Berlin Museum.

## DICHROMETRA KLUNZINGERI.

*Antedon klunzingeri* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 175.

—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 46, pl. 2, figs. 22, 25.

*Dichrometra klunzingeri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 13.

HABITAT.—Koseir, Red Sea, Ras-el-Millan, Red Sea.

## DICHROMETRA DÖDERLEINI.

*Antedon döderleini* 1900. DE LORIOU, Rev. Suisse Zool., vol. 8, p. 93, pl. ix, fig. 2, a-i.

HABITAT.—Kagoshima, Japan.

DEPTH.—?

## DICHROMETRA STYLIFER.

*Antedon stylifer* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 149.

HABITAT.—South-western Japan.

DEPTH.—84 fathoms.

## DICHROMETRA DELICATISSIMA.

*Antedon delicatissima* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 32, p. 149.

HABITAT.—South-western Japan.

DEPTH.—84 fathoms.

## DICHROMETRA SUBTILIS.

*Antedon subtilis* 1895. HARTLAUB, Bull. Mus. Comp. Zoöl., vol. 27, No. 4, p. 144.

*Dichrometra subtilis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 13.

HABITAT.—Gaspard Strait, between Banka and Billiton.

## DICHROMETRA HELIASTER.

*Himerometra helianthus* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, p. 356.

*Himerometra heliaster* 1908. A. H. CLARK, Bull. Mus. Comp. Zoöl., vol. 51, No. 8, p. 242.

*Dichrometra heliaster* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 13.

HABITAT.—Marshall Islands.

## DICHROMETRA OCCULTA.

*Antedon occulta* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 236, pl. xlvi, figs. 1, 2; pl. xlix, figs. 3, 4.

*Dichrometra occulta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—? Fiji.

## DICHROMETRA GYGES.

*Antedon gyges* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 160, pl. xii, figs. B, B a-b.

*Dichrometra gyges* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Thursday Island.

DEPTH.—3-4 fathoms.

## DICHROMETRA REGINÆ.

*Antedon reginæ* 1884. BELL, Rep. Zool. Coll. H.M.S. "Alert," p. 160, pl. xii, figs. A, A a.

*Dichrometra reginæ* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Port Molle, Queensland.

DEPTH.—12-20 fathoms.

## DICHROMETRA REGALIS.

*Antedon regalis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 237, pl. xlvi.

*Dichrometra regalis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Tonga Islands.

## DICHROMETRA GRANDIS.

*Himerometra grandis* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 222.

*Dichrometra grandis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Korean (Cho Sen) Straits.

DEPTH.—40 fathoms.

## DICHROMETRA FLAGELLATA.

*Alecto flagellata* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 145.

*Alecto elongata* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 146.

*Antedon pulcher* LÜTKEN, MS.—1891. HARTLAUB, Nova Acta Acad. German., vol. , No. 1, p. 73.

*Dichrometra flagellata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 13.

HABITAT.—New Guinea; Amboina; Singapore; Pulau Ubin, Singapore; Pelew Islands; ? Madagascar; ? Zanzibar.

REMARKS.—In the type of *Alecto flagellata*, preserved at Leyden, the dorsal pole of the centrodorsal is concave; the cirrus spines are very small tubercles; the cirrus segments number 24, 25, 28 and 30.

There are thirty-nine arms, the extra IIIBr series being external. The division series and first six or eight brachials are in close apposition and are sharply flattened laterally.

$P_1$  is very small and short;  $P_2$  is large, over twice as long as  $P_1$ , of the same character as  $P_2$  in *D. protectus*; the component segments are slightly longer than broad;  $P_3$  is slightly longer and larger than  $P_2$ ;  $P_4$  is about the size of  $P_2$ ;  $P_5$  is somewhat smaller than  $P_4$ ; the following pinnules are small and weak. The enlarged lower pinnules are strongly curved outward and backward; they stand out very prominently through their large size, the middle and outer pinnules being especially short. The centrodorsal is rather large. The cirri number XL.

The type of *Alecto elongata*, also at Leyden, has about twenty very long and slender arms; the cirri are XXIV, 25; there are six IIBr series and four IIIBr 2 (external) series. The longest cirrus segments are about one third longer than broad; the ninth or tenth and following bear small but prominent dorsal spines. The synarthrial tubercles are slightly prominent, and the basal portion of the arms is rugose as in *D. protectus*. The rays and division series are not in lateral contact, though they have tolerably straight sides. The IBr<sub>1</sub> are entirely united laterally, but the axillaries are free. There are no lateral processes as seen in *Stephanometra*.  $P_3$  has from twenty to twenty-two segments;  $P_1$  is small and weak;  $P_2$  is nearly twice as long as  $P_1$ , and  $P_3$  is still longer.  $P_4$  is nearly as long and large as  $P_3$ , intermediate between  $P_2$  and  $P_3$ ;  $P_5$  is much shorter; the following pinnules are small and weak.

The proximal pinnules as a whole resemble those of *D. flagellata*, but are slightly less stiffened and more flexible, and more flagellate distally—at any rate than in large specimens of *flagellata* like the type. There is no essential difference between the type specimens of *flagellata* and *elongata* that cannot be perfectly well accounted for by the difference in size of the two animals, and the two appear undoubtedly to represent the same species.

#### DICHROMETRA BIMACULATA.

*Antedon bimaculata* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 186.

*Dichrometra bimaculata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Amboina.

#### DICHROMETRA ARTICULATA.

*Comatula (Alecto) articulata* 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, p. 263.

*Comatula polyactinis* (part) 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).

*Dichrometra articulata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 13.

HABITAT.—Moluccas; Port Molle, Queensland.

DEPTH.—Littoral, and down to 20 fathoms.

REMARKS.—The cirri of the type, which is in the Paris Museum, are XVII, 32, 33, 34, 36, 34 mm. long; dorsal spines are developed from the eleventh or thirteenth segment onward; these are rather short, though prominent; the longest cirrus segments are about one third longer than broad.

There are thirty-eight arms 105 mm. long, two HIBr series being missing; the division series resemble those of *Selenometra finschii*, and are in close lateral contact by their rather broadly extended lateral edges. The radials are barely visible.

The proximal pinnules are remarkable for their great length, though they are very slender and flagellate, like  $P_1$  in *Pontiometra andersoni*.

$P_1$  is very delicate, but long, and flagellate distally;  $P_2$  is half again as long as  $P_1$  and proportionately stouter basally; it is nearly as long as  $P_3$ ;  $P_3$  is the longest pinnule on the arm, 21 mm. long, but not greatly longer than  $P_2$ ; it has twenty-six segments, which become squarish on the third and then gradually elongate, being nearly or quite twice as long as broad distally.  $P_4$  is about as long as  $P_1$ , or slightly longer, and about as stout basally;  $P_5$  is not much more than one half as long as  $P_3$ , and is much weaker;  $P_6$  is smaller than  $P_5$ ; the following pinnules are like  $P_4$ , and are very short.

#### DICHROMETRA sp.

*Dichrometra* sp. 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 27.

HABITAT.—Madagascar; Zanzibar.

DEPTH.—Littoral, and down to 30 meters.

#### DICHROMETRA sp.

*Dichrometra* sp. 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 27.

HABITAT.—Zanzibar.

## Family COLOBOMETRIDÆ.

*Colobometridæ* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 640.—  
 Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 174.

## Genus CENOMETRA.

*Cenometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 8  
 (*Himerometra unicornis* A. H. Clark, 1908).

## CENOMETRA UNICORNIS.

*Himerometra unicornis* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly  
 Issue), vol. **52**, part 2, p. 216.

*Cenometra unicornis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
 p. 8.

HABITAT.—Philippine Islands.

DEPTH.—12–29 fathoms.

## CENOMETRA DELICATA.

*Cenometra delicata* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 398.

HABITAT.—Philippine Islands.

DEPTH.—18–23 fathoms.

## CENOMETRA ABBOTTI.

*Antedon abbotti* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 148.

*Cenometra abbotti* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
 p. 8.

HABITAT.—China Sea.

## CENOMETRA BELLA.

*Antedon bella* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 174.—1891.  
 Nova Acta Acad. German., vol. **58**, No. 1, p. 43, pl. 2, figs. 23, 26.

*Cenometra bella* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 8.

HABITAT.—Noordwachter Eiland (North Watcher Island), Gulf of Tonkin;  
 Philippine Islands.

DEPTH.—Littoral, and down to 30 fathoms.

## CENOMETRA BRUNNEA.

*Antedon bella* var. *brunnea* 1891. HARTLAUB, Nova Acta Acad. German., vol. **58**,  
 No. 1, p. 44.

*Cenometra brunnea* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
 p. 8.

HABITAT.—Amboina.

## CENOMETRA INSUETA.

*Cenometra insueta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 146.

DESCRIPTION.—With the arm and pinnule structure of the following, and the same slenderness of build, this form has the paired dorsal tubercles of the cirri situated with their apices much further apart, about two thirds of the transverse diameter of the dorsal surface of the segments instead of less than one half.

LOCALITY.—Arrakan Coast, Burma.—One specimen with twenty-eight arms, badly broken.

## CENOMETRA HERDMANI.

*Antedon bella* 1904. CHADWICK, in HERDMAN, Report Ceylon Pearl Oyster Fisheries, Supplementary Report xi, p. 155.

*Antedon bella* var. *brunnea* 1904. CHADWICK, T. c., p. 155.

*Cenometra herdmani* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 145.

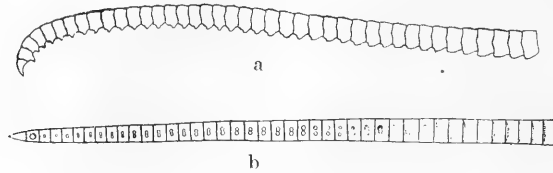


FIG. 19.—*Cenometra insueta*.

(a) Lateral view of a cirrus.  
(b) Dorsal view of a cirrus.

DESCRIPTION.—This species resembles *C. unicornis* in general appearance, but is more slender, especially the cirri. It may at once be distinguished from all the other species of the genus by the paired dorsal tubercles on the cirrus segments which are small and situated very close together, and by the shortness and comparative slenderness of  $P_2$ , which is very slightly, when at all, longer than  $P_1$ ;  $P_2$  also has comparatively few segments, these numbering less than twenty.

The colour in spirits is flesh colour, the cirri and  $P_2$  dull straw yellow, with a greyish wash on the disk which extends more or less over the division series; or, deep purple evenly studded with small round black spots, the cirri yellow-brown; or, flesh colour with purple bands on the arms.

LOCALITIES.—Ganjam Coast, Madras Presidency (Type Locality); 12 fathoms.—Four specimens.

Ganjam Coast; 24-30 fathoms.—One specimen.

OTHER RECORD.—Ceylon.

DEPTH.— $7\frac{1}{2}$ - $11\frac{1}{2}$  (? 36) fathoms.



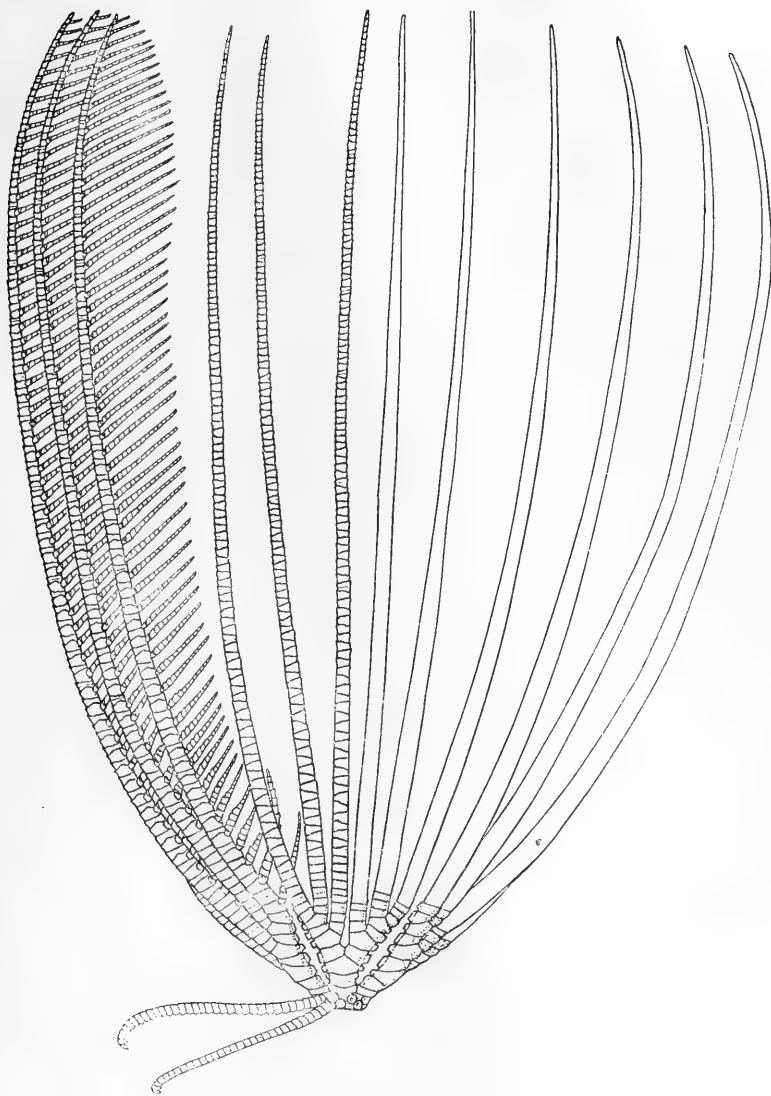


FIG. 20.—*Cenometra herdmanni*.  
Lateral view of the type.

## CENOMETRA CORNUTA.

- Antedon* sp. "near *macronema*" 1894. BELL, P. Z. S., 1894, p. 394.  
*Cenometra cornuta* 1911. A. H. CLARK, Memoirs of the Australian Museum.

HABITAT.—Adele Island, North Australia; north-western Australia.

## CENOMETRA EMENDATRIX.

- Antedon emendatrix* 1892. BELL, Ann. and Mag. Nat. Hist. (6), vol. 9, p. 428  
 pl. xviii.  
*Cenometra emendatrix* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22,  
 p. 8.—1911. Proc. U. S. Nat. Mus., vol. 40, p. 28.  
*Antedon spicata*?? 1909. BELL, Trans. Linn. Soc. (Zool.) (2), vol. 13, part 1,  
 p. 20.

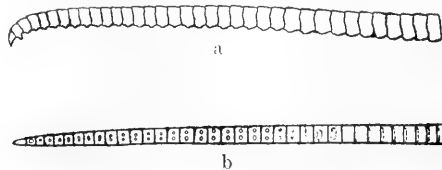


FIG. 21.—*Cenometra herdmani*.

- (a) Lateral view of a cirrus.  
 (b) Dorsal view of a cirrus.

HABITAT.—Mauritius; Seychelles.

DEPTH.—Littoral, and down to 39 fathoms.

## Genus CYLLOMETRA.

- Cyllometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50,  
 part 3, p. 356 (*Antedon manca* P. H. Carpenter, 1888).

## CYLLOMETRA MANCA.

- Antedon* sp. 1881. P. H. CARPENTER, Bull. Mus. Comp. Zool., vol. 9, No. 4, p. 5.  
*Antedon manca* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoö-  
 logy, p. 226, pl. xlv, figs. 2, 3.  
*Cyllometra manca* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
 vol. 50, part 3, p. 357.

HABITAT.—Ki and Philippine Islands.

DEPTH.—80-140 fathoms.

## CYLLOMETRA SOLUTA.

*Cyllumetra soluta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 146.

DESCRIPTION.—Centrodorsal thin discoidal, the bare polar area 2 mm. in diameter.



FIG. 22.—*Cyllumetra soluta*.  
Lateral view of the type.

Cirri XVI, 21-28, 11 mm. to 13 mm. long, the fourth or fifth and following segments subequal, about as long as broad; third or fourth and following segments with produced distal ends, which soon transform into prominent paired dorsal spines, becoming single median dorsal spines on the terminal five or six.

Ray and arm structure as in *C. manca* and *C. albopurpurea*.

Fourteen to eighteen arms 55 mm. long.

$P_a$  absent;  $P_1$  small and very slender, 3 mm. long, with about twelve segments;  $P_2$  the largest and the longest on the arm, 11 mm. long with seventeen segments, the first not so long as broad, the third twice as long as broad, the remainder about three times as long as broad; the pinnule is much more slender than the corresponding pinnule in the other species of the genus, and is nearly smooth, the distal edges of the segments in the terminal portion projecting only very slightly;  $P_3$  7 mm. long, similar to  $P_2$  but very slender, the segments distally proportionately somewhat longer; following pinnules more slender still, about 5 mm. long with fifteen segments, and flexible, gradually decreasing in length to 4 mm. and increasing again to 8 mm. distally.

The colour in spirits is flesh colour, with a few narrow bands dorsally and large blotches ventrally of purple.

LOCALITIES.—*Straits of Ormuz, at the entrance to the Persian Gulf* (26° 22' N. lat., 56° 10' 00" E. long.); 48-49 fathoms; *mul* (Type Locality).—One specimen with fourteen arms.

? *Kurrachi*.—Two specimens, one with sixteen, the other with eighteen arms.

#### CYLLOMETRA ALBOPURPUREA.

*Cyllometra albopurpurea* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 239.

HABITAT.—Liu Kiu Islands and southern Japan.

DEPTH.—8-100 fathoms.

#### CYLLOMETRA DISCIFORMIS.

*Antedon disciformis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 228, pl. iv, figs. 2 *a-d*; pl. xxxix, fig. 4.

HABITAT.—Philippine Islands.

DEPTH.—Littoral, and down to 58 fathoms.

#### CYLLOMETRA ANOMALA.

*Cyllometra anomala* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 225.

HABITAT.—Southern Japan.

#### CYLLOMETRA CLARÆ.

*Antedon claræ* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 174.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 41, pl. 2, fig. 19.

HABITAT.—Amboina.

Genus DECAMETRA.

*Decametra* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 31 (*Antedon informis* P. H. Carpenter, 1888).

DECAMETRA TAPROBANES.

*Antedon ? laevissima* (part) 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

*Cyllometra taprobanes* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 641.

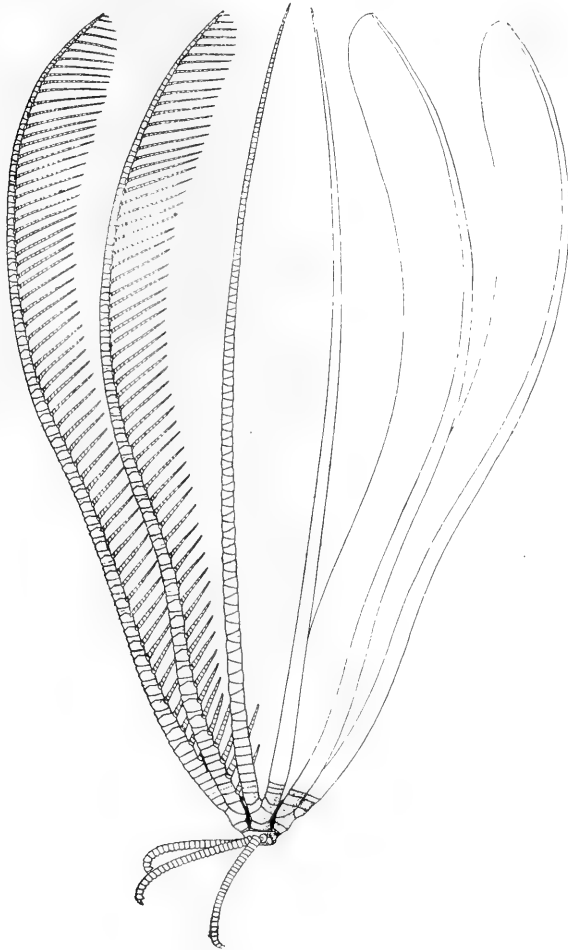


FIG. 23.—*Decametra taprobanes*.  
Lateral view of the type.

DESCRIPTION.—Centrodorsal thin, discoidal, the bare polar area flat, 2 mm. to 3 mm. in diameter; cirrus sockets arranged in a single slightly irregular crowded marginal row.

Cirri XX-XXI, 25-29, 12 mm. or 13 mm. long; first segment short, the next about two and one half times as broad as long, the following slowly increasing in length to the fifth or sixth, which is twice as broad as long, and the tenth or twelfth, which is half again as broad as long, and still further increasing, so that the antepenultimate and one or two of the preceding segments are about as long as broad; fifth to seventh and succeeding segments with the distal dorsal edge prominent, forming a low transverse ridge which slowly moves anteriorly, attaining a median position on about the twelfth, and gradually narrows distally, becoming reduced to a small median tubercle on the last twelve; opposing spine prominent, rather slender, median, equal in height to about one half the diameter of the penultimate segment; terminal claw slightly longer than the penultimate segment, moderately slender and moderately curved, rather more so proximally than distally.

Radials projecting very slightly beyond the centrodorsal, slightly separated distally; IBr<sub>1</sub> oblong or slightly trapezoidal, four times as broad as long; IBr<sub>2</sub> broadly pentagonal, twice as broad as long; synarthrial tubercles moderately developed.

Ten arms about 80 mm. long, resembling those of *D. studeri*; distal ends of the brachials very slightly if at all produced.

P<sub>a</sub> absent; P<sub>1</sub> 4.5 mm. long, small and slender, with about fourteen segments, the first short, the second slightly longer, the third squarish, those in the distal portion being half again as long as broad; P<sub>2</sub> 8 mm. long, stouter and stiffer than P<sub>1</sub> though not especially enlarged, with fifteen to seventeen segments, the first short, the second and third squarish, the remainder one third to one half again as long as broad, becoming again somewhat shorter at the extreme tip; the segments in the distal half have slightly enlarged distal ends; P<sub>3</sub> 6 mm. long, less stout than P<sub>2</sub>, but similar to it, with fourteen segments; P<sub>4</sub> 5 mm. long, slightly less stout than P<sub>3</sub>, but similar, with twelve segments; P<sub>5</sub> and following pinnules 4 mm. long, about as stout as P<sub>4</sub>, but not stiffened, with twelve segments, the third squarish, the remainder longer than broad, becoming half again as long as broad in the distal half; the distal ends of the component segments are slightly everted and spinous; distal pinnules slender with smooth segments, 7 mm. long.

The colour in spirits is violet, the cirri and a few small blotches on the arms and pinnules, the synarthrial tubercles, and a median line on the arm bases, yellow; or, brownish yellow narrowly banded with purple.

LOCALITIES.—Off Colombo Light House, Ceylon; 26½ fathoms (Type Locality).—Six specimens.

South of Ceylon (6° 6.5' N. lat., 81° 23' E. long.); 32 fathoms.—One large specimen.

? *India*.—One specimen.

OTHER RECORDS.—Fadifolu, Muhlos, Maldives; Muhlos, Maldives.

#### DECAMETRA ARABICA sp. nov.

*Antedon carinata* BRIT. MUS., MS.

DESCRIPTION.—Cirri XIX, 26-27, 13 mm. long, slender, the earlier segments about twice as broad as long, the terminal about as long as broad; small paired dorsal spines are developed from the ninth or tenth segment onward.

The ten arms are 110 mm. long, resembling those of *D. taprobanes*.

P absent; P<sub>1</sub> very small and weak, 4.5 mm. long; P<sub>2</sub> 9 mm. long with fifteen segments, most of which are twice as long as broad, with produced and spinous distal angles, suggesting the condition found in *Oligometra serripinna*; the pinnule is comparatively slender, though stiff, and tapers evenly to the tip; P<sub>3</sub> is similar, but shorter, 6 mm. to 7 mm. long; P<sub>4</sub> is 4.5 mm. long; P<sub>5</sub> is similar, but shorter; the following pinnules are small and weak; the distal pinnules are 9.5 mm. long.

The colour in spirits is yellow, narrowly but frequently banded with purple, the cirri purplish; or, blotched purple and yellow.

HABITAT.—Muscat; I have examined sixteen specimens of this species in the British Museum.

#### DECAMETRA ALAUDÆ.

*Decametra alaudæ* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 33.

HABITAT.—Cargados Carajos.

DEPTH.—30 fathoms.

#### DECAMETRA MOLLIS.

*Cyllometra mollis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 76.

DESCRIPTION.—Centrodorsal discoidal, thin, the polar area flat, 2 mm. in diameter; cirrus sockets arranged in one and a more or less partial second crowded marginal row.

Cirri XX, 20-22, 10 mm. long; first segment short, second and third about twice as broad as long, the remainder very slightly broader than long, becoming almost squarish in the terminal five or six; second and following segments with the distal dorsal edge produced and finely spinous, this projection progressively narrowing distally, at the same time very slowly moving to a more proximal position, after about the eighth becoming a pair of small subterminal tubercles, which on the last five to seven segments give place to small median tubercles: opposing spine much larger than the spines on the preceding segments, triangular, the apex terminal to nearly median, in height reaching to one half or rather more of the diameter of the penultimate segment; terminal claw very slightly longer than the penultimate segment, moderately stout and moderately curved basally, becoming more slender and less curved distally.

Radials about even with the edge of the centrodorsal;  $IBr_1$  oblong, about three times as broad as long, not in contact basally;  $IBr_2$  pentagonal, about twice as broad as long, the lateral edges about half as long as those of the  $IBr_1$ , making

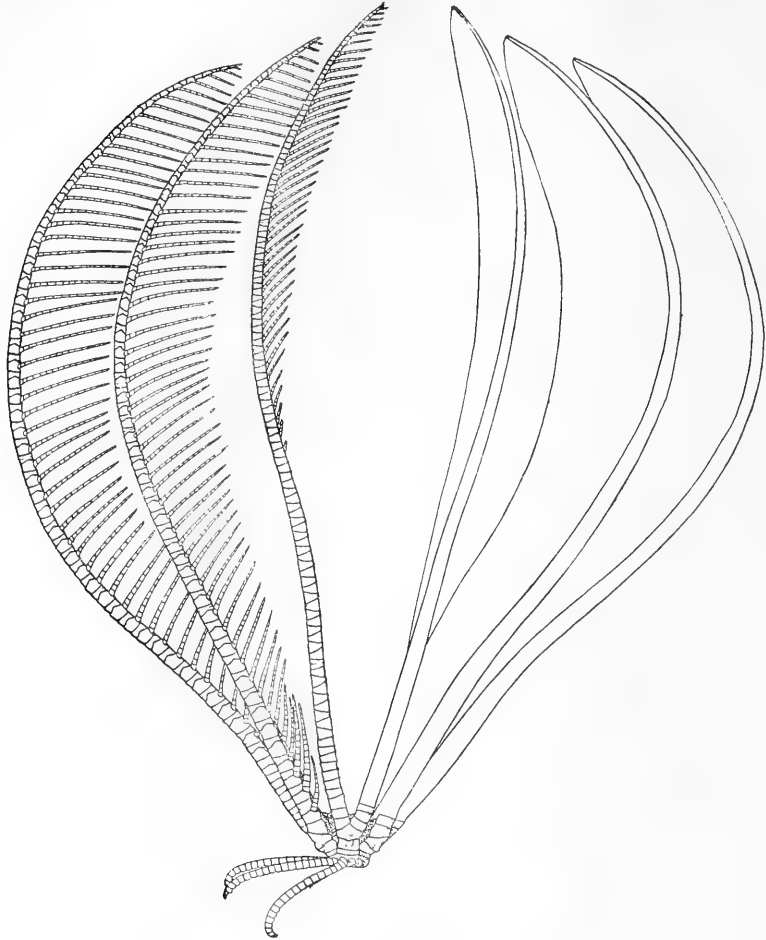


FIG. 24.—*Decametra mollis*.  
Lateral view of the type.

with them a very obtuse angle;  $IBr$  series and lower brachials with a slightly indicated rounded median carination.

Ten arms 65 mm. long; first two brachials approximately equal, wedge-



shaped, about twice as broad as their exterior length; third and fourth (syzygial pair) oblong or slightly longer interiorly than exteriorly, once and one half times to twice as broad as long; next four or five brachials oblong, about three times as broad as long, then becoming very obliquely wedge-shaped, almost triangular, half again as broad as long, in the distal portion of the arm less obliquely wedge-shaped and somewhat longer, and in the terminal portion longer than broad. Syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of from four to eight (usually six or seven) oblique muscular articulations. The second syzygy is occasionally between the fifth and sixth brachials, and the third may be as far out as between the sixteenth and seventeenth.

P absent; P<sub>1</sub> small and weak, 4 mm. long with fourteen segments, the first short, the second squarish, the following gradually increasing in length, becoming twice as long as broad distally; the segments in the distal third have the edges armed with fine spines; P<sub>2</sub> 13 mm. long, stouter than P<sub>1</sub>, though of the same proportions, with seventeen segments, which become squarish on the third and fourth as long as broad terminally; second and following with a few spines on the distal edge; P<sub>3</sub> 6 mm. long, basally as stout as P<sub>2</sub> but not tapering so rapidly, and therefore less delicate distally, with fifteen segments, the distal elongated; P<sub>4</sub> 4 mm. long, not so delicate as P<sub>1</sub>, with ten segments; P<sub>5</sub> 3 mm. long; following pinnules increasing slowly in length, the distal pinnules being 7 mm. long, slender, with elongated segments.

The colour in spirits is brown, the perisome darker.

LOCALITIES.—? *Kurrachi*.—The type.

KURRACHI.—Six specimens.

REMARKS.—In the British Museum I found six specimens of this species from *Kurrachi*; the cirri are XII-XV, 20-23, 10 mm. long; the dorsal processes on the cirrus segments, as in the type, are very small; most of the cirrus segments are about twice as broad as long. P<sub>1</sub> has about thirteen segments, and resembles P<sub>2</sub>, but is shorter and correspondingly more slender; P<sub>2</sub> is the largest, but is slender; most of its segments are about twice as long as broad or even longer; the segments number about fourteen; those in the outer half have projecting outer corners; P<sub>3</sub> is about like P<sub>1</sub>; P<sub>4</sub> is shorter, and P<sub>5</sub> is shorter still; sometimes P<sub>1</sub> is considerably shorter than P<sub>2</sub> or than P<sub>3</sub>. The arms are 65 mm. long.

#### DECAMETRA MODICA.

*Decametra modica* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 32.

HABITAT.—Bagamoyo, German East Africa.

#### DECAMETRA MÖBIUSI.

? *Antedon laevissima* (part) 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

*Decametra möbiusi* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 31.

HABITAT.—Mauritius; Muhlos, Maldives; Fadifolu, Maldives.

DECAMETRA TIGRINA.

*Antedon tigrina* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 147

HABITAT.—Southern Japan.

DECAMETRA STUDERI.

*Oligometra studeri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, pp. 41, 88.

HABITAT.—Dirk Hartog Island, Western Australia.

DEPTH.—7 fathoms.

DECAMETRA INFORMIS.

*Antedon informis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 205, pl. xxxiii, fig. 3.

HABITAT.—Philippine Islands; Singapore.

DEPTH.—Littoral, and down to 23 fathoms.

DECAMETRA sp.

*Cyllometra* sp. 1909. A. H. CLARK, Zool. Anzeiger, vol. **34**, No. 11-12, p. 368.

The German ship "Gazelle" dredged in the southern Indian Ocean (exact locality and depth not recorded) a small mutilated individual of some species of *Decametra*.

Genus COLOBOMETRA.

*Colobometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 5 (*Antedon perspinosa* P. H. Carpenter, 1881).

COLOBOMETRA PERSPINOSA.

*Antedon perspinosa* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. **3**, p. 178.

*Antedon insignis* 1882. BELL, P. Z. S., 1882, p. 534.

*Antedon loveni* 1884. BELL, Report Zoöl. Coll. H.M.S. "Alert," p. 158, pl. x, figs. B, C *a-e* (not A *a-e* as given in the reference to the plate).

*Cyllometra belli* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, p. 357.

*Colobometra perspinosa* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 6.

HABITAT.—Island of Jobie, near New Guinea; Amboina; Port Denison, Queensland; Port Jackson.

REMARKS.—In the type, which I examined at Leyden, the cirri are XIII, 53, 55, 56, 57, 58 and 59, long, and comparatively slender, 47 mm. long, tapering slightly in the distal half; the longer proximal segments are slightly (about one third) longer than broad.  $P_n$  is absent. The  $IBr_1$  is three times as broad as long; the  $IBr_2$  is twice as broad as long; both these segments are comparatively short. The synarthrial tubercles are small, but well marked, with the proximal half (on the  $IBr_1$ ) more or less spinous.  $P_1$  is slightly stiffened, about two thirds the length of  $P_2$ , with about fifteen segments which become squarish on the third and distally three times as long as broad.  $P_2$  is enlarged and greatly stiffened.  $P_3$  is slightly larger than  $P_2$ , but similar to it. The following pinnules to  $P_4$  or  $P_5$  are similar, but slowly decrease in length and thickness; the following are only slightly stiffened. The distal pinnules are very long and slender with about twenty-seven segments. The proximal pinnules are comparatively slender, not so stout as those of *C. vepretum*; the cirri are also less stout than those of that species.  $P_1$  is rather strongly prismatic, and the following pinnules are prismatic for a diminishing distance basally. The arms are 140 mm. long.

Another specimen at Leyden, from Amboina, is exactly like the type; the cirri are XII, 56–65, like those of the type.

The comparative slenderness of the proximal pinnules of this species, and the stiffness of  $P_1$ , which has elongated segments, appear to separate this form sharply from *C. vepretum* and to place it in the *diadema* group of species.

#### COLOBOMETRA DIADEMA.

*Colobometra diadema* 1910. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 23, p. 7.

HABITAT.—Ugi, Solomon Islands.

#### COLOBOMETRA VEPRETUM.

*Antedon perspinosa* 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 85 (part), pl. 5, fig. 54.

*Colobometra vepretum* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 174.

HABITAT.—Amboina; Singapore.

#### COLOBOMETRA SUAVIS.

*Cyllometra suavis* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 25, part 2, p. 220.

*Colobometra suavis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 6.

HABITAT.—Philippine Islands.

DEPTH.—20–23 fathoms.

## COLOBOMETRA DISCOLOR.

*Colobometra discolor* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 640.

DESCRIPTION.—Cirri XVIII–XXII, 29–40 (usually about 35), 25 mm. to 30 mm. long, slender, resembling those of *C. perspinosa*, but with the distal ends of the segments not so strongly spinous.

Radials projecting slightly beyond the edge of the centrodorsal;  $IBr_1$  oblong, slightly over twice as broad as long, the ventrolateral edges slightly produced into a thin border by which they are in apposition;  $IBr_2$  broadly pentagonal, twice as broad as long, the lateral edges somewhat more than half the length of those of the  $IBr_1$ , making with them a straight line, and with the same ventrolateral projection; a slight constriction is usually present just below the lateral angles.

Ten arms 80 mm. long, resembling in general those of *C. suavis*.

$P_a$  absent;  $P_1$  6.5 mm. long, small, tapering rapidly to a slender and delicate tip, with fifteen or sixteen segments; first segment twice as broad as long, second somewhat longer, third about as long as broad, the fourth similar, the following very gradually increasing in length to about half again as long as broad, and becoming squarish again in the terminal four or five;  $P_2$  15 mm. long, moderately stout and very stiff and spine-like, with about twenty segments, the first about twice as broad as long, the second slightly longer, the third nearly half again as long as broad, the remainder about twice as long as broad; beginning on the second segment there is a faintly indicated broadly rounded keel running along the middle of the outer side, as on  $P_1$ ; on the third and following segments the distal dorsal edge projects in the line of this keel in a narrow fringe of spines which broadens on succeeding segments, the spines at the same time becoming longer, and is supplemented by additional spines on the ventrolateral angles of the segments;  $P_3$  similar to  $P_2$ , usually about 1 mm. shorter;  $P_4$  10 mm. long, resembling  $P_3$  and  $P_5$  though not quite so stiff, with fifteen segments;  $P_5$  and following pinnules very slowly decreasing in length and stiffness, at the same time becoming more slender, with the spines on the distal ends of the segments less and less pronounced;  $P_9$  is 8 mm. long and  $P_{13}$  is 7 mm. long, each with fifteen segments; from this point the pinnules very gradually increase to 10 mm. distally, the distal pinnules being slender, comparatively little stiffened, with from twenty to twenty-two segments which have moderately everted ends armed with fine spines; the distal pinnules are somewhat compressed laterally.

The colour in spirits is purple, the arms thickly covered with yellow spots, the cirri with occasional narrow yellow bands, the proximal pinnules mainly yellow; or, purple, the cirri and proximal pinnules yellow.

LOCALITIES.—Near *Coco Island* ( $14^{\circ} 04' 30''$  N. lat.,  $93^{\circ} 51' 00''$  E. long.); 41 fathoms (Type Locality).—Four specimens.

Off *norib-eastern Ceylon* ( $8^{\circ} 51' 30''$  N. lat.,  $81^{\circ} 11' 52''$  E. long.); 28 fathoms.—Three specimens.

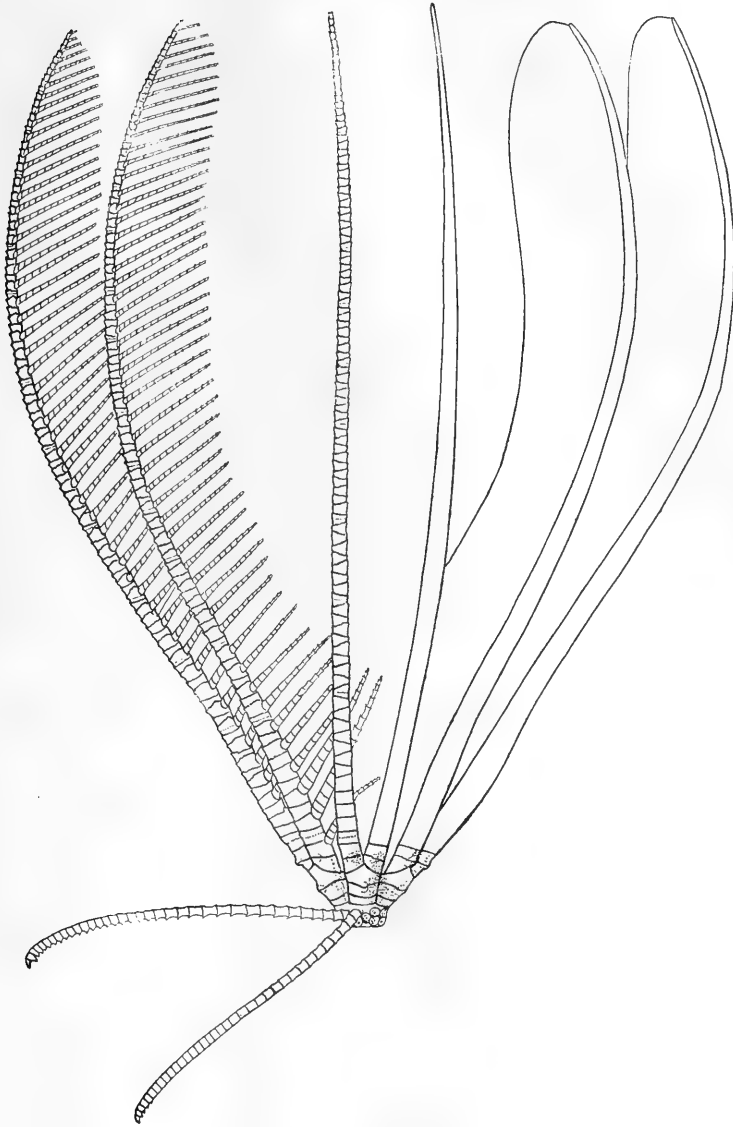


FIG. 25.—*Colobometra discolor*.  
Lateral view of the type.

*Port Blair, Andaman Islands.*—One specimen.

OTHER RECORD.—Philippine Islands.

DEPTH.—28–58 fathoms.

#### COLOBOMETRA CHADWICKI.

*Antedon serripinna* 1908. CHADWICK, Journ. Linn. Soc. (Zool.), vol. **31**, p. 44.

*Colobometra chadwicki* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 30.

HABITAT.—Suez.

DEPTH.—10 fathoms.

#### Genus OLIGOMETRA.

*Oligometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 126

(*Antedon serripinna* P. H. Carpenter, 1881).

#### OLIGOMETRA GRACILICIRRA.

*Oligometra gracilicirra* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 221.

LOCALITY.—*Andaman Islands.*—Five specimens: one of these, in a fairly good state of preservation, has arms approximately 50 mm. long, the cirri being XV, 30–31, 12 mm. long; the segments of the lower pinnules have exceedingly spiny distal ends, this character becoming gradually less marked and disappearing at about the tenth pair; the first and following cirrus segments have the distal dorsal edge everted, this eversion gradually becoming higher and narrower, and transforming into a long spine after the seventh. The colour is white, the IBr series and arms with a lateral purple line which fades away distally on the arms; each cirrus segment has a narrow central purple band. This specimen, when placed side by side with the type, showed no differences. Three of the others resemble it. The remaining one is deep violet in colour, the cirri yellow with the usual purple bands on each segment. The proximal pinnules are not so spiny as usual, and P<sub>2</sub> has about twelve segments instead of nine.

OTHER RECORD.—Tawi Tawi group, Philippine Archipelago.

DEPTH.—49 fathoms.

#### OLIGOMETRA GRACILICIRRA var. ORNATA.

*Oligometra gracilicirra* var. *ornata* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 544.

HABITAT.—Philippine Islands.

DEPTH.—44 fathoms.

#### OLIGOMETRA IMBRICATA.

*Antedon cupuliferus* var. LÜTKEN, MS.

*Oligometra imbricata* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 228.

LOCALITIES.—*Ganjam Coast, Madras Presidency; 24–30 fathoms.*—Two specimens; the lower pinnules are strongly serrate.

? *India.*—One typical specimen.

OTHER RECORD.—? *Tranquebar.*

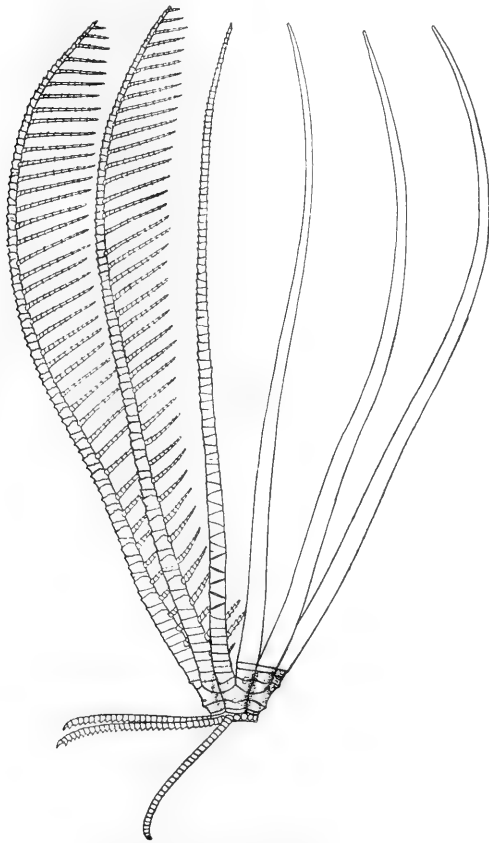


FIG. 26.—*Oligometra gracilicirra.*  
Lateral view of a typical specimen.

#### OLIGOMETRA SERRIPINNA.

*Antedon serripinna* 1881. P. H. CARPENTER, Notes from the Leyden Museum, vol. 3, p. 182.—1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 82.

*Antedon cupulifera* (Lütken, MS.) 1891. HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, p. 82.

*Antedon carinata* 1894. BELL, P. Z. S., 1894, p. 396.

*Oligometra serripinna* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21,

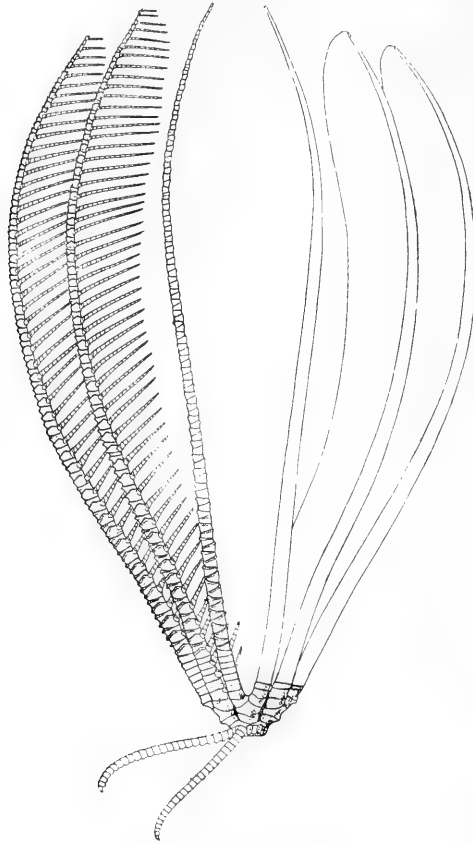


FIG. 27.—*Oligometra imbricata*.  
Lateral view of a typical specimen.

p. 126.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 179.

*Oligometra pulchella* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 226.



LOCALITIES.—*Pedro Shoal* (north of the Laccadives).—One large specimen, with cirri XVI, 21–23.

*Off northeastern Ceylon* ( $6^{\circ} 01' N. \text{ lat.}, 81^{\circ} 16' E. \text{ long.}$ ); 34 fathoms.—Seven medium-sized and small specimens.

*Off Puri* (Rocky Bank); 10 fathoms.—Three specimens.

*One mile east of the Terribles*; 13 fathoms.—Five specimens.

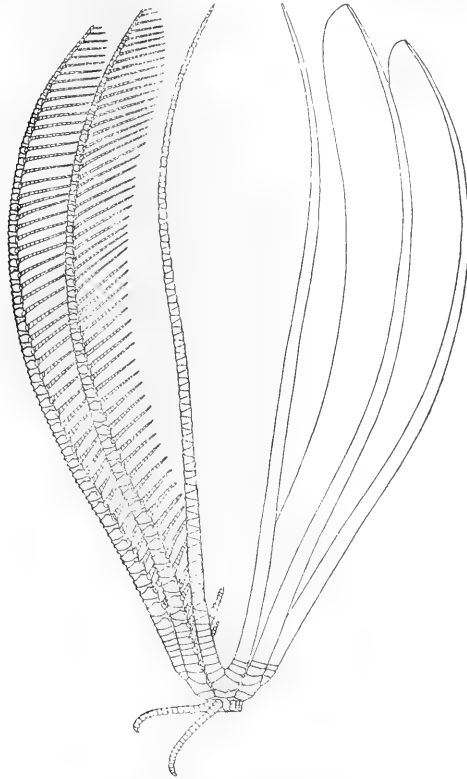


FIG. 28.—*Oligometra serripinna*.  
Lateral view of a typical specimen.

*Two and one half miles southeast of Santapillay light-house*; 7–8 fathoms.—Three specimens; one of these has the processes on the lower pinnules more pronounced than usual, and the synarthrial tubercles prominent.

*Off the Ganjam Coast* (Madras Presidency); 15–25 fathoms.—Eight specimens; one of these is peculiar in having  $P_3$  similar to, and nearly as large as,  $P_2$ , which last is somewhat smaller than usual.

*Off the Ganjam Coast*; 8-16 fathoms.—Seven specimens.

*Arrakan Coast, Burma*.—Two specimens.

*Snod Island, Mergui Archipelago* (12° N. lat., 98½° E. long.).—Three specimens.

OTHER RECORDS.—Tonga Islands; Philippine Islands; Macclesfield Bank; Singapore; Andai, New Guinea; Ceylon.

DEPTH.—Littoral, and down to 32 (? 46) fathoms.

REMARKS.—When I was studying the crinoid collections belonging to the Zoological Museum at Copenhagen I was unable to identify a pretty little species of *Oligometra* from Singapore which was abundantly represented therein with any species previously known, and I therefore described it as new under the name of *Oligometra pulchella*, believing that the strongly rounded laterally flattened production of the distal dorsal ends of the segments of the more or less styliform lower pinnules amply served to distinguish it from *O. serripinna*, in which the production of the distal ends of the pinnule segments is sharp. The collections of the Indian Museum contained thirty specimens resembling my *O. pulchella* from Singapore, except that the production of the pinnule segments is sharp. I accordingly described the supposed new form in MS. as *Oligometra concinna*. Upon reviewing the subject more carefully, I found that this was at best only an average difference, and that no definite line between *O. pulchella* and *O. concinna* could be drawn, and, further, that neither appeared to be separable from *O. serripinna*, as redescribed by Hartlaub in 1891. It has seemed advisable therefore to relegate both *Oligometra pulchella* and *Oligometra concinna* to the synonymy of *Oligometra serripinna*, especially in view of the usually abundant differences by which the species of *Oligometra* are distinguished *inter se*.

A detailed description of typical Indian specimens may be of interest for comparison with the form from Singapore which I called *pulchella*; the description is based mainly upon an example from Puri, but is comprehensive enough to include all the specimens except that from the Pedro Shoal, which has slightly more numerous cirrus segments. The specimen from the Red Sea, which I examined in the British Museum, and which was collected by the cable repair ship "Electra" in 20 fathoms, represents an apparently well-marked variety which I have called *electra*, characterized by being exceptionally ornate, with extravagantly developed processes on the proximal pinnules.

*Oligometra concinna*.—Centrodorsal thin discoidal, the bare polar area flat, 2 mm. in diameter; cirrus sockets arranged in a single closely crowded, but fairly regular, marginal row.

Cirri rather slender, proportionately short, XIII-XVII, 19-21, 8 mm. long; first segment very short, the following slowly increasing in length to the seventh or eighth which, with the remainder, is as long as to half again as long as broad; proximal segments abruptly flattened ventrally; on the fourth or fifth the distal dorsal edge is slightly prominent, forming a low finely serrate transverse ridge across the end of the segment; on the succeeding segments this ridge increases in

height and moves anteriorly, on the twelfth and following being median in position; distally the ridge very gradually narrows, becoming finally, on the antepenultimate, reduced to a sharp median tubercle; opposing spine much larger than the spine on the preceding segment, sharp, arising from the entire dorsal surface of the penultimate segment, the apex median in position, equal to about the distal diameter of the penultimate segment in height; terminal claw longer than the penultimate segment, stout, more strongly curved proximally than distally.

Radials even with the edge of the centrodorsal, diverging slightly distally;  $1Br_1$  short, oblong, about four times as broad as long, not united basally;  $1Br_2$  almost triangular, the lateral edges only half as long as those of the  $1Br_1$ , twice as broad as long; synarthrial tubercles small, but prominent.

Ten arms about 80 mm. long, moderately slender; first brachial wedge-shaped, about twice as broad distally as the exterior length, interiorly united for the proximal two thirds, the interior edges widely flaring apart in the distal third; second brachial about the same size, irregularly quadrate; third and fourth brachials (syzygial pair) slightly longer interiorly than exteriorly, twice as broad as the interior length; next four brachials oblong or slightly wedge-shaped, about three and one half times as broad as long, then becoming triangular, about twice as broad as long, and after the middle of the arm wedge-shaped, twice as broad as long, and in the terminal portion wedge-shaped, about as long as broad. From the ninth or tenth onward the brachials have rather prominently overlapping finely spinous distal ends which very gradually die away in the distal third of the arm. Syzygies occur between the third and fourth brachials, again between the thirteenth and fourteenth to fifteenth and sixteenth (with sometimes an extra one between the fifth and sixth to ninth and tenth) and distally at intervals of from four to six (usually five) oblique muscular articulations.

$P_1$  small and weak, 4.5 mm. to 5.0 mm. long with seventeen segments, the first small, irregularly quadrate, the second wedge-shaped, twice as broad as the proximal (greater) length, the third half again as broad as long, the following gradually increasing to the sixth which, with the remainder, is about as long as broad; from the third segment onward a dorsal ridge begins to develop along the median external line of the pinnule, after the seventh becoming a high carination; the eighth and following segments bear prominent processes on the distal border on the line of this carination, triangular in shape, the apex terminal, arising from the whole exterior line of carination, the distal height being equal to about one half the diameter of the segment;  $P_2$  10 mm. to 12 mm. long, much stouter than  $P_1$  (by far the stoutest pinnule on the arm) and very stiff, tapering gradually from the base to a delicate tip, with twenty-five segments, the first two short, the following gradually increasing in length to the fifth which, with the following, is about as long as broad, at the extreme tip becoming somewhat longer; third and following segments strongly carinate, the fourth and following bearing on their distal edges along this line of carination sharp and prominent

anteriorly directed spines, the bases of which do not involve more than the distal third, or at most the distal half, of the segments: similar, though smaller, spines occur along the inner distal edge of the pinnule;  $P_2$  is most like  $P_1$ , 4 mm. long with fifteen segments, becoming as long as broad on the fifth and from one third to one half again as long as broad distally; second and third segments sometimes developing distal carinate processes, the third and following obscurely carinate dorsally with overlapping and finely spinous ends which are especially produced along the dorsal rounded-carinate ridge and along the ventral angles; following pinnules in general similar; distal overlap of the segments gradually becoming more uniform in height, after  $P_7$  becoming an even finely spinous projection which disappears altogether in the distal pinnules: the distal pinnules are slender and smooth, 9 mm. in length.

The colour in spirits is dull yellowish, the arms and pinnules thickly blotched with purple; or, brownish yellow; or, yellow, the rays and arm bases bordered with purple, the pinnules, cirri, and occasional narrow bands on the arms purple; or, violet, the cirri yellow.

The type in the Leyden Museum, from Andai, New Guinea, resembles the specimen from Singapore which I described as *Oligometra pulchella*. The serration of the pinnules is not greatly accentuated. The purple bands on the arms are very narrow.

OLIGOMETRA SERRIPINNA var. ELECTRÆ.

*Oligometra serripinna* var. *electræ* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 51.

HABITAT.—Red Sea, south-east of Massawa.

DEPTH.—20 fathoms.

OLIGOMETRA SERRIPINNA var. OCCIDENTALIS.

*Oligometra serripinna* var. *occidentalis* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 33.

HABITAT.—Mauritius; Cargados Carajos.

DEPTH.—Littoral, and down to 30 fathoms.

OLIGOMETRA CARPENTERI.

*Antedon carpenteri* 1884. BELL, Report Zool. Coll. H.M.S. "Alert," p. 157, pl. x, figs. A a-c.

*Antedon serripinna* 1894. BELL, P. Z. S., 1894, p. 394.

*Antedon milberti* (part) 1894. BELL, P. Z. S., 1894, p. 394.

*Oligometra carpenteri* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 126.

HABITAT.—Queensland; Prince of Wales Channel; north-western Australia; Baudin Island; Holothuria Bank; Bassett-Smith Bank.

DEPTH.—Littoral, and down to 39 fathoms.

REMARKS.—In London I was able to examine the specimens upon which the record of *Oligometra serripinna* in north-western Australia was based, and I found that they were in reality, as I had long suspected, examples of *O. carpenteri*.

#### OLIGOMETRA JAPONICA.

*Antedon japonica* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 172.

—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 84, pl. 4, fig. 49.

*Oligometra japonica* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 126 (but not Proc. U. S. Nat. Mus., vol. 34, p. 308).

HABITAT.—Southern Japan; Philippine Islands.

DEPTH.—55–58 fathoms.

#### OLIGOMETRA ADEONÆ.

*Comatula adeonæ* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 535.

*Antedon bidens* 1884. BELL, Report Zoöl. Coll. H.M.S. "Alert," p. 158, pl. xi, figs. A a-c.

*Oligometra adeonæ* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 126.

HABITAT.—"Australia"; Queensland; northern Australia; Torres Strait; Thursday Island; Baudin Island; north-west Australia.

DEPTH.—Littoral, and down to 15 fathoms.

REMARKS.—An examination of the types of *Comatula adeonæ* at Paris and of *Antedon bidens* at the British Museum has shown that in reality the two are the same species. The "Alert" collection contains specimens identified both as "*Antedon adeonæ*" and as "*Antedon bidens*." The only adequate figure of the species yet published is that given by Döderlein.

#### OLIGOMETRA THETIDIS.

*Oligometra thetidis* 1909. H. L. CLARK, Memoirs Australian Museum, iv, p. 522, pl. xlvii, figs. 1, 2, 3.

HABITAT.—South-eastern Australia.

DEPTH.—55–56 fathoms.

#### OLIGOMETRA CALEDONIÆ sp. nov.

DESCRIPTION.—Cirri XI, 18–19, very short, rather stout, resembling those of *O. serripinna*; first segment about twice as long as broad, the following very gradually increasing in length so that the eleventh to the thirteenth and following are about as long as broad; on the fifth the distal dorsal edge becomes slightly

everted, this becoming a median transverse ridge on the twelfth and following, appearing as a minute spine in lateral view; the opposing spine is prominent, median, and erect.

The ten arms, which resemble those of *O. serripinna*, are 83 mm. long.

$P_1$  is slender, flagellate distally, with twenty-one segments which become squarish on the fifth, the remainder being slightly longer than broad;  $P_2$  is half as long again and proportionately stouter with from twenty-one to twenty-three segments of which the longest are only slightly longer than broad;  $P_3$  and the following pinnules are shorter and more slender than  $P_1$ ;  $P_3$  has fourteen or fifteen segments; the distal pinnules are long and slender, with from thirty-two to thirty-six segments.

HABITAT.—New Caledonia; the type, which was collected by M. Vigué in 1875, is in the Paris Museum.

#### Family TROPIOMETRIDÆ.

*Tropiometridæ* (part) 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 211.

#### Genus TROPIOMETRA.

*Tropiometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 349 (*Comatula carinata* Lamarck, 1816).

#### TROPIOMETRA AFRA.

*Antedon afer* LÜTKEN, MS.

*Antedon afra* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 172.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 86, pl. 5, fig. 50.

*Antedon macrodiscus* 1895. HARA, Zool. Mag. Tokyo, vol. 7, p. 115.

*Tropiometra afra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 349.

HABITAT.—Bowen, Queensland, and north to southern Japan.

DEPTH.—Littoral, and down to 50 fathoms.

#### TROPIOMETRA CARINATA.

? *Alecto carinata* 1815. LEACH, Zool. Miscell., vol. 2, p. 63.

*Comatula carinata* 1816. LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, p. 534.—1869. VON MARTENS, in VON DER DECKEN, Reise in Ost-Africa, vol. 3, p. 129.

*Comatula bicolor* 1862. DUJARDIN and HUPÉ, Hist. nat. des zoophytes. Échinodermes, p. 208 (*nomen nudum*).

*Actinometra solaris* 1869. VON MARTENS, in VON DER DECKEN, Reise in Ost-Africa, vol. 3, p. 129.

*Antedon carinata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 199 (part) (but not pl. xxxiv).

*Antedon capensis* 1905. BELL, Marine Investigations in South Africa, vol. 3, p. 139, pl. 2.

*Tropiometra carinata* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 349.—1911. Proc. U. S. Nat. Mus., vol. 40, p. 34.

HABITAT.—Southern and south-eastern Africa, including Madagascar, Mauritius, the Seychelles, Réunion, the Mascarin Islands, Saya de Malha, Cargados Carajos, Farquhar Atoll, and Zanibar.

DEPTH.—Littoral, and down to 30 fathoms.

#### TROPIOMETRA ENCRINUS.

? *Alecto carinata* 1815. LEACH, Zool. Miscell., vol. , p. 63.

*Comatula* sp. 1817. AUDOUIN, in SAVIGNY, Description de l'Égypte, p. 205, pl. i.

? *Antedon* sp. 1877. MOSELEY, Quart. Journ. Micros. Sci., vol. 17, p. 8.—1890.

MACMUNN, *idem*, vol. p. 55.

*Alecto encrinus* LÜTKEN, MS.

*Antedon adeonæ* 1887. BELL, Sci. Trans. Roy. Dublin Soc., (2), vol. 3, p. 645.

*Antedon marmorata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 202 (*nomen nudum*).

*Tropiometra carinata* (part) 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 349.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 182.

*Tropiometra encrinus* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 36.

LOCALITIES.—Galle, Ceylon.—Seventeen small or medium-sized specimens.

Sadras.—Two medium-sized specimens.

? India.—Five medium-sized specimens; one of these has the median brachial carination exceptionally well developed.

OTHER RECORDS.—East Indies; Muscat; Indian Ocean; east coast of Asia; Java; Aden; Tor, Red Sea; Red Sea; Tuticorin, Madras Presidency; Ceylon; Norfolk Island; ? SUEZ.

DEPTH.—Littoral, and down to 8 (? 40) fathoms.

REMARKS.—In a series of specimens from Ceylon which I examined at the British Museum the cirri are XXVI–XXIX, 23–26 (usually 25), 21 mm. to 22 mm. long; the outer segments are about twice as broad as long as in *T. carinata*, and the last four taper rather rapidly. As a whole the cirri are rather slender and weak, but very numerous, arranged in two and a partial third very irregular marginal rows, giving a characteristic appearance to the animals. The lower pinnules are stiffened.

#### Family CALOMETRIDÆ nov.

*Tropiometridæ* (part) 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 211.

#### Genus CALOMETRA.

*Calometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 362 (*Antedon callista* A. H. Clark, 1907).

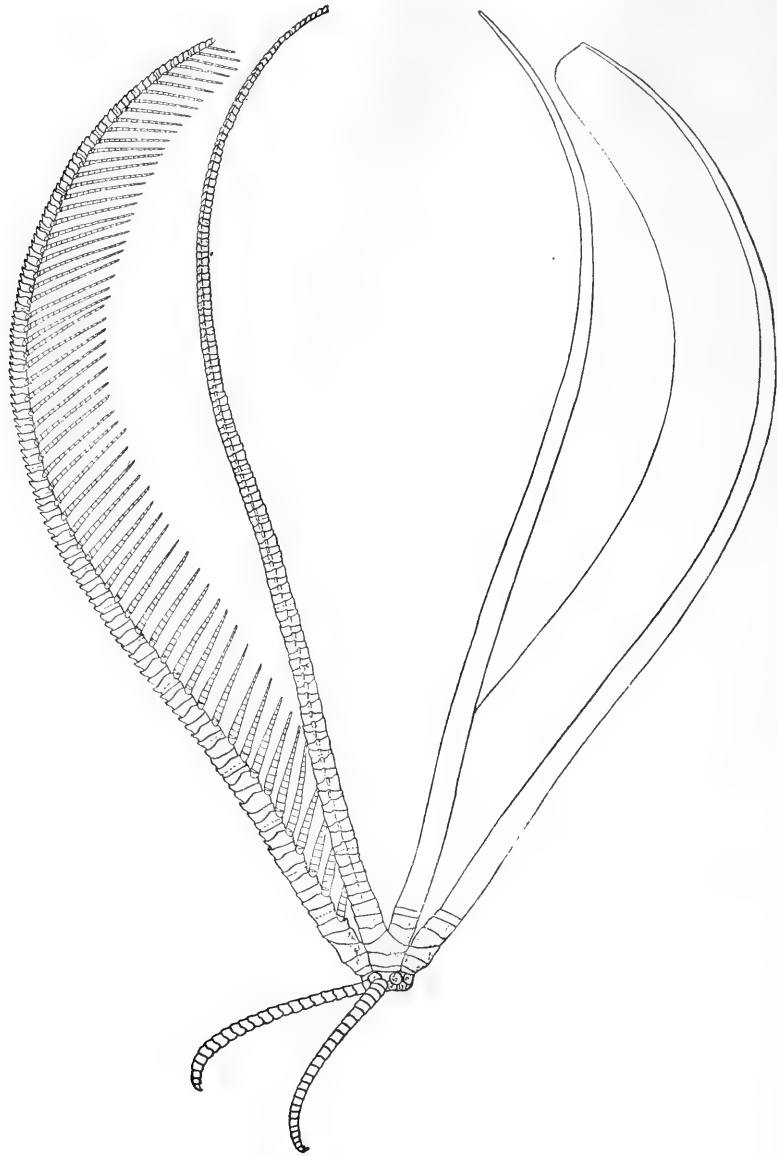


FIG. 29.—*Tropiometra encrinus*.  
Lateral view of a typical specimen from eastern Asia.



## CALOMETRA CALLISTA.

*Antedon callista* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 135.

*Calometra callista* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 363.

HABITAT.—Southern Japan.

DEPTH.—107–139 fathoms.

## CALOMETRA DISCOIDEA.

*Antedon discoidea* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 134, pl. x, figs. 1, 2.

*Calometra discoidea* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 363.

HABITAT.—Ki and Philippine Islands.

DEPTH.—140–240 fathoms.

## Genus OREOMETRA, nov.

GENOTYPE.—*Oreometra marixæ*, sp. nov.

DIAGNOSIS.—A genus of Calometridæ in which the IIBr series are 4 (3+4); the centrodorsal is thick-discoidal, with a single marginal row of cirri, whose sockets are largely supported by the radials; cirri long (nearly half of the arm length), rounded rhombic in cross-section, the outer segments bearing triple dorsal spines; first segment of the earlier pinnules not greatly enlarged.

## OREOMETRA MARLÆ, sp. nov.

*Antedon macronema* BRIT. MUS., MS.

DESCRIPTION.—Centrodorsal thick discoidal, bearing a single fairly regular marginal row of cirrus sockets; the flat dorsal pole is 4 mm. in diameter.

Cirri XV, 44–47 (usually 46–47), 25 mm. to 27 mm. long; all the segments are approximately equal, all being about twice as broad as long. The ventral and the lateral distal edges of the segments project rather strongly over the base of the succeeding segments. The cirri are rounded rhombic in cross section, suggesting the cirri of *Neometra acanthaster* though the corners are less sharp. On about the fourth segment a faint very narrow longitudinal ridge is visible; after the middle of the cirrus this becomes a narrow low sharp carination, and terminally grows into a fairly prominent rounded spine. The cirri taper slightly in the outer half. In the distal third of the cirri supplementary spines appear, one on either side of the central carination, at first small and confined to the vicinity of the distal edge, but on the terminal segments nearly as large as the median spine; the spine on the antepenultimate segment is single; the opposing spine is laterally broadened. The cirri as a whole are moderately stout.

The ventral view of the radial pentagon (the specimen has no disk) shows a very broad and shallow central cavity with a small central plug; the radial faces are broad laterally but very narrow dorsoventrally, just as in *Neometra multicolor*.

Radials moderate in length, resembling those of *Neometra multicolor*, except that they are not produced interradially. The dorsal surface of the radials is marked by a series of semicircular pits or gouges which serve to accommodate the dorsal part of the cirrus bases. The cirrus sockets are all partly on the centro-dorsal and partly on the radials; the central canal, however, is always on the centrodorsal, though it may be only very slightly below its rim. The elements of the IBr series are united by an exceedingly close synarthry which appears like a syzygy in external view; IBr<sub>1</sub> oblong, two and one half to three times as broad as long; IBr<sub>2</sub> broadly pentagonal, twice as broad as long; the elements of the IBr series are broad, in close lateral apposition, and slightly flattened laterally, just as in *Ptilometra mülleri*; as in that species also the ossicles are very thin dorsoventrally. The IBr<sub>1</sub> has a sharp tubercle in the middle near the proximal border, and another smaller one in the middle of its anterior margin; the IBr<sub>2</sub> has a tubercle in the middle of each of the two anterior edges. The IIBr<sub>1</sub> and the first brachial have each a median tubercle on their anterior border; the IIBr<sub>2</sub> has two tubercles on its anterior border. The axillaries and preceding segments of the IIBr series resemble the corresponding ossicles of the IBr series. The IIBr series are 4 (3+4).

Seventeen arms (in the type) 60 mm. long, the brachials in general resembling those of *Pectinometra versicolor*; as in that species there is rather a sharp overlap, especially at the distolateral angles; the arms do not become laterally flattened or carinate distally.

Sacculi are abundant. The side and covering plates are highly developed.

P<sub>1</sub> about 7 mm. long, small and weak, flexible, rather strongly prismatic, with eighteen segments; it is at first moderately stout but tapers rapidly after the basal third, being exceedingly slender and flagellate in the outer half; the component segments are broader than long proximally, becoming slightly longer than broad distally; the first segment is about twice as broad as the second, though in comparison with the other species of the family it does not strike one as being especially enlarged; the second segment is also enlarged, but very slightly; it bears a small dorsal carinate process as does also the third, which is not enlarged. P<sub>2</sub> stiff and spinelike, 8 mm. long with ten segments, the first short, the second squarish, the remainder much elongated with slightly spinous distal ends. P<sub>3</sub> and P<sub>4</sub> equal, slightly longer than P<sub>2</sub> but similar to it, with twelve segments. The first segment of P<sub>2</sub> and sometimes also of P<sub>3</sub> has a slight rounded dorsal carination but is not otherwise modified. P<sub>5</sub> about as long as P<sub>2</sub> but more slender distally and less spinous. The following pinnules are slightly shorter than P<sub>5</sub> with eleven segments which have slightly prominent distal ends. All of the pinnules are strongly prismatic. The distal pinnules are 9 mm. long.

In spirits the calyx, division series, and sides of the arms are light brown; a broad median band on the arms, most of the pinnules, and the cirri, are white.

HABITAT.—Unknown; the type is in the British Museum.

Genus NEOMETRA, nov.

GENOTYPE.—*Antedon multicolor* A. H. Clark, 1907.

DIAGNOSIS.—A genus of Calometridæ in which the IBr series are 2; the centrodorsal is thick discoidal or hemispherical, with from one to three marginal rows of cirrus sockets; the cirri are of moderate length, one third as long as the arms; the radials are produced interradially in the form of a broad process which entirely and widely separates the bases of the IBr<sub>1</sub>; the elements of the IBr series have smooth sides without lateral projections, and are widely separated; the brachials are long, so that the pinnules, which are stiff, but slender, appear rather widely separated.

NEOMETRA SPINOSISSIMA.

*Calometra spinosissima* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 79.

DESCRIPTION.—Centrodorsal discoidal, moderately thick, the bare polar area flat, 3 mm. in diameter; cirrus sockets arranged in a single crowded marginal row

Cirri XI, 42–55, moderately slender, 25 mm. long; first segment about three times as broad as long, the following slowly increasing in length to the sixth or seventh, which is nearly as long as broad, then remaining similar to the twelfth or fifteenth, then very gradually decreasing so that the segments in the terminal portion are twice as broad as long; at about the fifteenth a low sharp dorsal keel makes its appearance, at first in the distal portion only, but soon along the entire dorsal surface, which very slowly increases in height, becoming very prominent on the short terminal segments though never exceeding more than one fourth of their diameter in height; opposing spine and terminal claw as in *N. multicolor*.

Disk lacking; side and covering plates very highly developed along the brachial and pinnule ambulacra.

Ends of the basal rays visible as small tubercles or small rhombic areas in the angles of the calyx, but not raised above the general surface of the radials and therefore not especially obvious; radials short in the median line, but extending up into the angles of the calyx in the form of an equilateral triangle the rounded apex of which entirely separates the bases of the IBr<sub>1</sub>; IBr<sub>1</sub> slightly trapezoidal, about two and one half times as broad as long, the ventrolateral margins very thin; IBr<sub>2</sub> pentagonal, as long as, or only very slightly shorter than, broad, the lateral edges nearly as quite as long as those of the IBr<sub>1</sub>, slightly constricted just below the lateral angles; IIBr 2, the first united in the proximal two thirds, diverging at approximately a right angle distally.

Nineteen arms (in the type) 136 mm. long, resembling in the main those of

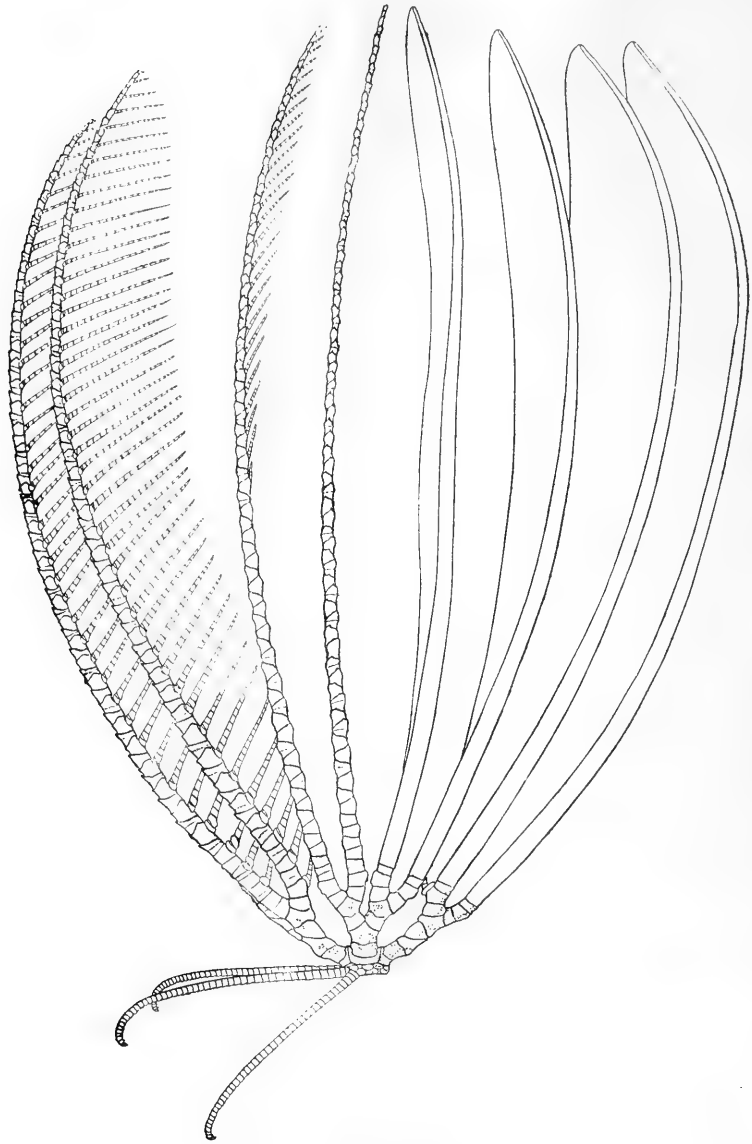


FIG. 30.—*Neometra spinosissima*.  
Lateral view of the type.

*N. multicolor*; first brachial wedge-shaped, about as long exteriorly as broad distally, interiorly united for almost the entire length; second brachial similar, but swollen exteriorly to form an attachment for the greatly enlarged lower segments of  $P_1$ ; third and fourth (syzygial pair) slightly longer than broad to half again as long as broad, slightly constricted centrally; next three or four brachials wedge-shaped, progressively more and more oblique, somewhat longer than broad, then becoming triangular, as long as broad, the long exterior side somewhat convex, and wedge-shaped terminally; at about the seventh brachial the distal edge becomes projecting and overlapping and armed with fine spines, this projection ending, on the side toward the longer lateral edge of the segment, abruptly in a more or less pronounced sharp point or spine, so that the arms appear to have dorsally a double row of more or less marked short overlapping spines; distally these spines move gradually nearer and nearer the median line, at the same time becoming rounded carinate, and gradually die away distally. Syzygies occur between the third and fourth brachials, again between the tenth and eleventh to the twelfth and thirteenth, and distally at intervals of three (more rarely two or four) oblique muscular articulations.

$P_1$  10 mm. long, very slender and weak, with thirty-five segments, the first proportionately greatly enlarged, twice as broad as long, with a strong carinate process, the second much shorter, strongly trapezoidal, the remainder very small and squarish;  $P_2$  somewhat longer, but stiff and spine-like with elongated segments like  $P_3$ ;  $P_3$  20 mm. long, not especially stout, but very stiff, with about twenty segments, the first about twice as broad as long, slightly carinate, the second trapezoidal, about as broad distally as the proximal length, the third half again as long as broad, the fourth over twice as long as broad, the remainder two and one half to three times as long as broad and even longer distally; the segments have slightly projecting and spinous distal ends, this character increasing in intensity distally;  $P_4$  similar to  $P_3$  and of the same length; the following pinnules decrease to 12 mm. on  $P_4$ , then become somewhat stouter, and more slender again distally, though remaining of the same length; the segments in the distal portion of all the pinnules have prominent, somewhat expanded, spinous distal ends. The pinnules on the outer arms of each ray appear to be considerably longer than those on the inner arms.

The colour in spirits is white, thickly blotched on the rays, arms, and pinnules with purple, which colour also forms on the rays and division series a more or less well defined dorsolateral line.

LOCALITY.—*Andaman Islands*.—One specimen.

#### NEOMETRA MULTICOLOR.

*Antedon discoidea* (part) 1906. McCLENDON, Bull. American Mus., vol. 22, pp.

120, 125, 126 (not of Carpenter).

*Antedon multicolor* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 130.

*Antedon thetis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 151.

*Calometra multicolor* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 363.

HABITAT.—Southern Japan.

DEPTH.—20–110 fathoms.

#### NEOMETRA ACANTHASTER.

*Calometra acanthaster* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 224.

HABITAT.—Philippine Islands.

DEPTH.—49 fathoms.

#### NEOMETRA ALECTO.

*Calometra alecto* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 544.

HABITAT.—Philippine Islands.

DEPTH.—42–58 fathoms.

#### Genus GEPHYROMETRA, nov.

GENOTYPE.—*Antedon versicolor*, A. H. Clark, 1907.

DIAGNOSIS.—A genus of Calometridæ including species with twenty long arms composed of from one hundred and twenty to one hundred and thirty brachials, the IIB series being 2; the anterior interradiar processes of the radials are narrow and short, so that the IB<sub>r</sub> are in apposition beyond them, basally or entirely; the IB<sub>r</sub> axillaries are entirely free laterally, with smooth margins; the cirri are rather slender, composed of about forty-five segments of which the longest are about as long as or slightly longer than broad, and reach to from one-fourth to one-third of the arm length; the proximal pinnules are all slender, but (excepting P<sub>1</sub>) stiffened; P<sub>2</sub> is the longest, longer than the distal pinnules.

#### GEPHYROMETRA VERSICOLOR.

*Antedon versicolor* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 132.

*Calometra versicolor* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 363.

HABITAT.—South-western Japan.

DEPTH.—53 fathoms.

#### GEPHYROMETRA PROPINQUA.

*Antedon propinqua* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 133.

*Calometra propinqua* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 363.

HABITAT.—South-western Japan.

DEPTH.—95 fathoms.

## Genus PECTINOMETRA, nov.

GENOTYPE.—*Antedon flavopurpurea* A. H. CLARK, 1907.

DIAGNOSIS.—A genus of Calometridæ in which the IIBr series are 2; the cirri are of moderate length, about one third as long as the arms, composed of short segments, of which the longest are rarely longer than broad; the radials are seldom produced interradially, rarely separating the bases of the IBr<sub>1</sub>; the elements of the IBr series, and usually also of the IIBr series and the first two brachials, have strong, more or less irregular lateral processes; the brachials are short so that the pinnules, which are not especially slender, appear closely set.

## PECTINOMETRA MAGNIFICA.

*Calometra magnifica* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 77.

DESCRIPTION.—Centrodorsal hemispherical, the bare polar area convex, 2 mm. in diameter; cirrus sockets arranged in two or three closely crowded irregular marginal rows.

Cirri XX, 41-48, 40 mm. long; first segment short, the next two about twice as broad as long, the following gradually increasing in length to the fifth or seventh, which is about one third broader than long; following segments similar to almost the middle of the cirrus, at which point they begin to decrease gradually in length, being twice as broad as long in the terminal portion; at about the eighth segment the median portion of the distal dorsal edge begins to project in a small A-shaped spine; this very slowly increases distally, the whole dorsal surface of the segment becoming rounded carinate and rising at the same time until in the terminal third the cirrus segments bear broad spatulate carinate processes which are equal in height to about one third their diameter; opposing spine triangular, similar in shape and size to the spine on the preceding segment, blunt, the apex terminal, arising from the distal two thirds of the penultimate segment, about equal to one half of the lateral diameter of the penultimate segment in height; terminal claw conical, equal in length to the penultimate segment, stout, slightly curved.

Disk completely covered with a pavement of rather small rounded plates, those in the angles of the calyx between the division series bearing conical processes in their centres; this calcareous covering is not closely united to the perisome beneath except along the ambulacra, but draws away from it in drying; ambulacra with side and covering plates highly developed.

Ends of the basal rays visible as small, though prominent, tubercles in the angles of the calyx; radials even with the edge of the centrodorsal, but over the ends of the basal rays extending upward in a narrow slightly wedge-shaped (base upward) process which terminates distally in a spatulate tip between the lateral edges of the IBr<sub>2</sub>; IBr<sub>1</sub> short, slightly trapezoidal, not in contact basally, about four times as broad as long, rather strongly convex dorsally, with a rather promi-

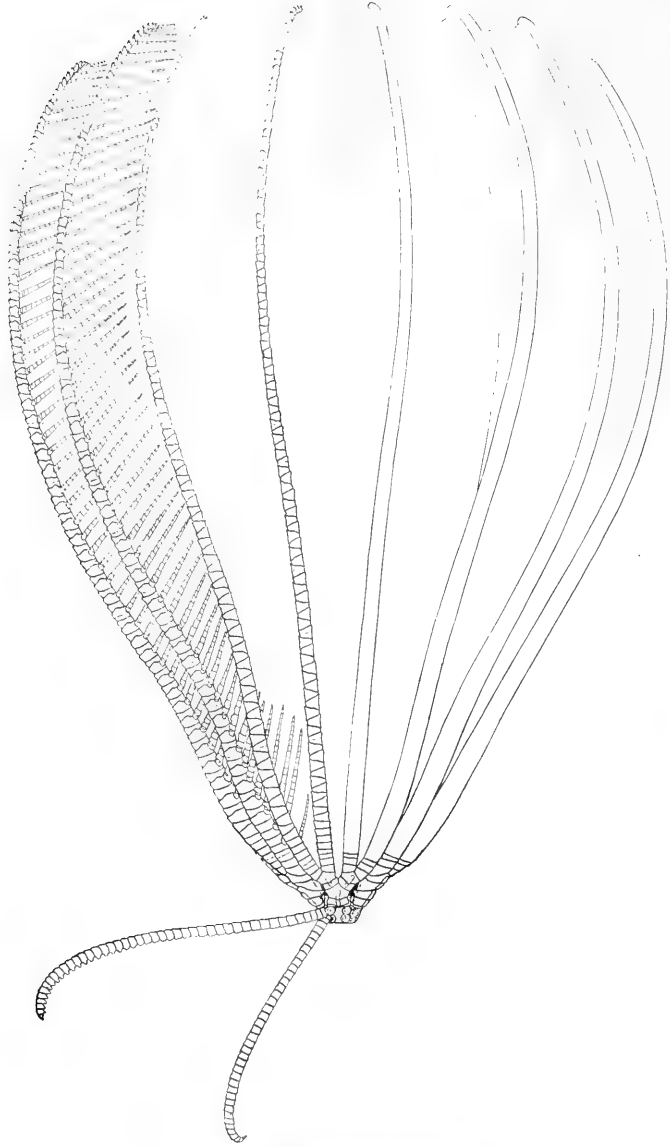


FIG. 31.—*Pectinometra magna*.  
Lateral view of the type.



ment narrow rounded median ridge;  $IBr_2$  pentagonal, nearly or quite twice as broad as long, the lateral edges slightly shorter than those of the  $IBr_1$ , making with them an obtuse angle, with a narrow rounded median ridge similar to that on the  $IBr_1$  in the proximal half;  $IIBr_2$ , with the rounded median ridge much less prominent than on the  $IBr$  series.

Twenty arms about 120 mm. long; first brachial small, wedge-shaped, twice as broad as long exteriorly, almost entirely united interiorly; second brachial considerably larger, irregularly quadrate, both usually with a trace of a rounded median keel; third and fourth brachials (syzygial pair) oblong, half again as broad as long; next four brachials oblong, twice as broad as long, with a low tubercle in the proximal half of the median line; following two or three brachials wedge-shaped, the following triangular, about as long as broad; arm tips not preserved. On the lower part of the arm traces of tubercles are found on alternate sides of the median line; the proximal third of the arm is somewhat compressed laterally, and bears on either side a shallow lateral groove. The arms increase slowly in diameter up to about the twelfth brachial; from the fourth onward the brachials have moderately projecting finely spinous distal edges. Syzygies occur between the third and fourth brachials, again between the eighteenth and nineteenth (rarely the seventeenth and eighteenth or twentieth and twenty-first), and distally at intervals of from four to nine (usually six to eight) oblique muscular articulations.

$P_1$  8 mm. long, slender and weak, with twenty segments, the first broad, slightly wedge-shaped, about twice as broad as the length of its proximal edge, produced distally into a high rounded carinate process; second segment longer, half again as broad as long, bearing a large fan-shaped carinate process with a scalloped or dentate distal edge; third and fourth considerably less in diameter than the second, slightly longer than broad with strong oblong carinate processes; following segments non-carinate, slowly increasing in length, becoming twice as long as broad in the terminal portion; after the second segment the pinnule is rather sharply triangular; in the distal half the segments project somewhat over the bases of the succeeding segments at the angles of the prism, this increasing toward the tip where the ends of the segments overlap all around and are more or less spinous;  $P_2$  14 mm. long, slender, but stiff, with twenty-one segments; first segment broad, about twice as wide as its proximal diameter, roundedly carinate distally; second segment wedge-shaped, about as long as the proximal length, with a thin carinate process about twice as broad as high distally; third segment one third longer than broad, strongly carinate distally, but the carination not quite so high as that on the preceding segment; fourth segment twice as long as broad, carinate distally like the third; following segments about two and one half times as long as broad, slightly longer in the terminal part; the pinnule is strongly styliform, the segments being more or less produced anteriorly at the angles of the prism in the shape of a spine overlapping the bases of the succeeding segments; the distal ends of the segments are somewhat prominent and finely spinous, this becoming more pronounced distally;  $P_3$  15 mm. long, similar to  $P_2$ , though

very slightly stouter;  $P_4$  14 mm. long;  $P_5$  12 mm. long;  $P_6$  10 mm. long, similar to  $P_3$ , but with proportionately somewhat longer segments which in the distal portion have more expanded ends;  $P_6$  has fifteen segments;  $P_7$  10 mm. long, slightly stouter than  $P_6$ , with about the same number of segments which are proportionately rather shorter;  $P_8$  9 mm. long, stouter than  $P_7$ , especially on the third, fourth, and fifth segments, none of which are more than twice as long as broad; following pinnules of the same length and in general similar; the third-seventh segments are somewhat broadened, the pinnule tapering evenly from a maximum width on the fourth to a slender tip, composed of much elongate segments which have expanded and spinous distal ends; the distal pinnules are slender, 10 mm. long.

The colour in spirits is white.

LOCALITY.—*Malay Archipelago*; 160 fathoms.—One specimen.

#### PECTINOMETRA FLAVOPURPUREA.

*Antedon discoidea* (part) 1906. McCLENDON, Bull. American Mus., vol. 22, pp. 120, 125, 126 (not of Carpenter).

*Antedon flavopurpurea* 1907. A. H. CLARK, Proc. U.S. Nat. Mus., vol. 33, p. 134.

*Calometra flavopurpurea* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 363.

HABITAT.—Southern Japan.

DEPTH.—85–110 fathoms.

#### PECTINOMETRA CARDUUM.

*Calometra carduum* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 222.

HABITAT.—Philippine Islands.

DEPTH.—97–110 fathoms.

#### PECTINOMETRA SEPARATA.

*Antedon separata* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 133.

*Calometra separata* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 363.

HABITAT.—Southern Japan.

DEPTH.—55–106 fathoms.

#### Family THALASSOMETRIDÆ.

*Thalassometride* (part) 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 211.

*Thalassometrina* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, pp. 2, 13.

## Genus PTILOMETRA.

*Kallispongia* (part) 1877. WRIGHT, Proc. Roy. Irish Acad. (2), vol. **2**, p. 754 (*Kallispongia accheri*, sp. nov.).

*Ptilometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 358 (*Comatula macronema* J. Müller, 1846).

## PTILOMETRA MÜLLERI.

*Kallispongia archeri*, var. 1877. WRIGHT, Proc. Roy. Irish Acad. (2), vol. **2**, p. 754, pl. xl, fig. 3.

*Antedon macronema* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 212 (excepting specimens from King George's Sound, and figs. 4 and 5 on pl. xxxviii), and following authors.

*Ptilometra mülleri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 41.

*Himerometra pedophora* 1909. H. L. CLARK, Australian Museum Memoir iv, p. 524, pl. xlvii, figs. 4-10 (young).

HABITAT.—South-eastern Australia.

DEPTH.—6-48 fathoms.

## PTILOMETRA MACRONEMA.

*Comatula macronema* 1846. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss. 1846, p. 179.

*Antedon wilsoni* 1888. BELL, Ann. and Mag. Nat. Hist. (6), vol. **2**, No. 11, p. 403 (young).

*Antedon macronema* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 212 (specimens from King George's Sound), pl. xxxviii, figs. 4, 5.

*Ptilometra macronema* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 359.

*Ptilometra dorcadis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 39.

HABITAT.—Western and Southern Australia from Dirk Hartog Island to Port Phillip and Kangaroo Island.

DEPTH.—7-28 fathoms.

## Genus PTEROMETRA.

*Pterometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 177 (*Ptilometra trichopoda* A. H. Clark, 1908).

## PTEROMETRA SPLENDIDA.

*Ptilometra splendida* 1909. A. H. CLARK, Proc. U.S. Nat. Mus., vol. **37**, p. 33.

HABITAT.—Philippine Islands.

DEPTH.—37 fathoms.

## PTEROMETRA TRICHOPODA.

*Ptilometra trichopoda* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 224.

*Pterometra trichopoda* 1911. A. H. CLARK, Proc. U.S. Nat. Mus., vol. **39**, p. 545.

HABITAT — Philippine Islands.

DEPTH.—37 to 58 fathoms.

## Genus ASTEROMETRA.

*Asterometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 358.—1908. Bull. Mus. Comp. Zoöl., vol. **51**, No. 8, p. 245 (*Antedon macropoda* A. H. Clark, 1907).

## ASTEROMETRA MIRIFICA.

*Antedon longicirra* (part) 1893. BELL, Journ. Linn. Soc. (Zoöl.), vol. **24**, p. 339.

*Asterometra mirifica* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 146.

DESCRIPTION.—This is a ten-armed species, in general similar to *A. cristata* and to *A. longicirra*, but it may be readily distinguished from these species by the very high sharp median keel on the IBr series and on the first two brachials; this keel is convex in a profile view so that the outline of the lower part of the animal is indicated by a series of convex scallops instead of by a straight line as in *A. cristata*, or well-spaced angular tubercles as in *A. longicirra*.

The colour in spirits is white, the perisome brown.

LOCALITY.—*Sahul Bank* (16° 30' S. lat., 125° E. long.).—One specimen.

REMARKS.—I have examined some additional specimens of this species which are preserved in the British Museum; there appears to be but little individual variation.

## ASTEROMETRA CRISTATA.

*Asterometra cristata* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 547.

HABITAT.—Philippine Islands.

DEPTH.—74 fathoms.

## ASTEROMETRA LONGICIRRA.

*Antedon longicirra* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 103, pl. xvii.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

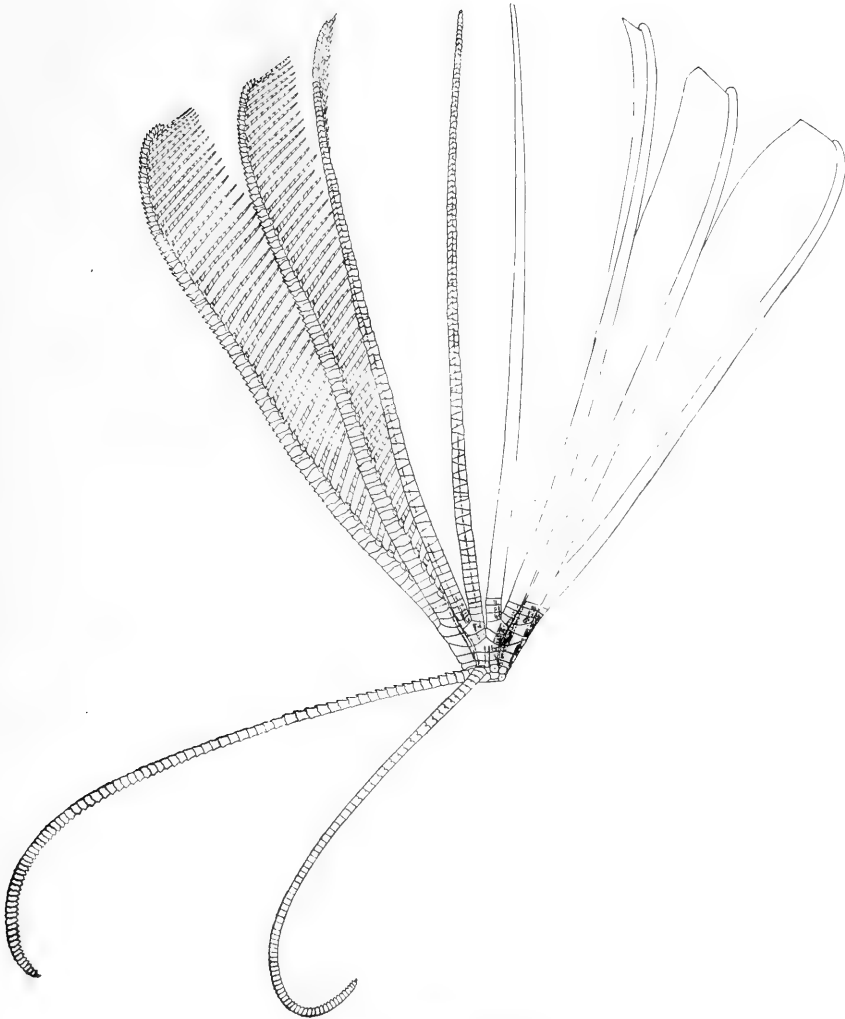


FIG. 32.—*Pterometra trichopoda*.  
Lateral view of a typical specimen.

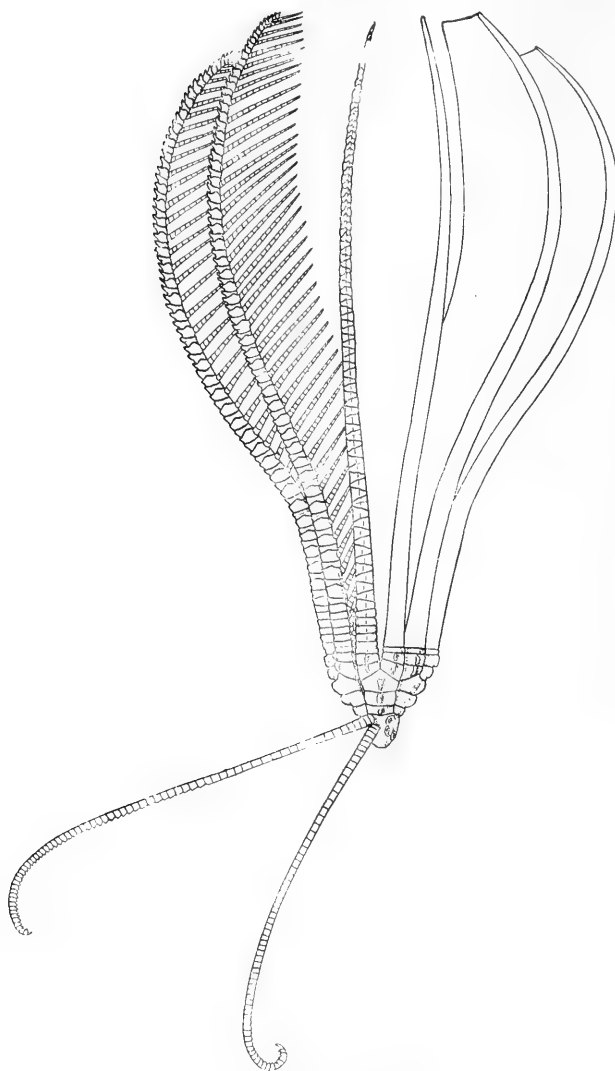


FIG. 33.—*Asterometra mirifica*.  
Lateral view of the type.

## ASTEROMETRA MAGNIPEDA.

*Asterometra magnipeda* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 546.

HABITAT.—Philippine Islands.

DEPTH.—42 fathoms.

## ASTEROMETRA MACROPODA.

*Antedon macropoda* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 136.

HABITAT.—Southern Japan.

DEPTH.—103 fathoms.

## ASTEROMETRA PULCHERRIMA.

*Ptilometra pulcherrima* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 400.

*Asterometra pulcherrima* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 547.

LOCALITY.—*Southwest of the mouths of the Irrawaddy River* (15° 25' N. lat., 93° 45' E. long.); 49-40 fathoms.—One specimen, agreeing well with the type, and with another specimen in the "Siboga" collection.

OTHER RECORDS.—Philippine Islands.

DEPTH.—28 fathoms.

## ASTEROMETRA ANTHUS.

*Antedon anthus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 136.

HABITAT.—Southern Japan.

DEPTH.—103 fathoms.

## ASTEROMETRA ACERBA.

*Antedon longicirra* (part) 1893. BELL, Journ. Linn. Soc. (Zool.), vol. 24, p. 339.

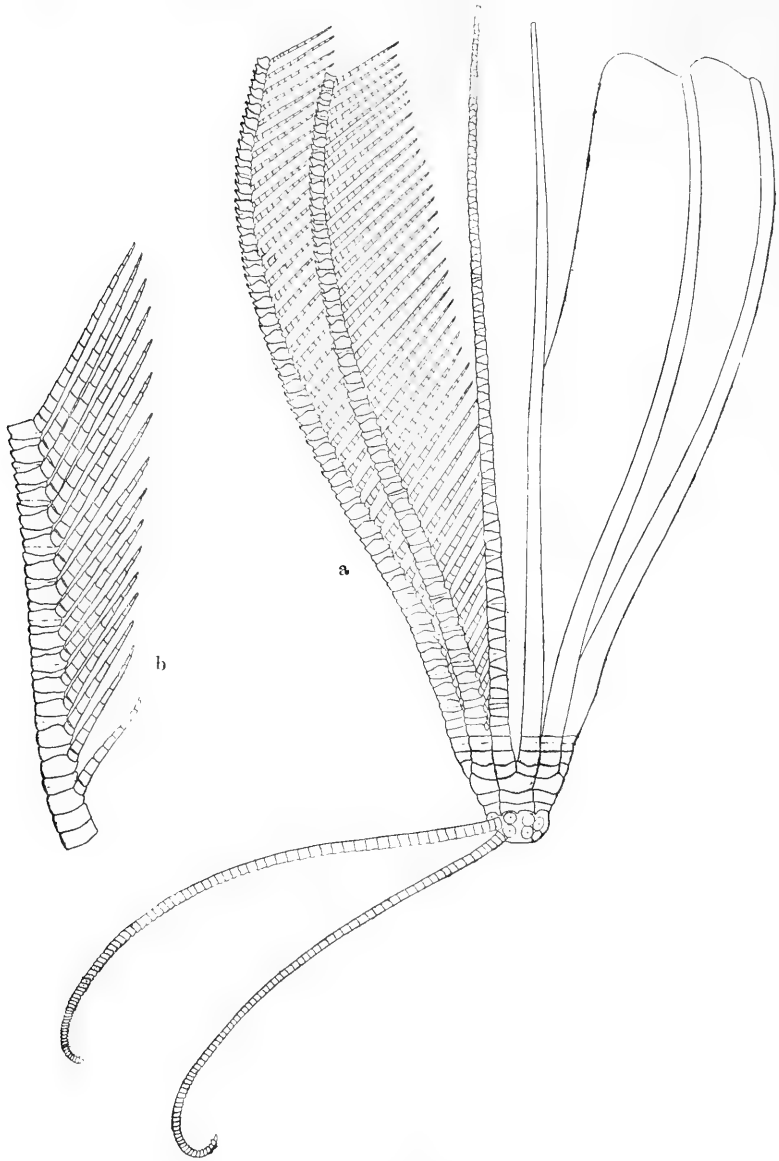
*Asterometra acerba* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 147.

DESCRIPTION.—In general this species comes nearest to *A. anthus* of southern Japan, but it is a more slender species and possesses only ten arms.

Cirri XX, 84-90, 55 mm. long, more slender than those of *A. anthus*.

Radials with a moderately prominent dorsoventrally elongate median tubercle; IBr series with a faint narrow low median carination.

Ten arms 80 mm. long, slightly more slender than those of *A. anthus*, with slightly longer brachials; arms strongly compressed distally as in that species; but the overlapping spines developed on the brachials are not nearly so long or so stout.

FIG. 34.—*Asterometra acerba*.

(a) Lateral-view of the type.  
(b) The proximal pinnules.



Pinnules much longer than those of *A. anthus*, and more slender with proportionately longer segments, those in the terminal portion being three times as long as broad or even longer, whereas in *A. anthus* they do not exceed twice the breadth;  $P_1$  is 7 mm. long with twelve segments;  $P_2$  is similar, 7.5 mm. long;  $P_3$  is slightly stouter, 8 mm. long;  $P_5$  is 9 mm. long; the distal pinnules are 13 mm. long.

The colour in spirits is brownish white.

LOCALITY.—*Sahul Bank* (10° 30' S. lat., 125° E. long.)—One specimen.

REMARKS.—It is interesting to note that this species represents the smaller and more slender component of a specific pair inhabiting a single locality (the larger and stouter component being *Asterometra mirifica*) just as *A. anthus* is the smaller and more slender component of the *anthus-macropoda* pair of southern Japan; and that, while both species of the latter pair have more than ten arms, both species of the *acerba-mirifica* pair have ten arms only.

I have examined some additional specimens of this species from the same locality which are preserved in the British Museum.

#### ASTEROMETRA LEPIDA.

*Asterometra lepida* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 229.

HABITAT.—Straits of Formosa (Taiwan).

DEPTH.—35 fathoms.

#### Genus THALASSOMETRA

*Thalassometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 359 (*Antedon villosa* A. H. Clark, 1907).

#### THALASSOMETRA ANNANDALEI.

*Crotalometra annandalei* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 642.

*Thalassometra annandalei* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 551.

DESCRIPTION.—Centrodorsal columnar, the tip truncated conical as in *Asterometra*, 5 mm. long by about 5 mm. broad at the base; cirrus sockets arranged in ten columns of usually three each, the columns of adjacent radial areas being closely crowded and more or less alternating, the two columns of each radial area being separated by a slightly concave median area of about half their width; polar area with five more or less marked interradial ridges which terminate in five small tubercles about the apex.

Cirri comparatively slender, XXX, 62–79, 65 mm. long; first three segments approximately equal, short, about twice as broad as long, the following gradually

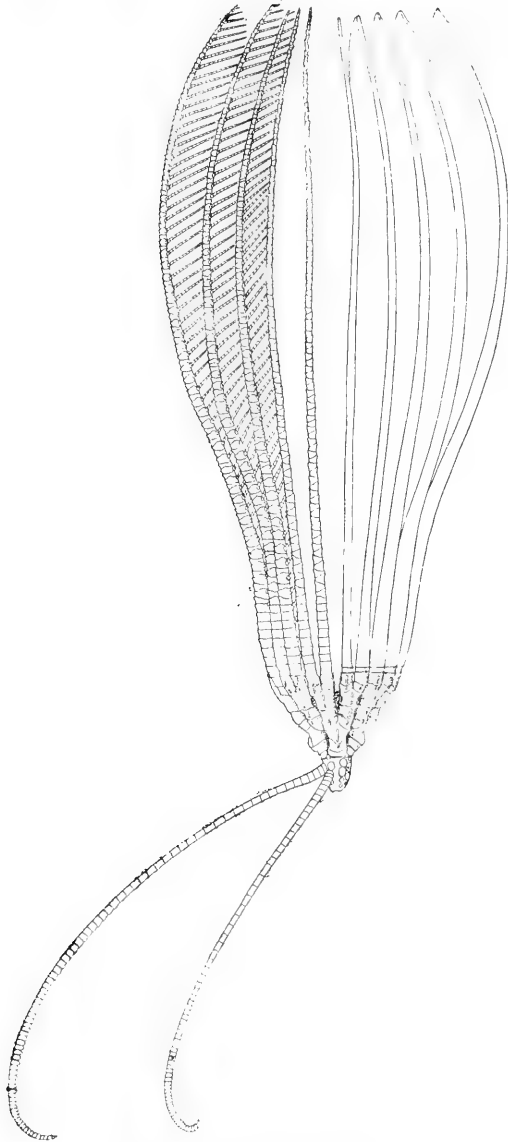


FIG. 35.—*Thalassometra amandalei*.  
Lateral view of the type.

increasing in length, becoming squarish on the fifth or sixth and half again or nearly twice as long as broad on the eighth or ninth; next three or four segments similar, the length then very slowly decreasing, the segments in the middle of the cirrus being squarish and those in the distal part about twice as broad as long; eighth, ninth, or tenth a transition segment; shortly after the transition segment, the median portion of the distal dorsal edge of the segments begins to become prominent; this very slowly increases in height, arising from progressively more and more of the dorsal surface of the segments, which become progressively more and more carinate, so that in the terminal forty-five or fifty the dorsal surface is produced into a sharp thin keel, straight in front, convex posteriorly, the outer edge parallel with the median line of the cirrus, in height equal to about one third of the lateral diameter of the segment which bears it; opposing spine small and blunt, arising from the entire dorsal surface of the penultimate segment, the apex subterminal or central, in height equal to about one third the diameter of the penultimate segment; terminal claw small, about equal in length to the penultimate segment, stout and moderately curved. The cirri are rounded in the basal third, subsequently becoming strongly compressed laterally and, when viewed from the side, somewhat broader.

Ends of the basal rays visible as dorsoventrally elongated tubercles in the angles of the calyx; a deep and narrow cleft is seen between the radials and the centrodorsal; radials very narrow, convex proximally, concave distally, with a small sharp tubercle in the median part of the proximal border; IBr<sub>1</sub> about three times as broad as long, the proximal border convex, the distal concave, in close lateral apposition and extending rather well up into the angles of the calyx; the lateral edges are more or less denticulate, and there is a low, though sharp, serrate median keel; IBr<sub>2</sub> slightly longer than broad, shield-shaped, the posterior border produced into a rounded projection incising the IBr<sub>1</sub>, the anterior edges concave, the anterior angle somewhat produced, the lateral edges somewhat denticulate; it bears a sharp serrate median keel in the proximal two thirds; IBr 4 (3+4), rarely 2, strongly convex dorsally, in close lateral apposition and sharply flattened like the IBr series, the lateral edges produced and strongly denticulate; IBr 3+4 (syzygial pair) centrally constricted with the lateral angles produced as in the other species of the genus.

Twenty arms 115 mm. long; first brachial short, slightly longer exteriorly than interiorly, interiorly united, somewhat incised by the second which is nearly twice as large and has a rounded posterior projection; these two brachials, like the IBr<sub>1</sub> and <sub>2</sub>, have a slightly marked median carination; third and fourth brachials (syzygial pair) not quite so long as broad, somewhat constricted centrally; next five or six brachials almost oblong, about twice as broad as long, the surface rather strongly concave, then becoming wedge-shaped, and soon triangular, nearly as long as broad, and after the middle of the arm wedge-shaped again and about as long as broad. The arms are at first evenly rounded dorsally, but after the basal third they gradually become compressed and more

sharply rounded dorsally, and in the outer half very narrow and very sharply rounded dorsally, though not really carinate; after the basal third of the arms the brachials develop slightly projecting and finely spinous distal edges. The dorsal (but not the dorsolateral) side of the fourth and following brachials is covered with fine short spines which gradually become coarser after the proximal third of the arm and tend to arrange themselves in longitudinal lines; segments of the division series and arm bases with strongly denticulate borders. Syzygies occur between the third and fourth brachials, again between the twenty-fifth and twenty-sixth to thirty-fifth and thirty-sixth (usually in the vicinity of the twenty-ninth), and distally at intervals of from five to seventeen (usually seven to ten) oblique muscular articulations.

$P_D$  12 mm. long, moderately stout in the proximal half but becoming slender distally, with about twenty segments, all of which are approximately as long as broad and the basal two-thirds of which are strongly carinate;  $P_1$  10 mm. long, similar to  $P_D$ , but less stout basally;  $P_2$  6 mm. long, much more slender than  $P_1$ , tapering evenly from the base to the tip, with fifteen segments, the proximal four or five squarish, then becoming longer than broad and about twice as long as broad terminally.  $P_3$  similar, 6 mm. long;  $P_4$  and following pinnules 5 mm. long with about thirteen segments, less slender distally than the preceding; the segments have slight overlapping spines developed on the distal edge along the dorsal crest; distal pinnules 10 mm. long, rather slender, with about twenty segments, the first short and crescentic, the second trapezoidal, about as broad distally as its median length, the following half again as long as broad, the terminal four or five disproportionately small; the dorsal crest is sharp and somewhat spinous.

The colour in spirits is brownish white; living specimens are bright yellow.

LOCALITY.—*Malay Archipelago*; 30 fathoms.—Two specimens.

OTHER RECORDS.—Philippine Islands.

DEPTH.—180 to 279 fathoms.

#### THALASSOMETRA MAGNICIRRA.

*Antedon magnicirra* 1905. BELL, Marine Investigations in South Africa, vol. 3, p. 141, pl. iv.

HABITAT.—South Africa.

DEPTH.—300–450 fathoms.

#### THALASSOMETRA RUSTICA.

*Crotalometra rustica* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 80.

DESCRIPTION.—Centrodorsal apparently as in *T. magnicirra*, with the cirrus sockets arranged in ten columns, two in each radial area.

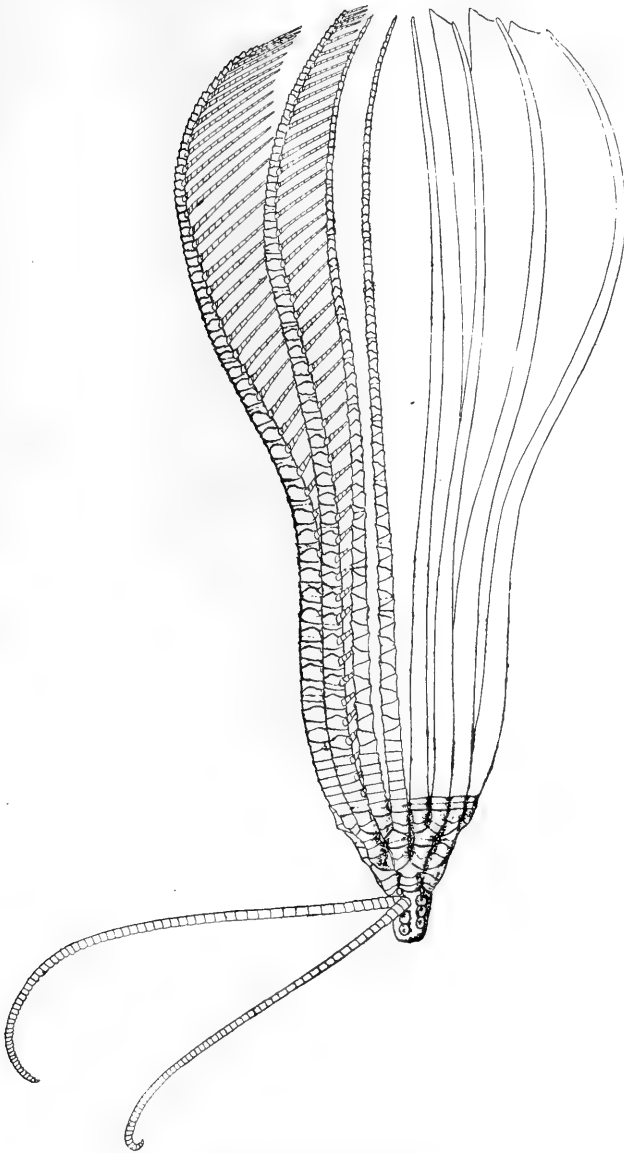


FIG. 36.—*Thalassometra rustica*.  
Lateral view of the type.

Cirri XX, about 70 (69 to broken tip), 85 mm. long, large and stout; first three segments subequal, about three times as broad as long, fourth slightly longer, fifth squarish or slightly longer than broad, the following segments about one third longer than broad, after the eighteenth becoming squarish, and after four or five more about twice as broad as long; eighteenth a transition segment; after the transition segment the dorsal surface of each segment gradually rises to a subterminal dorsal tubercle, which, however, never projects in the form of a spine; the tubercle is at first rather broad transversely and rounded dorsally, but distally it becomes narrower so that the dorsal surface of the segment becomes bluntly carinate. Viewed laterally the dorsal profile of the cirri presents a slightly serrate appearance.

Ends of the basal rays visible as prominent dorsoventrally elongated tubercles in the angles of the calyx; radials projecting very slightly beyond the edges of the centrodorsal;  $IBr_1$  very short, band-like, about five times as broad as long, convex proximally, concave distally, in close lateral apposition;  $IBr_2$  broadly pentagonal, half again as broad as long, all the sides strongly concave; the lateral edges of the two components of the  $IBr$  series taken together are evenly and strongly concave, the proximal width of the  $IBr_1$  and the distal width of the  $IBr_2$  being about the same; both these segments are sharply flattened laterally, with the apposed edges somewhat everted.  $IIBr 4(3+4)$ , very strongly rounded dorsally like the  $IBr$ , in close lateral apposition and sharply flattened, the lateral edges somewhat produced; the segments of this division series are proportionately rather long.

Twenty arms about 150 mm. long, deep and compressed, strongly rounded dorsally; first brachial very short, strongly concave anteriorly; second brachial much larger, with a posterior rounded process incising the first; third and fourth brachials (syzygial pair) about as long as broad, concave dorsally and laterally like the  $IIBr 3+4$ ; following brachials to the ninth wedge-shaped, half again as broad as long; following brachials triangular, about as long as broad, in the terminal portion of the arm becoming wedge-shaped and slightly longer. After the proximal third of the arm the brachials develop prominent and spinous distal ends and a striated dorsal surface. Syzygies occur between the third and fourth brachials, again between the fifteenth and sixteenth to nineteenth and twentieth, and distally at intervals of from four to nine oblique muscular articulations.

$P_D$  15 mm. long, large and stout in the basal half but tapering to a slender tip, with about twenty-five segments, the second-seventh broader than long, the remainder about as long as broad;  $P_1$  12 mm. long with twenty-three segments, much less stout than  $P_D$ , the outer segments somewhat spinous along their dorsal ridge;  $P_3$  7 mm. long, considerably more slender than  $P_2$ , tapering evenly from the base to the end of the proximal half, slender from there outward, with sixteen segments all but the first two of which are approximately squarish; following pinnules of about the same length but scarcely tapering at

all until near the tip, and hence appearing somewhat stouter; they are composed of about fourteen segments; distal pinnules moderately slender, 12 mm. long with twenty segments, the first trapezoidal, about twice as broad distally as its median length, the second trapezoidal, somewhat broader distally than the median length, the remainder slightly longer than broad; the dorsal ridge is very sharp and more or less spinous.

The colour in spirits is white.

LOCALITY.—*Malay Archipelago*; 30 fathoms.—One specimen.

REMARKS.—The single known specimen of this species is, unfortunately, badly broken, though it is possible to piece it together so that most of its characters may be made out.

There is a possibility that this is identical with *Th. magnicirra* described from South Africa by Professor Bell, but neither his diagnosis nor his figure is sufficiently accurate to admit of satisfactory comparison. He states that in *magnicirra* the centrodorsal bears "three or four vertical rows" of cirrus sockets, but his figure shows five in one half of the centrodorsal only; he says that the cirri "may be as much as 70 mm. long," but his detailed figure of a cirrus, according to the explanation of the plate, shows one 41 mm. long, while that on his drawing of the entire animal is 60 mm. long. He says further that "no pinnules are very long, but they are all stout," and figures them all as slender. There is figured "an arm from the side, showing the form of the plates and pinnules, as well as the remarkable subsidiary plates between the arm joints"; this figure is four times natural size and shows PP  $a-k$ , which are given as from 3 mm. to 4 mm. long (corrected); as his specimens are not much smaller, apparently, than the one under consideration (cirri 70 mm., arms 100 mm.) this would make these pinnules proportionately only about one half as long, and, judging from Mr. Berjeau's figure, this appears to be the case. It should be noticed that the portion of arm figured ( $\times 4$ ) is shown as 75 mm. long, while the same portion of an arm measured on the figure of the entire animal ( $\times 2$ ) is 47 mm. "The remarkable subsidiary plates" were long ago described by P. H. Carpenter. The pinnules in *magnicirra* are figured as arising in pairs from alternate brachials, an impossible arrangement, and, moreover, have a certain suppleness far removed from what is actually found in the Thalassometridæ. Professor Bell placed the species "next to *A. angustiradia*" (= *Adelometra angustiradia*; Antedonidæ) of Carpenter's "Savignyi group" in spite of its very obvious relations to Carpenter's "Granulifera group" (Thalassometridæ). The delineation of the pinnules of the inner side of the arm is misleading, as one naturally would consider them to be the outer pinnules if there is nothing said to the contrary, and would therefore obtain a very erroneous idea of the animal.

#### THALASSOMETRA SENTIFERA.

*Crotalometra sentifera* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 23, p. 147.

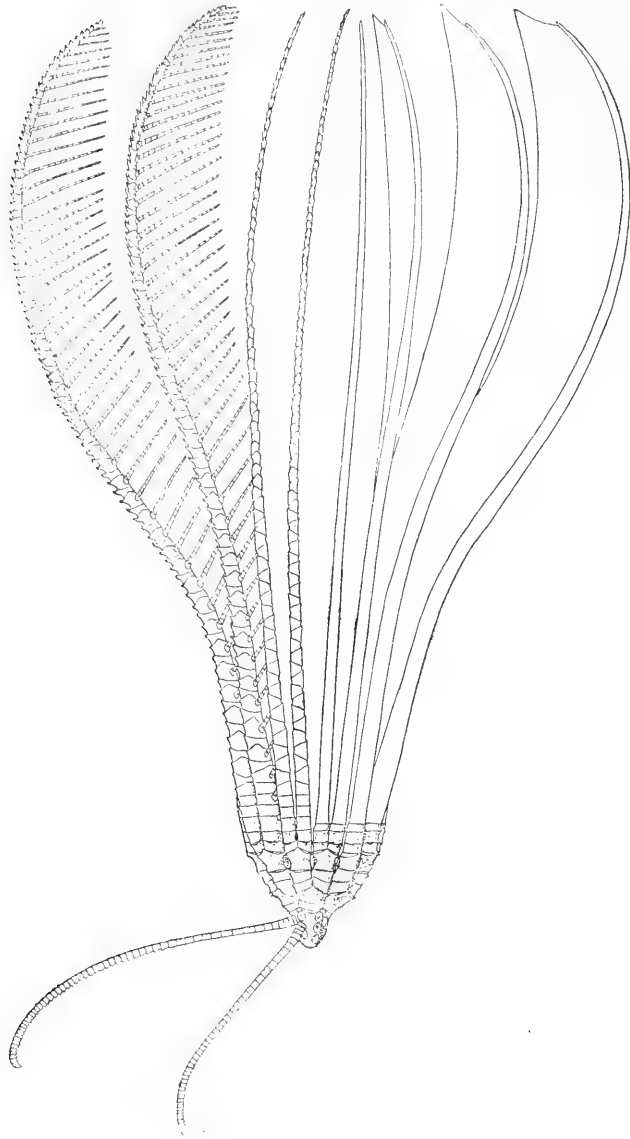


FIG. 37.—*Thalassometra sentifera*.  
Lateral view of the type.



DESCRIPTION.—This new form is most nearly related to *Th. magnicirra* and to *Th. rustica*; while of the same arm length or even somewhat larger than the latter (150 mm. to 160 mm. arm length) it is more slender, the arms are fewer in number (twelve to sixteen), the cirri are shorter and less stout, with fewer segments (XX, 59–62, 50 mm. long), and the brachials after the proximal third of the arm bear long overlapping spines which are more or less flattened dorso-ventrally and rounded or truncated at the tip.

The colour in spirits is light yellowish brown.

LOCALITY.—*Laccadive Islands* (10° 47' 45" N. lat., 72° 40' 20" E. long.; Station No. 124); 703 fathoms; large waterworn fragments of reef coral.—Two badly broken specimens.

#### THALASSOMETRA INFELIX.

*Crotalometra infelix* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 550.

HABITAT.—Philippine Islands.

DEPTH.—230 fathoms.

#### THALASSOMETRA GIGANTEA.

*Thalassometra gigantea* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 222.

HABITAT.—Hawaiian Islands.

DEPTH.—430–477 fathoms.

#### THALASSOMETRA HAWAIIENSIS.

*Antedon hawaiiensis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 152.

*Thalassometra hawaiiensis* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Hawaiian Islands.

DEPTH.—298–351 fathoms.

#### THALASSOMETRA VILLOSA.

*Antedon villosa* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 138.

*Thalassometra villosa* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Western Aleutian Islands, Territory of Alaska.

DEPTH.—1046 fathoms.

#### THALASSOMETRA AGASSIZII.

*Antedon agassizii* 1895. HARTLAUB, Bull. Mus. Comp. Zoöl., vol. 28, No. 4, p. 131, pl. i, figs. 4, 7, 8; pl. ii, figs. 16, 18, 19; pl. iii, fig. 23.

*Thalassometra agassizii* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly issue), vol. 50, part 3, p. 360.

HABITAT.—Galápagos Islands.

DEPTH.—327–782 fathoms.

#### THALASSOMETRA ATTENUATA.

*Thalassometra attenuata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 147.

DESCRIPTION.—Centrodorsal conical, the sides slightly convex, 3 mm. broad at the base and 2 mm. high, the cirrus sockets arranged in ten columns of usually two each, the pairs of columns usually slightly separated radially by a shallow furrow or a coarsely tubercular ridge.

Cirri XX, 62–71, elongated and very slender, 50 mm. long, the longest segments being twice as long as broad or slightly longer, those after about the twenty-fifth being slightly broader than long; the segments after the seventeenth or twentieth have the distal dorsal edge produced into a serrate ridge which soon gives place to small carinate dorsal spines.

Ends of the basal rays visible as small, though rather prominent, tubercles in the angles of the calyx; radials just visible, or entirely concealed, sometimes bearing on the dorsal surface a row of small tubercles; IBr<sub>1</sub> very short, widely chevron-shaped, the proximal and outer thirds of the distal edge somewhat everted and the distal lateral angles more or less produced; IBr<sub>2</sub> triangular, twice as broad as long, the anterior edges somewhat everted, the lateral angles more or less produced; IIBr 4 (3+4), developed in two out of six specimens, the lateral edges of the component ossicles more or less produced.

Ten to thirteen arms 80 mm. to 90 mm. long, exceedingly slender, having in general more the appearance of those of some slender antedonid than of those of a thalassometrid; first brachial short, wedge-shaped, twice as long exteriorly as interiorly, basally united interiorly, the anterior and posterior edges slightly thickened, the lateral edges somewhat produced, and the anterolateral angles, both interior and exterior, more or less produced; second brachial similar in size and shape; third and fourth brachials (syzygial pair) usually slightly longer interiorly than exteriorly, half again as broad as to about as broad as long; next three or four brachials approximately oblong, twice as broad as long, then becoming triangular, as long as broad, distally slowly increasing in length and becoming wedge-shaped, being twice as long as broad in the outer part of the arm; synarthrial tubercles rather prominent; IBr series and first two brachials smooth dorsally or with a few small low inconspicuous tubercles, usually with slightly spinous lateral borders; following brachials with the dorsal surface studded with very fine short spines or sharp tubercles which in some specimens are nearly obsolete; at about the end of the proximal fourth of the arm the brachials begin to develop prominent longitudinal striations which increase in frequency and height

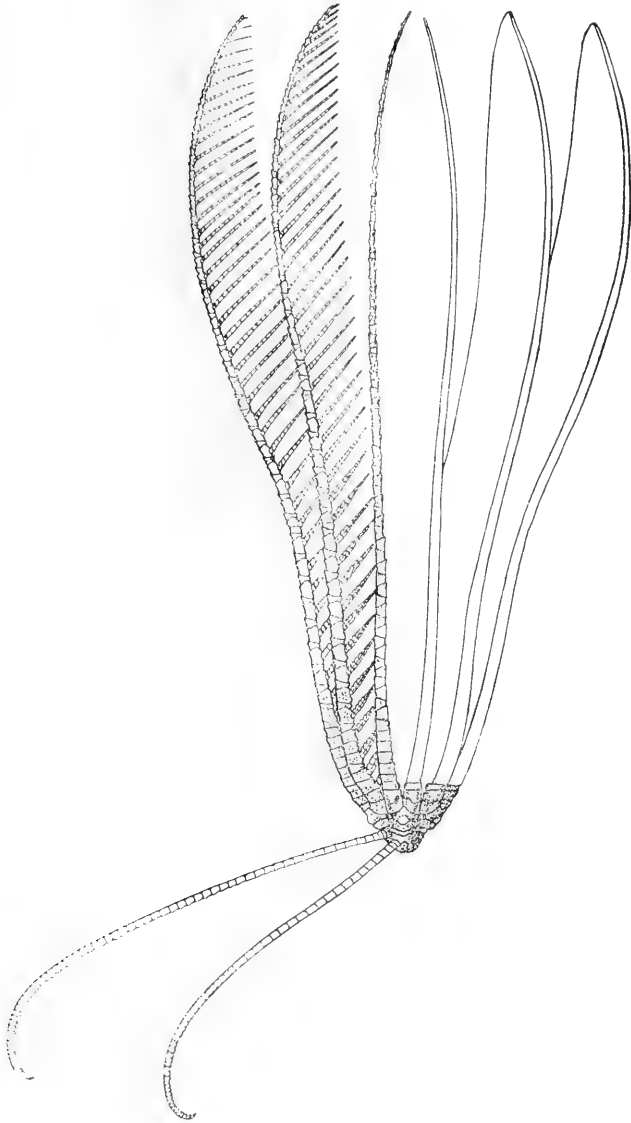


FIG. 38.—*Thalassometra attenuata*.  
Lateral view of the type.

distally. The proximal oblong brachials have the proximal and distal ends somewhat prominent; after about the twentieth brachial the distal edges begin to overlap, and in the distal portion of the arm the brachials have the distal part somewhat expanded, giving approximately the same "dice-box" appearance which is characteristic of the terminal portion of the arms among the Antedonidæ.

The pinnules are essentially as in the related species of the genus; the first three pinnules on each side (PP<sub>1-3</sub>, *a-c*) are very strongly carinate.

The colour in spirits is white, the perisome, and sometimes the IBr series and arm bases, light brownish.

LOCALITY.—*South of Kurrachi* (22° 24' 00" N. lat., 66° 51' 30" E. long.); 765 fathoms; bottom temperature 43° Fahr.; green mud.—Six specimens.

#### THALASSOMETRA ASTER.

*Antedon aster* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 145.

*Thalassometra aster* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Southern Japan.

DEPTH.—369–405 fathoms.

#### THALASSOMETRA HIRSUTA.

*Thalassometra hirsuta* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 552.

HABITAT.—Philippine Islands.

DEPTH.—117–383 fathoms.

#### THALASSOMETRA MARGINATA, sp. nov.

DESCRIPTION.—Centrodorsal truncated conical, the sides slightly convex, 3.5 mm. broad at the base, 1.5 mm. broad at the dorsal pole and 2.5 mm. long interradially; the dorsal pole is covered with long coarse tubercles; the cirrus sockets are arranged in ten columns of two each which are in close lateral contact exteriorly, but which are separated in the midradial line by an irregularly wedge-shaped smooth area which at its base (proximally) is not quite so wide as a single cirrus socket, and comes to a point between the distal sockets, which are nearly or quite in apposition.

Cirri moderately stout. XX, 34-46, about 40 mm. long; the sixth or seventh is a transition segment; the longest proximal segment is from two to two-and-one-half times as long as broad.

The ends of the basal rays are visible in the angles of the calyx; the subradial clefts are shallow and broad.

IBr, short, about four and one-half times as broad as long, with the proximal and distal edges prominently everted and armed with about six or eight irregular coarse dentations which have numerous fine spines at their tips;

IBr<sub>3</sub> roughly rhombic with the lateral angles truncated and all the sides concave; the lateral edges are nearly as long as those of the IBr<sub>1</sub>; the proximal and distal edges are everted, the proximal resembling the distal edge of the IBr<sub>1</sub>, the distal with a more regular finely spinous margin; the ossicles of the IBr series are in close lateral apposition and are narrowly "wall-sided"; their lateral edges are perfectly plain, without spines or tubercles.

Ten arms, all broken off at the first syzygy, between the third and fourth brachials. In shape the brachials resemble those of the other ten-armed species of the genus; they are perfectly smooth, with no trace of spines or of median carination; the proximal and distal edges are slightly thickened and everted, with a few small spines or tubercles.

LOCALITY.—"Investigator" Station 218; Maldive Islands; 210 fathoms.—One specimen, very fragmentary.

REMARKS.—This new species is related to *Th. hawaiiensis* and to *Th. hirsuta*; from the former it differs in the much smaller centrodorsal, in the smaller number of cirrus segments, of which the proximal are much longer, in the shorter ossicles of the IBr series, which are in close lateral contact without intervening radial water pores, and in the eversion of the edges of the ossicles of the IBr series and of the earlier brachials, these in *Th. hawaiiensis* being armed with large coarse blunt scattered spines, though not as a whole turned outward; there are no spines on the dorsal surface of the ossicles in *Th. marginata* such as occur, though sparingly, in *Th. hawaiiensis*. From *Th. hirsuta* this new form differs in the very large and coarse instead of fine tubercles on the dorsal pole of the centrodorsal, in the smoothness of the wedge-shaped area separating the columns of cirrus sockets proximally, in the fewer cirrus segments, of which the longest are somewhat shorter, and in the much less and more coarsely spinous edges to the ossicles, as well as in the entire absence of a median carination and of spines on the dorsal surface of the ossicles of the IBr series and lower brachials.

#### THALASSOMETRA PUBESCENS.

*Antedon pubescens* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 139.

*Thalassometra pubescens* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Southern Japan.

DEPTH.—440 fathoms.

#### THALASSOMETRA PERGRACILIS.

*Antedon gracilis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 62, Zoölogy, p. 107, pl. xii, figs. 3-5; pl. xv, figs. 1-4.

*Thalassometra pergracilis* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

LOCALITY.—About 30 miles west of Middle Andaman; about 485 fathoms.—One mutilated specimen, agreeing well with Carpenter's description and figures. The centrodorsal is rounded conical, 4 mm. broad at the base and 3 mm. high; the cirrus sockets are arranged in ten columns, two to each radial area, those of each radial area being separated interiorly by a rather strong ridge, exteriorly in close apposition with the columns of adjacent radial areas; the dorsal pole is rough, covered with irregular tubercles; the disk is almost entirely covered with small rounded concretions; the disk ambulacra are bordered with similar, but somewhat smaller and more thickly set, plates which become radially elongated about the mouth; the perisome of the arms is covered with small round concretions, and the interbrachial perisome with large flat plates.

OTHER RECORD.—Off the Meangis Islands.

DEPTH.—500 fathoms.

#### THALASSOMETRA ECHINATA.

*Antedon echinata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 119, pl. xxi, figs. 4, 5.

*Thalassometra echinata* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Kermadec Islands.

DEPTH.—630 fathoms.

#### THALASSOMETRA LATIPINNA.

*Antedon latipinna* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 116, pl. x, fig. 3.

*Thalassometra latipinna* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Southern Japan.

DEPTH.—345 fathoms.

#### THALASSOMETRA BISPINOSA.

*Antedon bispinosa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 115, pl. xx, figs. 3, 4.

*Thalassometra bispinosa* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 360.

HABITAT.—Off the Crozet Islands.

DEPTH.—1600 fathoms.

#### THALASSOMETRA sp.

LOCALITY.—Northwest of Sokotra (14° 20' N. lat., 52° 30' E. long.).

DEPTH.—1200 fathoms.

REMARKS.—In the British Museum there is a badly broken specimen of a new

species of *Thalassometra* which was found upon a submarine cable raised by the cable repair ship "Electra" on July 10, 1909. Only the central portion of the animal remains; it is a very spinous form, the long spines on the calyx and arm bases resembling those seen in *Thalassometra bispinosa*.

Genus CROTALOMETRA.

*Crotalometra* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 403 (*Crotalometra eupedata*, sp. nov.).

CROTALOMETRA EUPEDATA.

*Crotalometra eupedata* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 404.

HABITAT.—Philippine Islands.

DEPTH.—494 fathoms.

CROTALOMETRA PROPINQUA.

*Crotalometra propinqua* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 549.

HABITAT.—Philippine Islands.

DEPTH.—340 fathoms.

CROTALOMETRA VALIDA.

*Antedon valida* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy p. 104, pl. xv, figs. 5-8.

*Crotalometra valida* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 404.

HABITAT.—Off the Meangis Islands.

DEPTH.—500 fathoms.

CROTALOMETRA INCERTA.

*Antedon incerta* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 106, pl. xviii, figs. 4, 5.

*Crotalometra incerta* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 404.

Genus STENOMETRA.

*Stenometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 14 (*Antedon quinquecostata* P. H. Carpenter, 1888).

STENOMETRA QUINQUECOSTATA.

*Antedon quinquecostata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 215, pl. iii, figs. 6 *a-d*; pl. xxxviii, figs. 1-3.

*Stenometra quinquecostata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 15.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

#### STENOMETRA DORSATA.

*Thalassometra quinquecostata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 310.

*Stenometra dorsata* 1909. A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 186.

HABITAT.—Southern Japan.

DEPTH.—80–170 fathoms.

#### STENOMETRA CRISTATA.

*Stenometra cristata* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 553.

HABITAT.—Philippine Islands.

DEPTH.—117 fathoms.

#### STENOMETRA DIADEMA.

*Antedon diadema* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 144.

*Stenometra diadema* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 15.

HABITAT.—Southern Japan.

DEPTH.—103–152 fathoms.

#### STENOMETRA HANA.

*Antedon hana* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 137.

*Stenometra hana* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 15.

HABITAT.—Southern Japan.

DEPTH.—107–139 fathoms.

#### Genus STIREMETRA.

*Stiremetra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 15 (*Antedon acutiradia* P. H. Carpenter, 1888).

#### STIREMETRA SPINICIRRA.

*Antedon spinicirra* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 112, pl. xi, figs. 1, 2.

*Stiremetra spinicirra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 15.

HABITAT.—Off New South Wales.

DEPTH.—950 fathoms.



## STIREMETRA ACUTIRADIA.

*Antedon acutiradia* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 113, pl. xi, figs. 3, 4.

*Stiremetra acutiradia* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 15.

HABITAT.—Off Fiji.

DEPTH.—1350 fathoms.

## STIREMETRA BREVIRADIA.

*Antedon radiospina* 1883. VON GRAFF, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, p. 133 (*nomen nudum*).

*Antedon breviradia* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 110, pl. iii, figs. 4, 5; pl. xi, fig. 5; pl. xix; pl. xx, figs. 1, 2.

*Antedon eversa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, pl. iii, fig. 5.

*Stiremetra breviradia* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 15.

HABITAT.—Off the Kermadec Islands.

DEPTH.—630 fathoms.

## STIREMETRA CARINIFERA, sp. nov.

DESCRIPTION.—Centrodorsal large and columnar, the sides practically parallel, 5 mm. in diameter and 3.5 mm. high interradially. The cirrus sockets are arranged in ten columns, which are segregated in five pairs; there are three or four cirrus sockets to a column. The two columns of each pair are separated by a narrow ridge of moderate height; the pairs, which are interradial in position, are separated in the midradial line by deep V-shaped furrows as broad as the adjacent cirrus sockets; the central groove of these furrows is slightly rounded off. The dorsal pole of the centrodorsal is flattened, but the surface is more or less irregular.

Owing to the depth of the midradial furrows on the centrodorsal the subradial clefts are practically obsolete, only their inner ends being visible as very narrow and very shallow grooves.

Cirri XXXV, 50-64 (usually 57 or 58) 45 mm. to 50 mm. long; the seventh or eighth (usually the latter) is a transition segment; the first segment is very short, the following gradually increasing in length and becoming about as long as broad on the fifth and nearly or quite twice as long as broad on the eighth (transition segment); the following segments gradually decrease in length, becoming about as long as broad on the twelfth or thirteenth and after the twenty-fifth about twice as broad as long. On the second after the transition segment prominent median terminal spines begin to appear; these gradually come to

involve more and more of the dorsal surface of the segments, which become carinate, so that after the twenty-third the dorsal profile (in lateral view) is straight and parallel to the longitudinal axis of the cirrus as a whole; in the next four to seven segments a shallow rounded notch is developed in this straight dorsal profile, so that the segments appear to have both a proximal and a distal spine; beyond this point the dorsal processes are of the high strongly carinate type common to the other species of the genus.

Ends of the basal rays visible in the angles of the calyx, just over the ridges separating the individual columns of cirrus sockets in the interradial pairs, as small dorsoventrally elongate tubercles; radials almost entirely concealed; they bear on their apposed edges, just over the ends of the basal rays, two tubercles or blunt spines, one on each radial.  $IBr_1$  extremely short, six or more times as broad as long, chevron-shaped, with both the anterior and the posterior edges prominently everted, smooth, somewhat wavy, or coarsely tubercular; in the middorsal line there is a prominent median rounded carination. The arms are lost beyond this point.

LOCALITY.—“*Investigator*” Station 232; 430 fathoms.—Two specimens.

REMARKS.—This appears to be a very distinct species. Its large cirri with numerous segments resemble those of *S. arachnoides*; but the centrodorsal is very much larger and the columns of cirrus sockets are segregated into widely separated pairs instead of being closely crowded; the ossicles of the calyx and arm bases also lack the spinous edges and the high median carinate processes so characteristic of that form. The small centrodorsal of *S. spinicirra*, which is hemispherical or bluntly conical with no differentiation into areas, as well as the short cirri with few segments, each of which bears a spine, at once differentiate that species. *S. acutiradia* has also a very small centrodorsal with only about fifteen cirrus sockets which do not appear to be grouped in any way. *S. breviradia* has cirri with from forty to fifty segments, “or a few more”; but the centrodorsal is of the type found in *S. arachnoides*, quite different from that in the species under consideration. It is probable, however, that this is the species to which *S. cariniifera* is most closely allied.

A smaller specimen found with the type appears to represent a younger stage of the same species. The cirri are about 40 mm. long, and have from 54 to 58 segments of which the sixth is a transition segment; the centrodorsal is truncated conical, 3.5 mm. in diameter at the base and 1.5 mm. at the dorsal pole, and 3 mm. high, measured along the inclination of the sides; the dorsal pole is covered with short spines; in general the centrodorsal is as in the other larger specimen, but, owing to its conical shape, the midradial furrows converge distally. The ends of the basal rays are rather more prominent than in the other specimen; the radials are smooth, without the lateral spines; the  $IBr_1$  have scarcely a trace of the eversion of their edges, but possess a higher and sharper median keel, and usually also a sharp tubercle on their distal border about one-third of the distance between the distal lateral angle and the median line. The

$I\text{Br}_2$  (axillaries), which are missing in the other specimen, are approximately triangular (though probably shield-shaped as in the other species of the genus when fully grown), twice as broad as long, with a high sharp carination in the proximal two-thirds of the median line, and with everted and spinous distal edges.

On one of the rays the  $I\text{Br}_3$  is not axillary as usual, but bears a pinnule, which is essentially similar to  $P_1$  in *S. arachnoides*; the second segment beyond this is axillary; there is no carination beyond the first pinnule. Only two axillaries are preserved, both detached; one has lost both derivatives at the first post-axillary articulation, the other bears on one side one and on the other side three brachials.

#### STIREMETRA ARACHNOIDES.

*Stenometra arachnoides* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 402.

HABITAT.—Queensland; Philippine Islands.

DEPTH.—Littoral, and down to 12 fathoms.

#### Genus PARAMETRA.

*Parametra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 15  
(*Antedon orion* A. H. Clark, 1907).

#### PARAMETRA COMPRESSA.

*Antedon compressa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 222, pl. xli.

*Parametra compressa* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 16.

HABITAT.—Ki and Philippine Islands.

DEPTH.—97–279 fathoms.

#### PARAMETRA ORION.

*Antedon orion* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 143.

*Parametra orion* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 16.

HABITAT.—Southern Japan and southward to Formosa (Taiwan).

DEPTH.—85–170 fathoms.

#### PARAMETRA FISHERI.

*Thalassometra fisheri* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 223.

*Parametra fisheri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22** p. 16.

HABITAT.—Hawaiian Islands.

DEPTH.—192-352 fathoms.

PARAMETRA ALBOFLAVA.

*Antedon alboflava* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 145.

HABITAT.—Southern Japan.

DEPTH.—103 fathoms.

Genus COSMIOMETRA.

*Cosmiometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 16  
(*Thalassometra komachi* A. H. Clark, 1908).

COSMIOMETRA WOODMASONI.

*Antedon woodmasoni* 1893. BELL, Journ. Linn. Soc. (Zool.), vol. 24, p. 340, pl. xxiii.

*Cosmiometra woodmasoni* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 17.

HABITAT.—Sahul Bank (north of Australia).

REMARKS.—The arms are 110 mm. long. In general this species is much like *C. crassicirra* from the Hawaiian Islands; the division series are strongly, though roundedly, carinate. The cirri are comparatively short and stout with 40 or 41 segments of which the seventh is a transition segment; they measure 27 mm. in length.

COSMIOMETRA GARDINERI.

*Cosmiometra gardineri* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 38.

HABITAT.—Saya de Malha.

DEPTH.—135 fathoms.

COSMIOMETRA KOMACHI.

*Thalassometra komachi* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 311.

*Cosmiometra komachi* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 17.

HABITAT.—Southern Japan.

COSMIOMETRA CONIFERA.

*Antedon conifera* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 173.—1891. Nova Acta Acad. German., vol. 58, No. 1, p. 76, pl. 4, fig. 46; pl. 5, figs. 51, 56.

HABITAT.—Southern Japan.

DEPTH.—“Deep water.”

#### COSMIOMETRA CRASSICIRRA.

*Thalassometra crasscirra* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 225.

*Cosmiometra crasscirra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 17.

HABITAT.—Hawaiian Islands.

DEPTH.—136–355 fathoms.

#### COSMIOMETRA DELICATA.

*Thalassometra delicata* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 225.

*Cosmiometra delicata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 17.

HABITAT.—Hawaiian Islands.

DEPTH.—319 fathoms.

#### COSMIOMETRA PHILIPPENENSIS.

*Cosmiometra philippenensis* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 548.

HABITAT.—Philippine Islands.

DEPTH.—230–340 fathoms.

#### Family CHARITOMETRIDÆ.

*Charitometrinae* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, pp. 2, 18.

#### Genus PACHYLOMETRA.

*Pachylometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 20 (*Antedon distincta* P. H. Carpenter, 1888).

#### PACHYLOMETRA SEPTENTRIONALIS.

*Charitometra distincta* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 312.

*Pachylometra septentrionalis* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 554.

HABITAT.—Southern Japan.

DEPTH.—?

## PACHYLOMETRA DISTINCTA.

*Antedon distincta* 1888. P. H. CARPENTER "Challenger" Reports, vol. **26**, Zoölogy, p. 247, pl. li, fig. 1.

*Pachylometra distincta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 21.

HABITAT.—Philippine Islands.

DEPTH.—279–423 fathoms.

## PACHYLOMETRA ANGUSTICALYX.

*Antedon angusticalyx* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 242, pl. ii, figs. 4 *a-d*; pl. l, figs. 1, 2; fig. 5B, p. 246.

*Pachylometra angusticalyx* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 21.

HABITAT.—Meangis Islands.

DEPTH.—500 fathoms.

## PACHYLOMETRA INÆQUALIS.

*Antedon inæqualis* 1888. P. H. CARPENTER, "Challenger" Reports vol. **26**, Zoölogy, p. 244, pl. ii, figs 5 *a-d*; pl. li, fig. 2; fig. 5A, p. 246.

*Pachylometra inæqualis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 21.

HABITAT.—Fiji.

DEPTH.—Between 210 and 610 fathoms.

## PACHYLOMETRA SCLATERI.

*Antedon sclateri* 1905. BELL, Marine Investigations in South Africa, vol. **3**, p. 140, pl. iii.

*Pachylometra sclateri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 21.

HABITAT.—South Africa.

DEPTH.—250–300 fathoms.

## PACHYLOMETRA INVESTIGATORIS.

*Pachylometra investigatoris* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 82.

DESCRIPTION.—Centrodorsal a truncated cone, 7 mm. broad at the base and 5 mm. high, the cirrus sockets arranged in two columns of from three to five each in each radial area, the two columns of each area separated by a narrow median line not quite so broad basally as the cirrus sockets, distally narrowing and ending

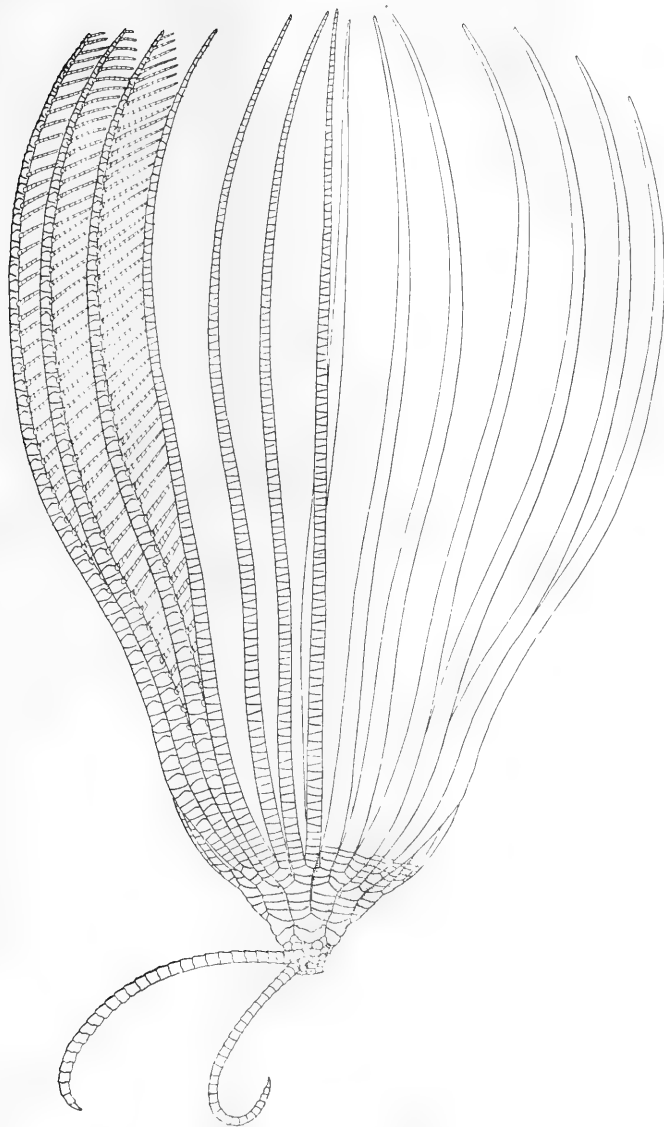


FIG. 39.—*Pachylometra investigatoris*.  
Lateral view of the type.

in a point at about the level of the third or fourth cirrus socket; the columns of each radial area are closely crowded against, and tend to alternate with, the columns of the adjacent areas.

Cirri XL, 25-26, about 40 mm. long; first segment very short, second and third equal in size, about twice as broad as long, fourth slightly longer, fifth as long as broad; sixth, seventh, and eighth segments the longest, slightly longer than broad to about one third again as long as broad, the following very gradually decreasing in length so that those in the distal half are about as long as broad or, in some cases, slightly broader than long; third segment from the distal end of the cirrus slightly longer than broad; antepenultimate segment about one-third longer than broad; penultimate segment, which is somewhat less in diameter than the preceding, half again as long as broad; the distal dorsal edges of the outer segments show an inclination to develop low blunt tubercles; opposing spine represented by a small blunt tubercle, terminally situated; terminal claw long, about as long as the penultimate segment, moderately curved. The cirri are rounded basally but moderately compressed in the distal two-thirds; there is no trace of dorsal carination.

Disk completely covered by a pavement of small plates; side and covering plates strongly developed along the pinnule ambulacra.

Ends of the basal rays visible as large rhombic tubercles in the angles of the calyx; radials concealed; IBr<sub>1</sub> short, four or five times as broad as long, chevron-shaped, in close lateral apposition, with a more or less wavy proximal and distal border; the apposed edges are somewhat thickened and produced and there are a few low broad tubercles on the distal border; IBr<sub>2</sub> rhombic, twice as broad as long, rising to a rather sharp dorsoventrally elongate tubercle with the IBr<sub>1</sub>; IIBr 4 (3+4); on three of the IIBr series the syzygy between the two outer elements is replaced by a synarthry; IIIBr 2 (1+2), developed interiorly. The division series are very strongly rounded dorsally and have a slightly indicated median carination; they are in very close lateral apposition and the lateral edges are slightly produced and everted, suggesting the conditions found in *Glyptonetra*.

Thirty-two arms (in the type) 150 mm. long; first two or four brachials oblong, short, united in syzygial pairs which are not quite so long as broad; following two or three brachials oblong, somewhat over twice as broad as long, then becoming wedge-shaped, twice as broad as long, and slightly longer and more oblique after the proximal third of the arm, when the brachials develop slightly prominent distal ends.

P<sub>D</sub> 17 mm to 20 mm. long, very slender and flagellate distally, with from fifty to fifty-three segments; first two segments disproportionately large, twice as broad as long, strongly flattened exteriorly; third segment about half as broad as the first and half as long as the second, twice as broad as long; following segments to the fifteenth decreasing in diameter and increasing in length, at first twice broad as long but becoming after the fifteenth uniformly small and about as long as broad; P<sub>1</sub> about the same length with forty-five segments, similar, but much



less stout basally and not tapering so rapidly;  $P_2$  13 mm. long with about thirty segments, about as stout basally as the preceding pinnules but tapering much more gradually, the first eight segments about three times as broad as long, then gradually becoming longer, and squarish about the eighteenth, and in the terminal portion longer than broad;  $P_3$  about 15 mm. long, and  $P_4$  16 mm. or 17 mm. long, resembling  $P_2$ ;  $P_5$  similar, 13 mm. long;  $P_6$  similar, and of the same length;  $P_7$  and the following pinnules 12 mm. long, with the segments in the proximal two thirds slightly expanded laterally; in the course of the next four or five the pinnules decrease in length to 8 mm., while the expansion of the segments becomes more pronounced, beginning on the second, reaching a maximum on the fourth or fifth, then gradually dying away distally; distal pinnules stout, as in the other species of the genus, 10 mm. long.

The colour in spirits is yellowish brown.

LOCALITY.—Malay Archipelago.

DEPTH.—30 fathoms.—One specimen.

#### PACHYLOMETRA LUNA.

*Pachylometra luna* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 556.

HABITAT.—Philippine Islands.

DEPTH.—224 fathoms.

#### PACHYLOMETRA SELENE.

*Pachylometra selene* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 556.

HABITAT.—Philippine Islands.

DEPTH.—230 fathoms.

#### PACHYLOMETRA FLEXILIS.

*Antedon flexilis* 1888. P. H. CARPENTER "Challenger" Reports, vol. 26, Zoölogy, p. 217, pl. xlii

*Pachylometra flexilis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 21.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

#### PACHYLOMETRA PATULA.

*Antedon patula* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 219, pl. xliii.

*Pachylometra patula* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 21.

HABITAT.—Ki Islands; Sahul Bank; Philippine Islands.

DEPTH.—58-140 fathoms.

## PACHYLOMETRA ROBUSTA.

*Antedon robusta* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 220, pl. xlv, fig. 1.

*Pachylometra robusta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 21.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

## PACHYLOMETRA SMITHI.

*Charitometra smithi* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 227.

*Pachylometra smithi* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 21.

HABITAT.—Philippine Islands.

DEPTH.—200-375 fathoms.

## PACHYLOMETRA INVENUSTA.

*Pachylometra invenusta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 149.

DESCRIPTION.—This species is in general similar to *P. macilenta*, but differs in many details.

Cirri XXIII, 20-21, 30 mm. to 34 mm. long, rather slender, like those of *P. macilenta*; the proportions of the component segments are the same as in that species, but the distal edges of the segments are slightly more thickened, giving the cirri as a whole a somewhat rougher appearance.

Twelve arms (in the type) 170 mm. long, slender, as in *P. macilenta*; the two IBr series are 4 (3+4); the ornamentation of the IBr and IIBr series is essentially as in *P. macilenta*; elements of the IBr series and IIBr series, first two brachials exteriorly and first three interiorly, in close apposition and sharply flattened laterally, the apposed edges somewhat everted; brachials with the same proportions as those of *P. macilenta*, but the proximal subquadrangular brachials have the distal ends thickened and everted, and the remaining brachials have rather prominently overlapping distal edges. The distal intersyzygial interval is four or five oblique muscular articulations.

The pinnules resemble those of *P. macilenta*, but the genital pinnules are somewhat more swollen than are those of that species.

The colour in spirits is dull yellowish white.

LOCALITY.—Off South Andaman Island (11° 46' 30" N. lat., 93° 16' 00" E. long.) 569 fathoms; bottom temperature 40° Fahr.; green mud and foraminiferal ooze.—One specimen.

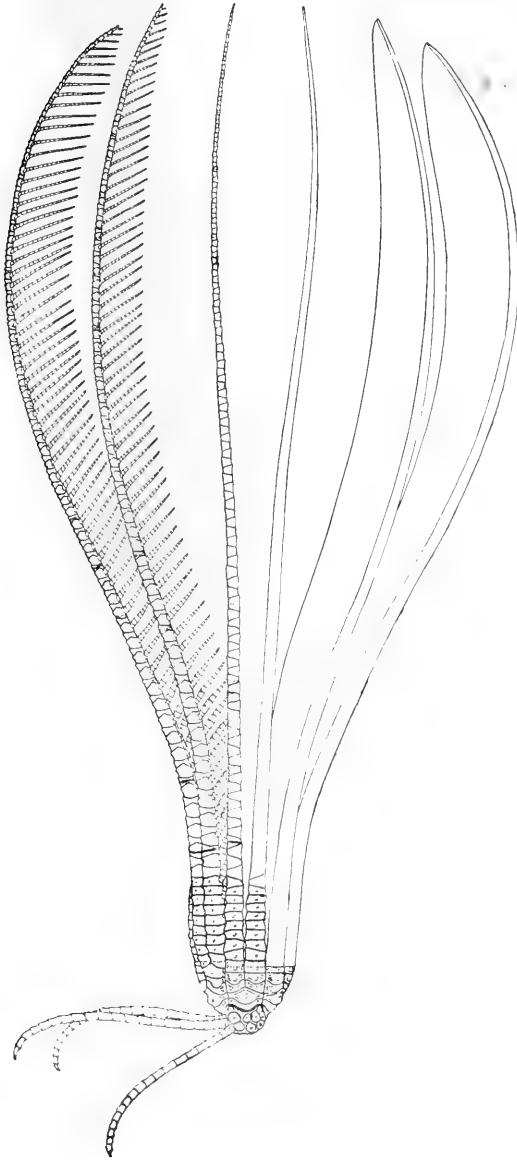


FIG. 40.—*Pachylometra invenusta*.  
Lateral view of the type.

## PACHYLOMETRA MACILENTA.

*Pachylometra macilenta* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 81.

DESCRIPTION.—Centrodorsal a short truncated cone, moderately large, the bare polar area flat, 2.5 mm. in diameter; cirrus sockets arranged in ten columns of usually two each, the columns of adjacent radial areas closely crowded and more or less alternating, those within the same radial area usually slightly separated anteriorly.

Cirri XX, 21—22, 25 mm. to 36 mm. long, comparatively long and slender; first segment very short, second twice as broad as long, third about as long as broad, the following gradually increasing in length to the sixth, which is about half again as long as broad; next two or three segments similar, the following very gradually decreasing in length, those in the terminal third of the cirrus being about as long as broad; antepenultimate segment about one third longer than broad; penultimate segment half again as long as broad, slightly less in diameter than the preceding; opposing spine very small, though prominent, terminally situated, directed obliquely forward; terminal claw about as long as the penultimate segment, stout basally, but becoming slender in the distal half, moderately curved. The cirri are moderately compressed in the distal two thirds; the two or three segments before the penultimate have slight traces of terminal dorsal tubercles.

Disk covered with a pavement of very small plates; side and covering plates well developed along the ambulacra.

Ends of the basal rays visible as large rhombic tubercles in the angles of the calyx; radials only visible as a large transversely oval tubercle between the centrodorsal and the IBr<sub>1</sub>; IBr<sub>1</sub> very short, arcuate, in close lateral apposition, the proximal edge more or less crenulate and bearing a large and rather high transversely oval median tubercle; IBr<sub>2</sub> rhombic, very short, somewhat over twice as broad as long, the edges somewhat crenulate and somewhat produced, the proximal imbricating more or less over the anterior border of the IBr<sub>1</sub>; the lateral edges are very short, in close apposition; it bears a rather large and high rounded median tubercle; IBr 4 (3+4), in close lateral apposition and sharply flattened, with the lateral edges slightly everted; the distal edge of the IBr<sub>1</sub> is somewhat everted, and the proximal edge of the IBr<sub>2</sub> more strongly everted, the latter imbricating over the former except in the median line; the IBr<sub>1</sub> usually bears a strong rounded median tubercle like that on the two components of the IBr series.

Thirteen arms (in the type) 170 mm. long, elongated and comparatively slender, resembling those of *P. robusta*.

The pinnules in general resemble those of *P. robusta*; the pinnules in the proximal part of the arm are strongly carinate.

The colour in spirits is white.

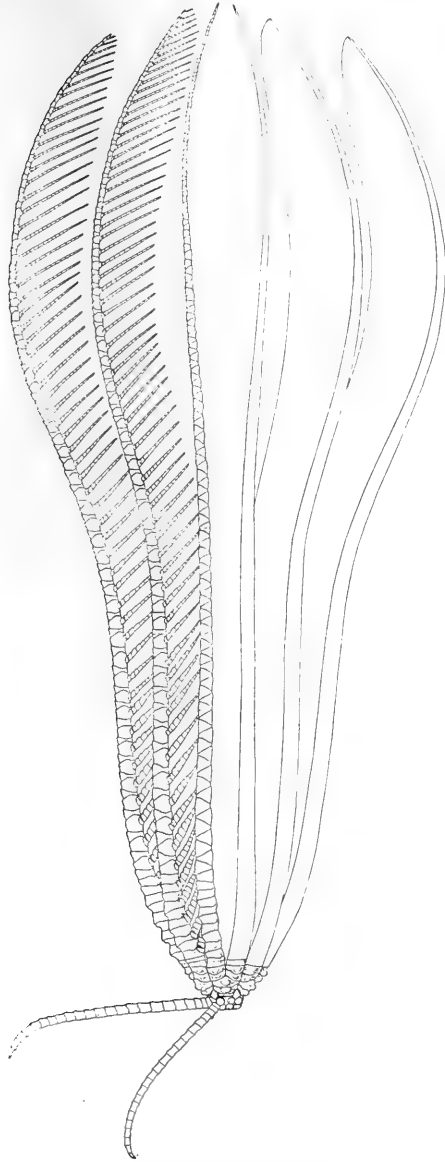


FIG. 41.—*Pachylometra macilenta*.  
Lateral view of the type.

LOCALITY.—*Laccadive Islands* ( $10^{\circ} 47' 45''$  N. lat.,  $72^{\circ} 40' 20''$  E. long.); 705 fathoms.—One specimen.

PACHYLOMETRA LEVIGATA.

*Pachylometra levigata* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 406.

HABITAT.—Philippine Islands.

DEPTH.—494 fathoms.

PACHYLOMETRA sp.

LOCALITY.—*Northwest of Sokotra* ( $14^{\circ} 20'$  N. lat.,  $52^{\circ} 30'$  E. long.).

DEPTH.—1200 fathoms.

REMARKS.—The cable repair ship "Electra" obtained a specimen of a large new species of *Pachylometra* which was adhering to a submarine cable raised at the above locality, on July 10, 1909. The specimen has twelve arms, the IIBr series being 4 (3+4). The cirri are long and fairly smooth.

Genus GLYPTOMETRA.

*Glyptometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 18 (*Antedon tuberosa* P. H. Carpenter, 1888).

GLYPTOMETRA TUBEROSA.

*Antedon tuberosa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 126, pl. xiv, fig. 9; pl. xxiii, fig. 2.

*Glyptometra tuberosa* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 19.

HABITAT.—Philippine Islands.

DEPTH.—51-423 fathoms.

GLYPTOMETRA LATERALIS.

*Charitometra lateralis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 226.

*Glyptometra lateralis* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 19.

HABITAT.—Hawaiian Islands.

DEPTH.—319-451 fathoms.

GLYPTOMETRA LATA.

*Antedon lata* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 129.

*Glyptometra lata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 19.

HABITAT.—Southern Japan.

DEPTH.—361 fathoms.

## Genus CHLOROMETRA.

*Chlorometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 21  
(*Antedon garrettiana* A. H. Clark, 1907).

## CHLOROMETRA GARRETTIANA.

*Antedon garrettiana* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 142.  
*Chlorometra garrettiana* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
p. 22.  
HABITAT.—Southern Japan.  
DEPTH.—95 fathoms.

## CHLOROMETRA ROBUSTA.

*Chlorometra robusta* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 558.  
HABITAT.—Philippine Islands.  
DEPTH.—375 fathoms.

## CHLOROMETRA ACULEATA.

*Antedon aculeata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**.  
Zoölogy, p. 128, pl. xxiii, fig. 3.  
*Chlorometra aculeata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
p. 22.  
HABITAT.—Meangis Islands.  
DEPTH.—500 fathoms.

## Genus PÆCILOMETRA.

*Pæcilometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**,  
part 3, p. 361 (*Antedon acœla* P. H. Carpenter, 1888).

## PÆCILOMETRA ACÆLA.

*Antedon acœla* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoö-  
logy, p. 132, pl. ii, fig. 3; pl. xvi.  
*Pæcilometra acœla* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
vol. **50**, part 3, p. 362.  
HABITAT.—Meangis Islands.  
DEPTH.—500 fathoms.

## PÆCILOMETRA SCALARIS.

*Antedon scalaris* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 141.  
*Pæcilometra scalaris* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
vol. **50**, part 3, p. 362.

HABITAT.—Southern Japan.

DEPTH.—361 fathoms.

Genus STROTOMETRA.

*Strotometra* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 19  
(*Antedon hepburniana* A. H. CLARK, 1907).

STROTOMETRA HEPBURNIANA.

*Antedon hepburniana* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 129.

*Strotometra hepburniana* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 20.

HABITAT.—Southwestern Japan.

DEPTH.—100–135 fathoms.

STROTOMETRA PARVIPINNA.

*Antedon parvipinna* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**,  
Zoölogy, p. 127, pl. xv, fig. 9.

*Strotometra parvipinna* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 20.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

REMARKS.—This species is closely related to *S. hepburniana*; it is a larger form, however; the genital pinnules are not nearly so much expanded; there is a delicate median carination on the IBr series and first two brachials which is easily traceable all along the arm.  $P_2$  is rather more like  $P_1$  than like  $P_3$ , though it is larger and has some of the characteristics of the latter.

Genus CHARITOMETRA.

*Charitometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 360 (*Antedon incisa* P. H. Carpenter, 1888).

CHARITOMETRA BASICURVA.

*Antedon basicurva* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**,  
Zoölogy, p. 102, pl. ii, figs. 2 *a-d*; pl. xxi, fig. 3; pl. xxii, figs. 3, 4; fig. on  
p. 122, A, B.

*Charitometra basicurva* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly  
Issue), vol. **50**, part 3, p. 361.

HABITAT.—Kermadec Islands.

DEPTH.—630 fathoms.



## CHARITOMETRA INCISA.

*Antedon incisa* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 124, pl. ii, figs. 1 *a-d*; pl. xxi, figs. 1, 2.

*Charitometra incisa* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 361.

HABITAT.—Kermadec Islands.

DEPTH.—630 fathoms.

## Suborder COMATULIDA MACROPHREATA.

*Comatulida Macrophreata* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 174.

## Family ANTEDONIDÆ.

*Antedonidæ* 1865. NORMAN, Ann. and Mag. Nat. Hist. (3), vol. 15, p. 98.—1908.

A. H. CLARK, Proc. U. S. Nat. Mus., vol. 4, p. 211 (emended).

## Subfamily ANTEDONINÆ.

*Antedoninæ* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 176.

## Genus MASTIGOMETRA.

*Mastigometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 229  
(*Mastigometra flagellifera*, sp. nov.).

## MASTIGOMETRA FLAGELLIFERA.

*Mastigometra flagellifera* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 229.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 190.

HABITAT.—Unknown.

## MASTIGOMETRA MICROPODA.

*Mastigometra micropoda* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 649.

DESCRIPTION.—Centrodorsal low-hemispherical, 4 mm. in diameter at the base, the polar area slightly convex, or flattened; cirrus sockets closely crowded, very numerous, in four or five alternating rows.

Cirri L-XC, 16, about 10 mm. long; first two segments short, rather over twice as broad as long, third as long as broad to about one third longer than broad, fourth and fifth slightly longer; succeeding segments subequal, about as long as broad; third to sixth segments slightly "dice-box shaped," the remainder with the ventral surface practically straight and the dorsal with a slight

median concavity (in lateral view); no trace of dorsal spines or of overlap; the cirri become somewhat compressed in the distal two-thirds and therefore appear very slightly broader in lateral view; opposing spine represented by a slight tubercle, terminally situated, which may be obsolete.

Scattered calcareous granules are present along the disk ambulacra, and single perisomic interradial plates may be present between the  $IBr_1$  as in *Antedon bifida*.

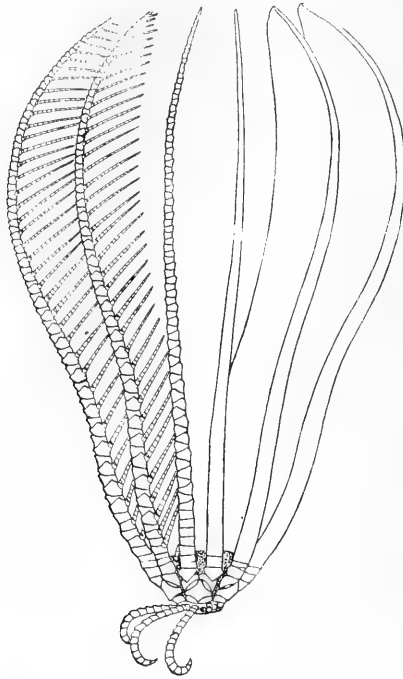


FIG. 42.—*Mastigometa micropoda*.  
Lateral view of the type.

Radials even with the edge of the centrodoīsal;  $IBr_1$  very short, five or six times as broad as long, of uniform height, not quite in apposition basally, the lateral edges diverging distally;  $IBr_2$  triangular, about half again as broad as long, the anterior angle somewhat produced, the proximal border as long as the proximal edge of the  $IBr_1$ .

Ten arms, probably about 80 mm. long, their structure being the same as those of *M. flagellifera*. The distal intersyzygial interval is three oblique muscular articulations.

P<sub>1</sub> 15 mm. long, much stouter basally than the succeeding, though tapering evenly to an exceedingly slender and delicate flagellate tip; P<sub>2</sub> 9 mm. long; following pinnules gradually decreasing in length. The pinnules are of the same proportions and structure as are those of *M. flagellifera*.

The colour in spirits is brownish white.

LOCALITIES.—? *India*. (Type Locality). Four specimens.

*Off Colombo Light House, Ceylon*; 26½ fathoms.—One small specimen.

#### Genus COMPSOMETRA.

*Compsometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131  
[*Antedon loveni* Bell, 1882 (= *Antedon pumila* Bell, 1884)].

#### COMPSOMETRA SERRATA.

*Antedon serrata*<sup>1</sup> 1908. A. H. CLARK, Bull. Mus. Comp. Zoöl., vol. **51**, No. 8, p. 240, pl. i, fig. 4.

*Compsometra serrata* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Formosa (Taiwan) to southern Japan.

DEPTH.—8–35 fathoms.

#### COMPSOMETRA CRISPA.

*Iridometra crispera* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 218.

HABITAT.—Hawaiian Islands.

DEPTH.—148–163 fathoms.

#### COMPSOMETRA LOVENI.

*Antedon loveni* 1882. BELL, P. Z. S., 1882, p. 534.—1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 481.

*Antedon pumila* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 157, pl. x, figs. B, B<sup>2</sup> a—b

*Compsometra loveni* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Southern Australia.

DEPTH.—Littoral, and down to 5 fathoms.

#### COMPSOMETRA INCOMMODA.

*Antedon incommoda* 1888. BELL, Ann. and Mag. Nat. Hist. (6), vol. **2**, No. xi, p. 404.

<sup>1</sup> Not *Antedon serrata* Örsted, MS. = *Stylometra spinifera*.

<sup>2</sup> On plate x, there are two figures lettered "B"; the present species is represented by the lower figure B, the upper being a misprint for "C."

*Compsometra lacertosa* 1910. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 38, p. 275.

HABITAT.—Southern Australia.

DEPTH.—Littoral, and down to 20 fathoms.

REMARKS.—There is nothing whatever in the diagnosis of this species which furnishes a clue to the characters separating it from *C. loveni*, and Professor Bell himself in 1889 published a note stating that the two were identical, the diagnoses differing only because he had established *loveni* (i.e. “*pumila*”) on a broken and *incommoda* on an entire specimen. I was much surprised, therefore, to find, upon visiting the British Museum, that the types of *Antedon incommoda* were specimens of the interesting and very distinct species which I recently described as *Compsometra lacertosa*.

#### COMPSOMETRA sp.

In the British Museum there are eleven specimens of a species of *Compsometra* from Lewis Island in the Dampier Archipelago; I was not able to determine them specifically while visiting that institution because of lack of time.

#### Genus IRIDOMETRA.

*Iridometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 130  
(*Antedon adrestine* A. H. CLARK, 1907).

#### IRIDOMETRA ADRESTINE.

*Antedon adrestine* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 340.

*Iridometra adrestine* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 131.

HABITAT.—Southern Japan.

DEPTH.—45–48 fathoms.

#### IRIDOMETRA MELPOMENE.

*Iridometra melpomene* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 559.

HABITAT.—Philippine Islands.

DEPTH.—88 fathoms.

#### IRIDOMETRA MAURITIANA.

*Iridometra mauritiana* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 40.

HABITAT.—Mauritius; Madagascar.

DEPTH.—Littoral.

## IRIDOMETRA ÆGYPTICA.

*Antedon parvicirra* 1908. CHADWICK, Journ. Linn. Soc. (Zool.), vol. **31**, p. 45.

*Iridometra ægyptica* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **40**, p. 42.

HABITAT.—Suez.

DEPTH.—10 fathoms.

## IRIDOMETRA NANA.

*Antedon nana* 1890. HARTLAUB, Nachr. Ges. Göttingen, Mai 1890, p. 170.—1891.

Nova Acta Acad. German., vol. **58**, No. 1, p. 89, pl. 5, figs. 57, 58.

*Iridometra nana* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

LOCALITY.—*Andaman Islands*; *surf line*.—One specimen with arms 30 mm. long.

OTHER RECORDS.—Philippine Islands; Tonga Islands; Nicobar Islands; Singapore; Amboina; Billiton; Macclesfield Bank; Male, Maldives.

DEPTH.—Littoral, and down to 41 fathoms.

## IRIDOMETRA BRISEIS.

*Antedon briseis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 83.

*Iridometra briseis* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Sea of Japan.

DEPTH.—59 fathoms.

## IRIDOMETRA PARVICIRRA.

*Antedon parvicirra* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 204, pl. xxxvi, figs. 7, 8.

*Iridometra parvicirra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Philippine Islands.

DEPTH.—18–44 fathoms.

## IRIDOMETRA SCITA.

*Iridometra scita* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 232.

HABITAT.—Philippine Islands; Billiton.

DEPTH.—Littoral.

## IRIDOMETRA PSYCHE.

*Antedon psyche* 1908. A. H. CLARK, Bull. Mus. Com. Zool., vol. **51**, No. 8, p. 241, pl. i, figs. 2, 3.

*Iridometra psyche* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Southern Japan.

DEPTH.—30 fathoms.

#### IRIDOMETRA MINUTA.

*Antedon minuta* (H. L. Clark, MS.) 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 341.

*Iridometra minuta* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 131.

HABITAT.—Southern Japan.

DEPTH.—13 fathoms.

#### IRIDOMETRA EXQUISITA.

*Iridometra exquisita* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **36**, p. 408.

HABITAT.—Philippine Islands.

DEPTH.—74–78 fathoms.

#### IRIDOMETRA, sp.

LOCALITY.—Albany Passage, Queensland.

REMARKS.—A very small specimen from this locality in the collection of the Australian Museum appears to be referable to the *I. nana* species group;  $P_2$  is longer than  $P_1$ , being nearly, though not quite, intermediate in length between  $P_1$  and  $P_3$ .

#### Genus TOXOMETRA.

*Toxometra* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 560 (**Toxometra paupera**, sp. nov.).

#### TOXOMETRA PAUPERA.

*Toxometra paupera* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 560.

HABITAT.—Philippine Islands.

DEPTH.—182 fathoms.

#### Subfamily PEROMETRINÆ.

*Perometrinae* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 176.

#### Genus PEROMETRA.

*Perometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 357 (**Antedon diomedea** A. H. CLARK, 1907).

## PEROMETRA AFRA.

*Perometra afra* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 43.

HABITAT.—Providence Island, north-east of Madagascar.

DEPTH.—125 fathoms.

## PEROMETRA DIOMEDEÆ.

*Antedon diomedæ* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 146.

*Perometra diomedæ* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 358.

HABITAT.—Southern Japan.

DEPTH.—51–110 fathoms.

## PEROMETRA PUSILLA.

*Antedon pusilla* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 131, pl. xxiii, fig. 1.

*Perometra pusilla* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 561.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

REMARKS.—This species differs markedly from *P. diomedæ* in possessing  $P_a$ , as I discovered upon examining the type in the British Museum<sup>1</sup>; the synarthrial tubercles are also much more strongly developed than in specimens of *P. diomedæ* of equal size.

## Genus ERYTHROMETRA.

*Erythrometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 126 (*Antedon ruber* A. H. CLARK, 1907).

## ERYTHROMETRA RUBER.

*Antedon ruber* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 146.

*Erythrometra ruber* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 126.—1909. Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 190.

HABITAT.—Southern Japan.

DEPTH.—55–105 fathoms.

## Subfamily ZENOMETRINÆ.

*Zenometrinæ* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 176.

<sup>1</sup> Cf. Proc. U. S. Nat. Mus., vol. 39, p. 562.

## Genus ZENOMETRA.

*Zenometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 354 (*Antedon columnaris* P. H. CARPENTER, 1881).

## ZENOMETRA TRISERIALIS.

*Zenometra triserialis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 219.

HABITAT.—Hawaiian Islands.

DEPTH.—193–352 fathoms.

## Genus PSATHYROMETRA.

*Psathyrometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 353 (*Antedon fragilis* A. H. CLARK, 1907).

## PSATHYROMETRA ERITHRYZON.

*Antedon erithryzon* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 79.

*Psathyrometra erithryzon* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 353.

HABITAT.—Sea of Japan.

DEPTH.—406–390 fathoms.

## PSATHYROMETRA FRAGILIS.

*Antedon fragilis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 80.

*Psathyrometra fragilis* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 353.

HABITAT.—Yezo Straits, Japan.

DEPTH.—500 fathoms.

## PSATHYROMETRA BOREALIS.

*Psathyrometra borealis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 236.

HABITAT.—Western Aleutian Islands.

DEPTH.—1046 fathoms.

## PSATHYROMETRA BIGRADATA.

*Antedon bigradata* 1895. HARTLAUB, Bull. Mus. Comp. Zoöl., vol. **27**, No. 4, p. 145, pl. i, fig. 5.

*Psathyrometra bigradata* 1906. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 353.



HABITAT.—Galápagos Islands.

DEPTH.—385–555 fathoms.

#### PSATHYROMETRA PROFUNDORUM.

*Psathyrometra profundorum* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 237.

HABITAT.—Queen Charlotte Islands, British Columbia.

DEPTH.—1588 fathoms.

#### PSATHYROMETRA CONGESTA.

*Psathyrometra congesta* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 221.

HABITAT.—Hawaiian Islands.

DEPTH.—400–500 fathoms.

#### PSATHYROMETRA MIRA.

*Psathyrometra mira* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 648.

DESCRIPTION.—Centrodorsal conical, rounded at the apex, 4 mm broad at the base and 4 mm. high, divided into five radial areas by five shallow inter-

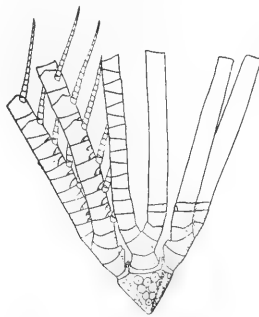


FIG. 43.—*Psathyrometra mira*.  
Lateral view of the type.

radial furrows, each equal in width to nearly or quite the diameter of the adjacent cirrus sockets; cirrus sockets closely crowded, regularly arranged in two converging columns in each radial area, with a single socket, the remnant of a third column, between the distal ends of the first sockets of the outer columns, which come together just beneath it.

Cirri XL, lacking in both specimens.

Ends of the basal rays visible as small tubercles in the angles of the calyx,

but with difficulty separable from the general surface of the centrodorsal and radials; radials even with the edge of the centrodorsal in the median line, but extending up in the angles of the calyx and entirely separating the bases of the  $IBr_1$ ;  $IBr_1$  oblong, slightly over twice as broad as long, evenly rounded dorsally and laterally;  $IBr_2$  broadly pentagonal, about as long as broad, the lateral edges not quite so long as those of the  $IBr_1$ , convex, the lateral angles somewhat produced outward.

Ten arms, all broken off at the base in the specimens at hand; first brachial slightly wedge-shaped, about twice as broad as its exterior length, entirely free anteriorly; second brachial considerably larger, approximately oblong, not quite so long as broad; third and fourth brachials (syzygial pair) not quite so long as broad; the remainder of the arms, and the pinnules, so far as can be judged from the fragments, are similar to those in other species of the genus. The synarthrial tubercles are very slightly marked.

The colour in spirits is brownish white, the perisome brown.

LOCALITIES.—*Duncan Passage, Andaman Islands* ( $11^{\circ} 31' 40''$  N. lat.,  $92^{\circ} 46' 40''$  E. long.); 188-220 fathoms. (Type Locality).—Two broken specimens.

*Near Interview Island, Andamans* ( $13^{\circ} 27' 00''$  N. lat.,  $93^{\circ} 00' 00''$  E. long.); 405 fathoms; bottom temperature  $48^{\circ}$  Fahr.; green mud.—One specimen.

*Gulf of Martaban* ( $14^{\circ} 54' 30''$  N. lat.,  $96^{\circ} 00' 00''$  E. long.); "6 fathoms"; soft mud.—One broken specimen.

#### PSATHYROMETRA PARVA.

*Psathyrometra parva* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, p. 562.

HABITAT.—Philippine Islands.

DEPTH.—422 fathoms.

#### PSATHYROMETRA GRACILLIMA.

*Psathyrometra gracillima* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 149.

DESCRIPTION.—This species is even smaller and more delicate than *Ps. mira* and *Ps. parva*.

Centrodorsal sharply conical, 4 mm. broad at the base and 2.5 mm. high, separated into five radial areas by five interradial furrows which are somewhat broader than the adjacent cirrus sockets; eight to ten well separated cirrus sockets in each radial area, arranged approximately in four columns, though apparently more or less irregular.

Cirri XL-L, about 25, 35 mm. long, slender, smooth, and delicate.

The ten arms which, except for their slenderness, resemble those of related species, are about 100 mm. long.

The colour in life is a "pale earthy brown."

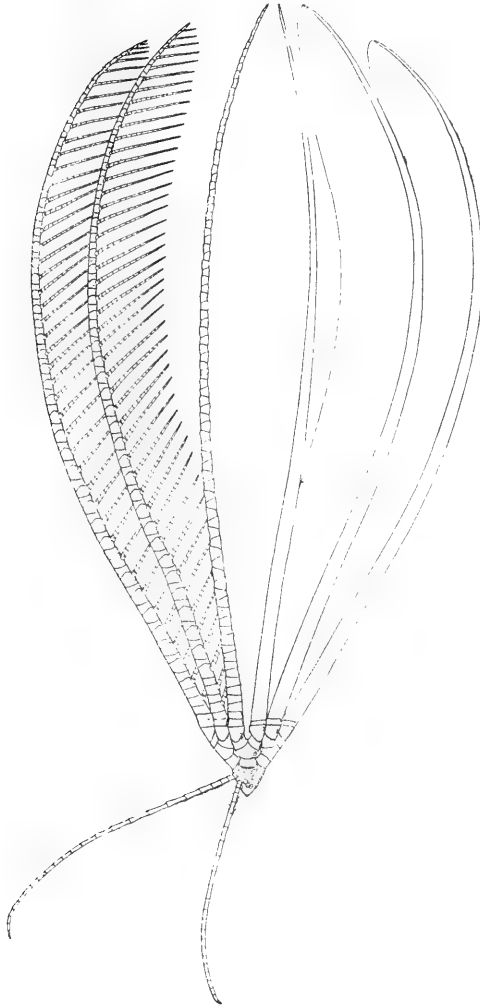


FIG. 44.—*Psathyrometra gracillima*  
Lateral view of the type.

LOCALITY.—*Southwest of Akyab, Burma* ( $19^{\circ} 35' N.$  lat.,  $92^{\circ} 24' E.$  long.);  
272 fathoms; bottom temperature  $50^{\circ}$  Fahr.—Three broken specimens.

Genus ADELOMETRA.

*Adelometra* 1907. A. H. CLARK, *Smiths. Miscell. Coll.* (Quarterly Issue), vol. 50,  
part 3, p. 363 (*Antedon angustiradia* P. H. Carpenter, 1888).

ADELOMETRA ANGUSTIRADIA.

*Antedon angustiradia* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26,  
*Zoölogy*, p. 253, pl. xlv, fig. 4.

*Adelometra angustiradia* 1907. A. H. CLARK, *Smiths. Miscell. Coll.* (Quarterly  
Issue), vol. 50, part 3, p. 364.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

Genus BALANOMETRA.

*Balanometra* 1909. A. H. CLARK, *Proc. Biol. Soc. Washington*, vol. 22, p. 177  
(*Antedon balanoides* P. H. Carpenter, 1888).

BALANOMETRA ELONGATA.

*Perometra elongata* 1908. A. H. CLARK, *Smiths. Miscell. Coll.* (Quarterly Issue),  
vol. 52, part 2, p. 229.

HABITAT.—Philippine Islands.

DEPTH.—78 fathoms.

BALANOMETRA BALANOIDES.

*Antedon balanoides* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26,  
*Zoölogy*, p. 207, pl. xxxiii, figs. 6, 7.

HABITAT.—Philippine Islands.

DEPTH.—82 fathoms.

Subfamily HELIOMETRINÆ.

*Helioetrince* 1909. A. H. CLARK, *Proc. Biol. Soc. Washington*, vol. 22, p. 176.

CYCLOMETRA, gen. nov.

GENOTYPE.—*Cyclometra flavescens*, sp. nov.

CHARACTERS.—This new genus is closely related to *Helioetra* and *Solanometra*,  
which it replaces in the East Indian region; it is distinguished, however, by  
having the  $P_2$  markedly shorter than  $P_1$  instead of approximately of the

same length or slightly longer, as in *Heliometra* and *Solanometra*, and by the outer segments of  $P_1$ , which are somewhat elongated instead of very short.

#### CYCLOMETRA FLAVESCENS, sp. nov.

DESCRIPTION.—Centrodorsal rounded conical.

Cirri XXVIII, 41–43, 30 mm. long; first segment short, second nearly as long as broad, the following gradually increasing in length and becoming twice as long as broad on the fourth; the next five are similar; the following gradually decrease in length, after about six more becoming about as long as broad and remaining of those proportions until the end of the cirrus. The earlier segments are slightly constricted centrally, with the distal ends all around finely spinous; the short outer segments are carinate, this carination appearing convex in lateral view.

The ten arms are 130 mm. long; the IBr series and brachials are essentially as in *Antedon bifida*, but the distal ends of the brachials are more prominent and are finely spinous. Syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals three or four oblique muscular articulations.

$P_1$  is very long, 17 mm. to 19 mm. in length, with from forty-two to forty-five segments of which the first seven are broader than long, those after the tenth or eleventh longer than broad, and the distal slightly elongated;  $P_2$  is apparently similar, but shorter;  $P_3$  bears a genital gland. The distal pinnules are exceedingly slender, 17 mm. long.

The colour in spirits is yellow.

LOCALITY.—South of Ras Sharweïn, Arabia; or, northwest of Sokotra ( $14^{\circ} 20'$  N. lat.,  $52^{\circ} 30'$  E. long.); 1200 fathoms.

REMARKS.—The type of this species, which was collected by the cable repair ship "Electra," is in the British Museum.

#### CYCLOMETRA CLIO.

*Antedon clio* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 79.

HABITAT.—Southwestern Japan.

DEPTH.—107 fathoms.

#### Genus TRICHOMETRA.

*Trichometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 131 (*Antedon aspera* A. H. CLARK, 1908).

#### TRICHOMETRA EXPLICATA.

*Trichometra explicata* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 232.

HABITAT.—Philippine Islands.

DEPTH.—283–730 fathoms.

#### TRICHOMETRA VEXATOR.

*Trichometra vexator* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 217.

HABITAT.—Hawaiian Islands.

DEPTH.—138–355 fathoms.

#### TRICHOMETRA OBSCURA.

*Trichometra obscura* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 149.

DESCRIPTION.—Centrodorsal conical, the sides slightly convex, 3.5 mm. broad at the base and 3 mm. high.

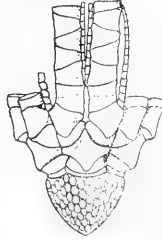


FIG. 45.—*Trichometra obscura*.  
Lateral view of the type.

Cirri lacking.

Radials even with the edge of the centrodorsal;  $IB_1$  very short and band-like, not quite in contact basally, the lateral edges diverging at a rather broad angle;  $IB_2$  almost triangular, slightly broader than long, the anterior and lateral angles rather strongly produced, with a rounded posterior process incising the  $IB_1$ .

The ten arms resemble those of the other species of the genus, so far as may be judged from the single mutilated specimen. The longest stump measures 9 mm. to the tenth brachial.

The colour in spirits is white.

LOCALITY.—Southwest of Cape Comorin ( $7^{\circ} 17' 30''$  N. lat.,  $76^{\circ} 54' 00''$  E. long.); 430 fathoms; bottom temperature  $38^{\circ}$  Fahr.; grey mud.—One badly broken specimen.

#### TRICHOMETRA PLANA, sp. nov.

DESCRIPTION.—Centrodorsal very low hemispherical, practically thin discoidal with the edge bevelled off, 2 mm. in diameter; in lateral view the centrodorsal appears thin discoidal with a single row of cirrus sockets, four to each

radius; cirrus sockets very numerous, from fifty-five to sixty in number, gradually decreasing in size from the periphery to the centre of the centrodorsal at the periphery being four to a radius, the central sockets being scarcely half as large as these; the dorsal pole is small and resembles that of the other species of the genus except in being practically flat; the small and numerous cirrus sockets are very closely crowded as in the related larger forms.

Cirri lacking.

Radials barely visible beyond the edge of the centrodorsal, their distal angles slightly separated;  $IBr_1$  very short, about six times as broad as long, the sides of adjacent  $IBr_1$  being parallel to each other and slightly separated;  $IBr_2$  twice as broad as long, almost triangular, the anterior angle produced, the anterior sides concave; the lateral angles are slightly produced and end in a fringe of fine spines.

The ten arms resemble those of the other small species of the genus; they measure 14 mm. in length to the eighteenth brachial (counting from the radial). Syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of three oblique muscular articulations.

$P_1$  5.5 mm. long with thirteen segments, exceedingly slender and hair-like; the first segment is twice as broad as long, the second is slightly longer than broad, the third is slightly over twice as long as broad; the following increase in length and the distal are excessively elongated with swollen articulations; the pinnule tapers gradually to the fifth segment, and is extremely slender from that point onward.  $P_2$  is 3.5 mm. long with eight segments, of which the first is broader than long, the second slightly longer than broad, and the remainder excessively elongated and slender; it is just perceptibly smaller basally than  $P_1$ ;  $P_3$  is 3 mm. long with eight segments and resembles  $P_2$ ; the following pinnules are all broken, but the segments of all of them, except for the first two, are excessively elongated.

LOCALITY.—“Investigator” Station 232; 430 fathoms.—One badly broken specimen.

REMARKS.—This curious little species is readily distinguished from all the others of the genus by its small and very flat centrodorsal, which looks much more like the centrodorsal of some species of *Antedon* than like the centrodorsal of the larger species of the genus *Trichometra*.

#### Genus NANOMETRA.

*Nanometra* 1907. A. H. CLARK, *Smiths. Miscell. Coll. (Quarterly Issue)*, vol. 50, part 3, p. 348 (*Antedon minor* A. H. CLARK, 1907).

#### NANOMETRA BOWERSI.

*Antedon minor* 1907. A. H. CLARK, *Proc. U. S. Nat. Mus.*, vol. 33, p. 144 (pre-occupied).

- Antedon bowersi* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 148.  
*Antedon orientalis* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
 vol. **50**, p. 341.  
*Nanometra minckerti* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue),  
 vol. **50**, part 3, p. 349.  
 HABITAT.—Southern Japan.  
 DEPTH.—103–191 fathoms.

Subfamily *THYSANOMETRINÆ*.

- Thysanometrince* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**,  
 p. 176.

Genus EUMETRA.

- Eumetra* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**,  
 part 2, p. 230 (**Eumetra chamberlaini**, sp. nov.).

EUMETRA CHAMBERLAINI.

- Eumetra chamberlaini* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly  
 Issue), vol. **52**, part 2, p. 231.  
 HABITAT.—Philippine Islands.  
 DEPTH.—78–80 fathoms.

EUMETRA INDICA.

- Eumetra indica* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 84.

DESCRIPTION.—Centrodorsal conical, 3 mm. broad at the base and 3 mm. high, the cirrus sockets arranged in six closely crowded alternating rows. The centrodorsal as a whole resembles closely that of the species of *Hathrometra*.

Cirri about LXX, all lacking.

Radials extending slightly beyond the edge of the centrodorsal, diverging at an acute angle in the angles of the calyx;  $IBr_1$  somewhat trapezoidal, about three times as broad as long, not in contact basally;  $IBr_2$  rhombic, the free lateral edges rather longer than those of the  $IBr_1$ , forming with them somewhat more than a right angle; synarthrial tubercles moderately developed.

Ten arms about 60 mm. long; first brachial longer outwardly than inwardly, slightly incised by the second, not united interiorly, but the inner edges diverging at approximately a right angle; second brachial nearly twice as large, irregularly quadrate, with a rounded posterior projection incising the first; third and fourth brachials (syzygial pair) about as long as broad; next eight or nine brachials slightly wedge-shaped, half again as broad as long, then becoming almost or quite triangular, about as long as broad, and further out on the arm



wedge-shaped again and longer than broad. Syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of three oblique muscular articulations.

$P_1$  about 6 mm. long, very slender and delicate, somewhat stiffened, with about nine segments, the first about as long as, or slightly longer than, broad, the second and third twice as long as broad, the following gradually increasing in length and becoming exceedingly elongated distally;  $P_2$  about 10 mm. long, proportionately stouter than  $P_1$  and stiffer, with fifteen segments, the first squarish, the second slightly longer than broad, the third twice as long as broad,

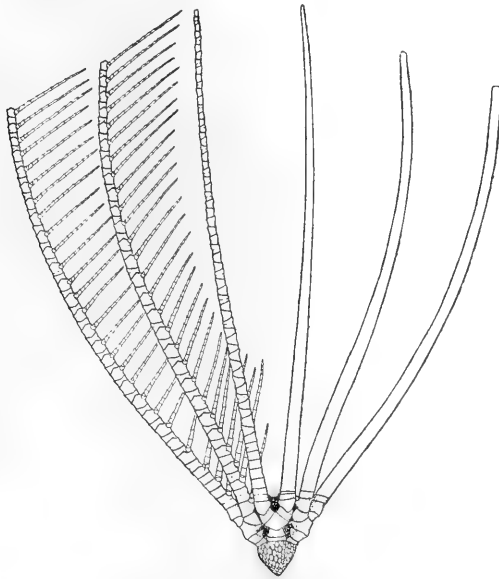


FIG. 46.—*Eumetra indica*.  
Lateral view of the type.

the remainder from three to four times as long as broad;  $P_3$  8 mm. long with fifteen segments, similar to  $P_2$  but slightly less stout;  $P_4$  like  $P_3$ ;  $P_5$  5 mm. long, slightly more slender than  $P_4$ , with ten segments which have slightly everted and spinous distal ends; the following pinnules are similar; the distal pinnules are lacking.

The colour in spirits is light brownish yellow with traces of a broad median dorsal line of purple.

LOCALITY.—Off Port Blair, Andaman Islands; 112 fathoms.—One broken specimen.

REMARKS.—The conical centrodorsal, visible radials, and widely separated IBr and lower brachials, which do not have produced lateral borders, give this species a somewhat different appearance from *E. chamberlaini*; in the latter  $P_3$  is stouter, longer, and stiffer than any of the other pinnules, while in *E. indica*  $P_2$  instead of  $P_3$  is enlarged.

Genus THYSANOMETRA.

*Thysanometra* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 351 (***Antedon tenelloides*** A. H. CLARK, 1907).

THYSANOMETRA TENELLOIDES.

*Antedon tenelloides* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 73.

*Thysanometra tenelloides* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, p. 351.

HABITAT.—Southern Japan.

DEPTH.—70 fathoms.

THYSANOMETRA TENUICIRRA.

*Antedon tenuicirra* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 186, pl. xxx, figs. 4-8; pl. xxxiii, figs. 4, 5.

*Antedon notata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 187, pl. xxxiii, figs. 4, 5.

*Thysanometra tenuicirra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 125.

HABITAT.—North of the Admiralty Islands.

DEPTH.—150 fathoms.

Subfamily BATHYMETRINÆ.

*Bathymetrina* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 177.

Genus BATHYMETRA.

*Bathymetra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 132 (***Antedon abyssicola*** P. H. CARPENTER, 1888, restricted).

BATHYMETRA ABYSSICOLA.

*Antedon abyssicola* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 191 (part), pl. xxxiii, fig. 1 (but not fig. 2).

*Bathymetra abyssicola* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 132.

HABITAT.—North Pacific.

DEPTH.—2900 fathoms.

## BATHYMETRA CARPENTERI.

*Antedon abyssicola* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 191 (part), pl. xxxiii, fig. 2 (but not fig. 1).

*Bathymetra carpenteri* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 235.

HABITAT.—West of Tasmania.

DEPTH.—2600 fathoms.

## BATHYMETRA BREVICIRRA.

*Bathymetra brevicirra* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 234.

HABITAT.—Western Bering Sea.

DEPTH.—1766 fathoms.

## BATHYMETRA sp.

*Antedon* sp. 1895. HARTLAUB, Bull. Mus. Comp. Zoöl., vol. 27, No. 4, p. 146, pl. iv, fig. 25.

No cirri, and arms lacking after the third (hypozygal) brachial.

Cirrus sockets about twenty-five, closely crowded and relatively large; radials entirely visible, the lateroanterior angles somewhat produced between the IB<sub>1</sub>, so that the latter are not in lateral apposition.

LOCALITY.—Near Malpelo Island, Bay of Panamá.

DEPTH.—1772 fathoms.

## Genus THAUMATOMETRA.

*Thaumatometra* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 127 (*Antedon ciliata* A. H. CLARK, 1907).

## THAUMATOMETRA TENUIS.

? *Antedon* 1884. VON GRAFF, "Challenger" Reports, vol. 10, Zoölogy, p. 79.

*Antedon tenuis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 80.

*Antedon ciliata* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, p. 81.

*Thaumatometra tenuis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, p. 117 (fig. 11).

HABITAT.—From Korea (Cho Sen) northward to the Amur.

DEPTH.—80-620 (? 800) fathoms.

## THAUMATOMETRA REMOTA.

*Antedon remota* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 184, pl. xxix, figs. 5-9.

*Thaumatometra remota* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Near the Crozet Islands.

DEPTH.—1600 fathoms.

#### THAUMATOMETRA ABYSSORUM.

*Antedon abyssorum* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 190, pl. xxix, figs. 10-13.

*Thaumatometra abyssorum* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Off the Crozet Islands.

DEPTH.—1600 fathoms.

#### THAUMATOMETRA EXIGUA.

*Antedon exigua* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 178, pl. xxxii, figs. 1-4.

*Thaumatometra exigua* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Off Marion Island.

DEPTH.—50-140 fathoms.

#### THAUMATOMETRA ALTERNATA.

*Antedon tenuis* 1887. P. H. CARPENTER, Quart. Journ. Micros. Sci., vol. **27**, p. 386 (*nomen nudum*).

*Antedon alternata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 179, pl. xviii, figs. 1-3; pl. xxxii, figs. 5-9.

*Thaumatometra alternata* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—New Zealand and New Guinea to Japan.

DEPTH.—630-1070 fathoms.<sup>1</sup>

#### THAUMATOMETRA COMASTER.

*Thaumatometra comaster* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 232.

HABITAT.—Yezo Straits, Japan.

DEPTH.—300-533 fathoms.

#### THAUMATOMETRA ISIS.

*Antedon isis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 82.

<sup>1</sup> Probably more than one species is included by Carpenter under this name.

*Thaumatometra isis* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Southern Japan and Korea (Cho Sen).

DEPTH.—361 fathoms.

#### THAUMATOMETRA LÆVIS.

*Antedon lævis* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 187, pl. xxxi, fig. 6.

*Thaumatometra lævis* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Off the Meangis Islands.

DEPTH.—500 fathoms.

#### THAUMATOMETRA PARVA.

*Thaumatometra parva* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 231.

HABITAT.—Southern Japan.

DEPTH.—120–265 fathoms.

#### THAUMATOMETRA PARVULA.

*Antedon parvula* 1895. HARTLAUB, Bull. Mus. Comp. Zoöl., vol. **27**, No. 4, p. 144, pl. iii, fig. 21.

*Thaumatometra parvula* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 128.

HABITAT.—Panamá.

DEPTH.—978 fathoms.

#### THAUMATOMETRA sp.

LOCALITY.—Northwest of Sokotra (14° 20' N. lat., 52° 30' E. long.).

DEPTH.—1200 fathoms.

REMARKS.—The cable repair ship "Electra," upon raising a cable at the above locality on July 10, 1909, found upon it a new species of *Thaumatometra*.

#### Family PENTAMETROCRINIDÆ.

*Pentametrocrinidae* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 135.

#### Genus DECAMETROCRINUS.

*Decametrocrinus* 1905. MINCKERT, Zool. Anzeiger, vol. **28**, p. 494 (**Promachocrinus abyssorum** P. H. Carpenter, 1888).<sup>1</sup>

<sup>1</sup> Vide A. H. Clark, Proc. U. S. Nat. Mus., vol. **34**, p. 516 (1908).

## DECAMETROCRINUS RUGOSUS.

*Decametrocrinus rugosus* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 215.

HABITAT.—Hawaiian Islands.

DEPTH.—762-1000 fathoms.

## DECAMETROCRINUS NARESI.

*Promachocrinus naresi* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 352, pl. lxi, figs. 8-10.

*Decametrocrinus borealis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **33**, p. 71.

HABITAT.—Meangis Islands, and northward to southern Japan.

DEPTH.—361-500 fathoms.

## DECAMETROCRINUS ABYSSORUM.

*Promachocrinus abyssorum* 1888. P. H. CARPENTER, "Challenger" Reports, vol. **26**, Zoölogy, p. 351, pl. i, figs. 4, 5; pl. lxi, figs. 5-7.

*Decametrocrinus abyssorum* 1905. MINCKERT, Zool. Anzeiger, vol. **28**, p. 494.

HABITAT.—Extreme southern part of the Indian Ocean.

DEPTH.—1600-1800 fathoms.

## DECAMETROCRINUS sp.

LOCALITY.—"Investigator" Station No. 124.

REMARKS.—A single incomplete arm of a large species of *Decametrocrinus* was dredged at this station. It is broken into eight fragments, all of which except one evidently belong in a linear series. The basal portion is 4 mm. in diameter, and the total length is 278 mm.; it is probable that at least 50 mm. of the basal part is missing, and 40 mm. of the tip, so that the arm length must have been nearly or quite 350 mm. This would give an expanse of 700 mm., and indicate a size approximate to that of *Helimetra maxima*, previously the largest known crinoid, recent or fossil, which I dredged in abundance about the southern end of Sakhalin Island in 1906.

The genital glands in this specimen, instead of being ovoid or fusiform bodies as in other comatulids, are broken up into a series of small bead-like bodies, approximately one to each of the greatly elongated pinnulars, and are protected by prominent calcareous plates. This may be a sexual differentiation but it appears more probable that it is in reality specific, and, taken in connection with the very large size and the intersyzygial interval of four or five oblique muscular articulations, it certainly differentiates this specimen sharply from the few other more perfect individuals heretofore known. Until more is

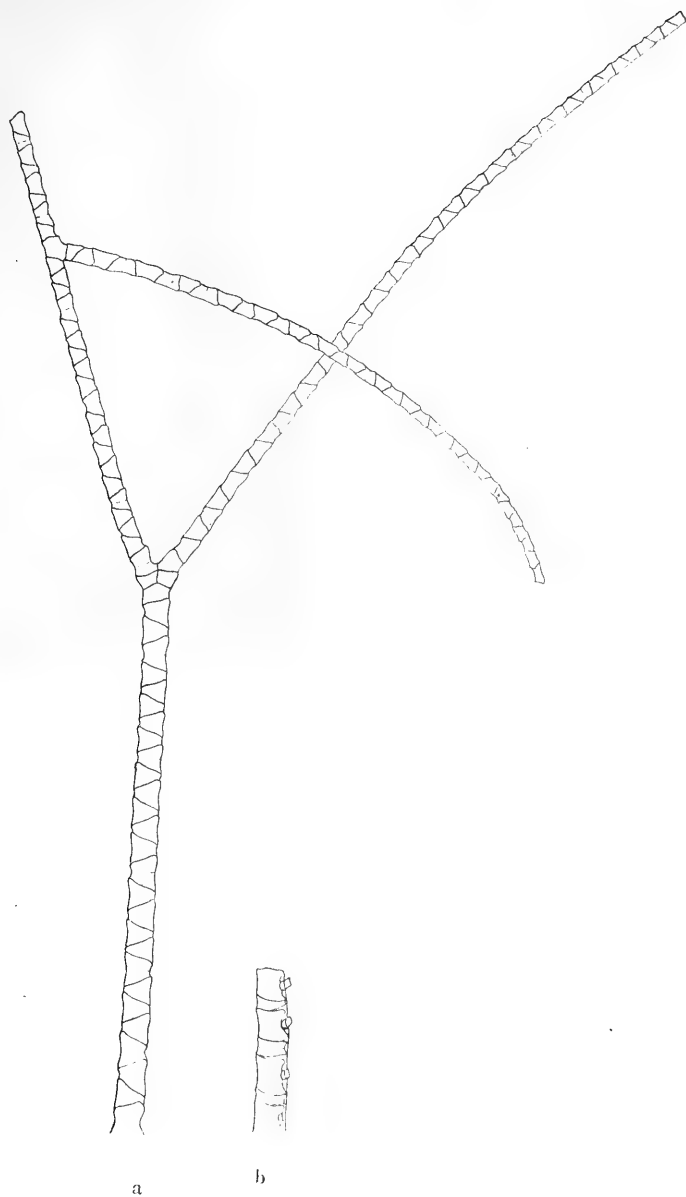


FIG. 47.—*Decametrocrinus* sp.  
(a) Dorsal view of the arm, reconstructed.  
(b) Lateral view of the base of the arm.

learned, however, the application of a specific name to this fragment could only cause confusion.

Placed side by side with the arms of *Decametrocrinus rugosus* from the Hawaiian Islands no differences, except the proportionately greater size and the somewhat different arrangement of the syzygies, were detected.

The Pentametrocrinidæ are peculiar among the comatulids in having undivided arms of very primitive structure, morphologically entirely different from the undivided arms of the species of the genus *Eudiocrinus*, which belongs to the Zygométridæ. This single arm, however, divides twice. The thirty-fourth brachial from the proximal end (as preserved) is the hypozygal of a syzygial pair; the epizygal of this syzygial pair has its distal face divided, and bears two brachials, both of which are but slightly smaller than the more normal one would have been; the first brachial beyond this axillary on the left (viewed dorsally) side is short, and is united by syzygy to the succeeding; on the right the first brachial is twice as long, obliquely wedge-shaped (the longer side inward); the two are interiorly united basally for about four-fifths of the length of the left (smaller and shorter) brachial. The twenty-fifth brachial further on bears a well developed arm as large as the main trunk instead of the usual pinnule. In this supernumerary arm the fourth and fifth brachials are united by syzygy as in primary arms.

#### Genus PENTAMETROCRINUS.

*Thaumatoocrinus* 1884. P. H. CARPENTER, Phil. Trans. Roy. Soc., 1883, p. 919 (Thaumatoocrinus *renovatus*, sp. nov., a young specimen not identifiable with certainty).

*Pentametrocrinus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 134 (*Eudiocrinus japonicus* P. H. Carpenter, 1882).

#### PENTAMETROCRINUS TUBERCULATUS.

*Eudiocrinus tuberculatus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 32, p. 573.

*Pentametrocrinus tuberculatus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 135.

HABITAT.—Southern Japan.

DEPTH.—169 fathoms.

#### PENTAMETROCRINUS DIOMEDEÆ.

*Pentametrocrinus diomedæ* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, p. 234.

HABITAT.—Philippine Islands, and northward to southern Japan.

DEPTH.—103–152 fathoms.



## PENTAMETROCRINUS JAPONICUS.

*Eudiocrinus japonicus* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 499.

*Pentametrocrinus japonicus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 135.

HABITAT.—Southern Japan.

DEPTH.—103-712 fathoms.

## PENTAMETROCRINUS VARIANS.

*Eudiocrinus varians* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 496.

*Pentametrocrinus varians* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 135.

LOCALITIES.—“Investigator” Station No. 315.

“Investigator” Station No. 331.

REMARKS.—A very fine specimen dredged at Station 315 resembles in the minutest details individuals at hand dredged by the United States Fisheries Steamer “Albatross” off southern Japan. The arms were probably 100 mm. to 110 mm. in length; the cirri are 30 mm. long, and are composed of 21 segments. This example is, therefore, of about the same size as the largest from Japan.

A specimen of the same size as, and similar to, the preceding, was dredged at Station 331.

OTHER RECORDS.—Philippine Islands, and northward to southern Japan.

DEPTH.—361-1050 fathoms.

## PENTAMETROCRINUS SEMPERI.

*Eudiocrinus semperi* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 497.

*Pentametrocrinus semperi* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 135.

HABITAT.—Off New South Wales.

DEPTH.—950 fathoms.<sup>1</sup>

## Family ATELECRINIDÆ.

*Atelecrinidæ* 1899. BATHER, Rep. British Association for 1898, p. 923.

<sup>1</sup> *Thaumatoocrinus renovatus*, which is the young of some undeterminable species of *Pentametrocrinus*, was found by the “Challenger” in the extreme south of the Indian Ocean at a depth of 1800 fathoms.

## Genus ATELECRINUS.

*Atelecrinus* 1881. P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, p. 166 (***Atelecrinus balanoides***, sp. nov.).

## ATELECRINUS CONIFER.

*Atelecrinus conifer* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, p. 214.

HABITAT.—Hawaiian Islands.

DEPTH.—552–809 fathoms.

## ATELECRINUS WYVILLII.

*Atelecrinus wyvillii* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 492.

HABITAT.—Near Fiji.

DEPTH.—610 fathoms.

## II.—THE STALKED CRINOIDS.

## Family PENTACRINITIDÆ.

*Pentacrinitidæ* 1842. J. E. GRAY, Synopsis Brit. Mus., p. 119.—1848. List Brit. Animals in Brit. Mus., Centroniæ or Radiated Animals, p. 28.

## Genus COMASTROCRINUS. nov.

GENOTYPE.—*Hypalocrinus springeri* A. H. Clark, 1909.

DIAGNOSIS.—A genus of Pentacrinitidæ in which the arms are more than ten in number, the division being by defective interpolated division as in *Capillaster*, by compound division as in *Comatella*, or by a combination of the two, but never by simple extraneous division as in *Metacrinus*, simple interpolated division as in *Hypalocrinus*, multiplex interpolated division as in *Endoxocrinus*, or interpolated-extraneous division as in *Isocrinus* or *Pentacrinites*. Following division series of two, the first syzygy on the outer arms is between the second and third brachials, on the inner arms between the third and fourth brachials (just the reverse of the conditions found in *Comatella*); in the former case the first pinnule is on the first brachial, in the latter it is on the second; following division series of more than two ossicles the first syzygy is between the second and third brachials as in *Capillaster*. The articulation between the ossicles of the IBr series is a pseudo-syzygy, of the type common to all the genera of the Pentacrinitidæ. All the proximal ossicles beyond the radials have the distal edges everted and strongly produced, this giving the species of this genus a very striking and characteristic appearance. The distal portion of the arms, as in *Metacrinus* and *Hypalocrinus*.

bears only rudimentary pinnules. Infrabasals are present, resembling those of *Isocrinus* and *Hypalocrinus*. The stem and cirri are essentially as in *Hypalocrinus*.

REMARKS.—The discovery of this extraordinary genus completes the parallel between the comatulids and the pentacrinites.

The only difference between the pentacrinites and the comatulids is that the former possess a stem, while in the latter the young are stalked, but during growth break away from the stem retaining only the topmost columnar attached to the calyx.

This difference is not nearly so fundamental as it would seem; for the pentacrinites always discard the distal part of the stem, and are continually dropping it off bit by bit all through their life; and the comatulids, while their calcareous centrodorsal is the last column to be formed, and is never composed of more than one columnar (representing a single pentacrinite nodal), really possess the entire pentacrinite stem enclosed within this columnar; so that where-as the pentacrinite possesses whorls of cirri at regular intervals (on the so-called nodals) along a greatly elongated stalk, the comatulids are forced to crowd all their cirri together and to extrude them all through the same nodal.

In its arm structure the genus *Endoxocrinus* is exactly similar to such comatulids as those comprised within the families Stephanometridæ, Marimetridæ, Pontiométridæ, etc., while the genus *Hypalocrinus* finds a counterpart in all the ten-armed species, no matter to what family they may belong. The most primitive type of arm structure is found in the species of the family Pentametrocrinidæ; but this is repeated, somewhat modified, in the genus *Metacrinus*. In *Comastrocrinus* we find represented the very highly specialized type of arm division characteristic of the most specialized comasterid subfamily, the Capillasterinæ, and we also find represented both the type characteristic of the genus *Capillaster* and that characteristic of the genus *Comatella*, the two often occurring side by side in the same individual. In addition we occasionally find the type of division characteristic of the comasterid subfamily Comasterinæ and of the Himerometridæ, so that in this genus all the missing data is supplied whereby the arm structure of the comatulids is shown to be exactly parallel to that of the pentacrinites. Moreover, many of the specimens of the various species of *Comastrocrinus* are very irregular, and their irregularity is recapitulated in the Capillasterinæ, being identical with that seen in the specimen of *Capillaster multiradiata* from 160 fathoms in the Malay Archipelago described in the Appendix.

The agreement in arm structure between the various pentacrinite and comatulid genera cannot in any sense be interpreted as suggesting a polyphyletic origin for the latter, or as suggesting the origin of certain comatulid genera from certain definite pentacrinite genera, hypotheses for which there is not the slightest evidence. It is merely a parallelism, the result of the development, under the same conditions, of two divergent branches from the same stock, each of which possesses all the latent tendencies inherent in the other.

## COMASTROCRINUS SPRINGERI.

*Hypalocrinus springeri* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 650.

DESCRIPTION.—Stem slender, 4 mm. in diameter, rounded pentagonal in cross section, the sides smooth, flat, or very slightly convex; interarticular pores extending to the eighth node; internodals 10 (rarely 9 or 11), of equal size, each face slightly over twice as broad as high; nodals slightly longer than the internodals, the small transversely oval cirrus sockets touching the distal (lower) border and extending upward to the proximal fourth of the joint face; neither the supra- nor the infranodals are modified in any way.

Cirri slender and delicate, twelve times the diameter of the stem in length (48 mm.), with fifty segments; first segment very short, the following gradually increasing in length to the fourth, which is twice as broad as long, and still further increasing to the sixth, which is about as long as broad; following segments slightly longer than broad, but in the terminal fourth becoming again about as long as broad; from the twentieth to the twenty-third segment onward small but prominent median dorsal tubercles are developed; terminal claw small and blunt, conical, twice as long as broad at the base, slightly longer than the preceding segment.

Infrabasals present, resembling those of *Isocrinus decorus*; basals prominent externally, rhombic in outline, just contiguous by their lateral angles, strongly convex exteriorly, bearing from one to three prominent tubercles; in dorsal view the basals form a figure similar to that made by the basals of *Isocrinus decorus*; radials large, strongly convex proximally, slightly concave distally, about half again as broad as long, ornamented with a few coarse high tubercles, irregularly placed;  $IBr_1$  oblong, about twice as broad as long, without ornamentation; the lateral edges are just in apposition but are not flattened; they are cut away somewhat anteriorly and posteriorly, forming small rhombic pores on the lines of articulation between the  $IBr_1$  and the radials, and between the  $IBr_1$  and  $IBr_2$ ;  $IBr_2$  short and broad, triangular, two and one half times as broad as long, the anterior edges everted and produced into a high scalloped ridge;  $IBr_1$  and  $IBr_2$  united apparently by syzygy;  $IIBr_2$ , the distal edges of the segments standing out in high prominent scalloped ridges;  $IIIBr_4$  (3+4), the distal edges of the  $IIIBr_1, 2, 3$ , and  $4$  forming high scalloped vertical ridges.

About twenty-five arms 140 mm. long, the terminal 30 mm. being slender and bearing only very rudimentary pinnules as in the species of *Metacrinus* and *Hypalocrinus*; first brachial very obliquely wedge-shaped, the distal edges forming a straight line with those of adjacent first brachials and standing out in a high scalloped vertical ridge or bearing two or three high tubercles, the interior edges entirely united; second brachial smaller, wedge-shaped, about twice as long outwardly as inwardly, the distal edge everted as in the preceding; following brachials obliquely wedge-shaped, about twice as broad as long, after the twelfth

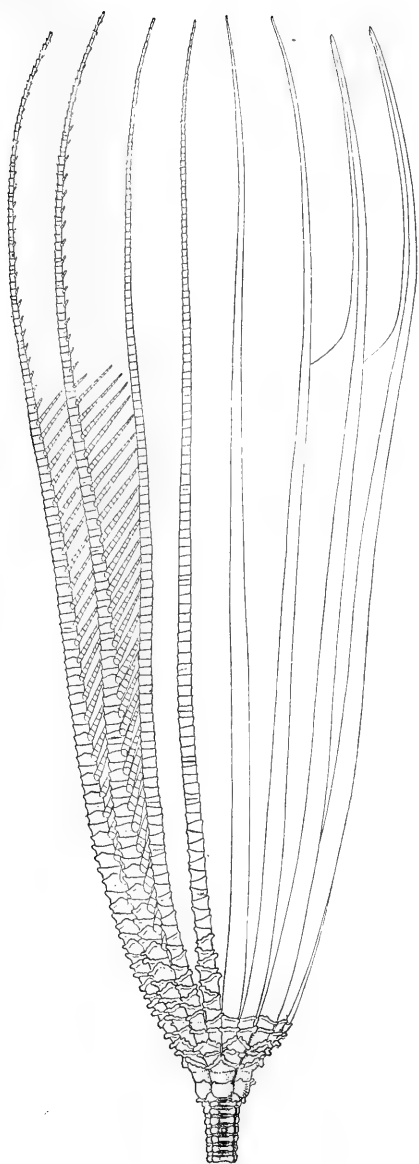


FIG. 48.—*Comastrocrinus springeri*.  
Lateral view of the crown.

becoming oblong, at first half again as broad as long, then gradually increasing in length and after about the middle of the arm being about as long as broad and in the terminal portion half again as long as broad; the great eversion of the brachials gradually dies away as the segments become oblong, giving place

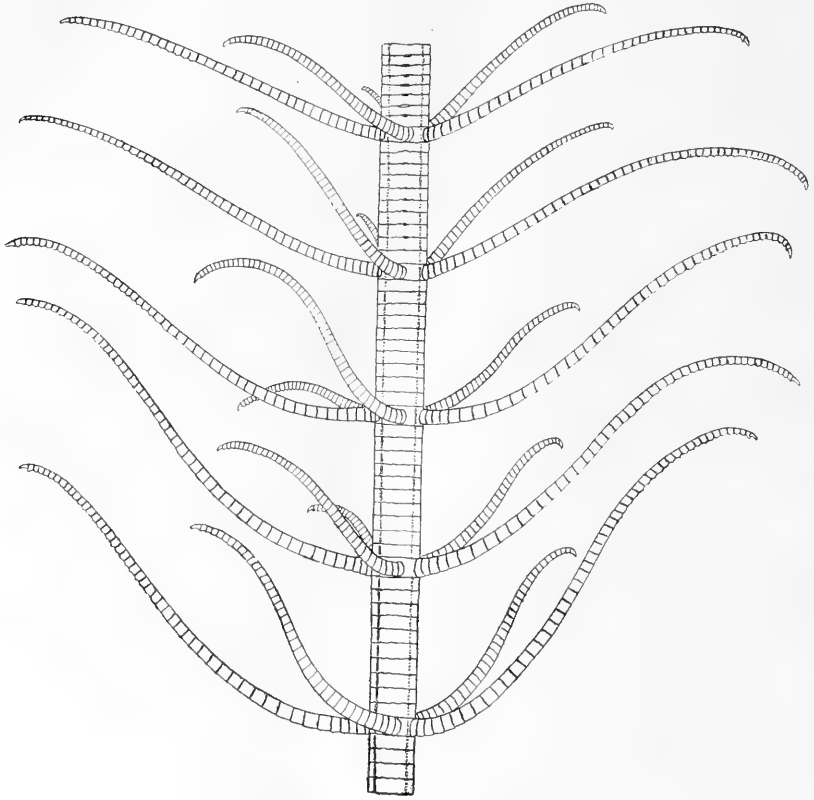


FIG 49.—*Comastrocrinus springeri*.  
The stem.

to a slight prominence of the distal edge which in the terminal part of the arm becomes a rather strong overlap. Syzygies occur between the second and third (or third and fourth) brachials (more rarely between the fourth and fifth), again between the fifteenth and sixteenth to thirty-first and thirty-second (usually in the vicinity of the twentieth) and distally at intervals of from four to nineteen

oblique muscular articulations, the interval being long in the proximal and short in the distal part of the arm.

The pinnules are in general like those of *Hypalocrinus navesianus*.

The colour in life is recorded as "stalks dark olive green, crown reddish at base of arms with green sub-tint, becoming deep olive green at the arm tips."

LOCALITIES.—*North of the Laccadive Islands* ( $13^{\circ} 47' 49''$  N. lat.,  $73^{\circ} 07' 00''$  E. long.); 636 fathoms (Type Locality).—Two broken specimens.

*West of Goa* ( $15^{\circ} 29'$  N. lat.,  $72^{\circ} 41'$  E. long.); 559 fathoms.—One broken specimen.

*Andaman Islands: 8 miles south of Cinquet*; 500 fathoms.—One specimen with seventeen arms; four of the IIBr series are 2, and two are 4 (3+4); the single IIIBr series is 4 (3+4).

#### COMASTROCRINUS ORNATUS.

*Hypalocrinus ornatus* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, p. 651.

DESCRIPTION.—In general like *C. springeri*, but a smaller and more delicate species.

Stem as in *C. springeri*, but only 3 mm. in diameter; cirri proportionately more slender, 30 mm. long (ten times the stem diameter) with forty segments, the dorsal tubercles commencing at about the seventeenth; basals as in *Isocrinus decorus*, without ornamentation; radials without ornamentation, but with the distal edges everted and produced into a high thin scalloped overlapping ridge; IIBr 4 (3+4).

Eighteen to twenty arms, about 95 mm. long from the radials.

The colour in spirits is white.

LOCALITIES.—*Andaman Sea*; 200 fathoms (Type Locality).—One specimen.

*Near the Pedro Shoal* ( $13^{\circ} 47' 49''$  N. lat.,  $73^{\circ} 07' 00''$  E. long.); 636 fathoms.—Four specimens.

#### COMASTROCRINUS LILIACEUS.

*Hypalocrinus liliaceus* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 150.

DESCRIPTION.—This species is closely related to *C. springeri*; the internodals are usually from twelve to fourteen in number; the IIBr are 4 (3+4), more rarely 2; the IIIBr are 3 (2+3); the elements of the division series and the lower brachials are not strongly everted as in *C. springeri*, but are rather prominently overlapping, this overlap forming a rather sharp point on the side of the brachial which bears the pinnule; this character gradually dies away after the proximal third of the arm, disappearing almost entirely in the outer half. The first syzygy occurs between the second and third brachials as in *Capillaster*, and the first brachial bears a pinnule.

The colour in spirits is white.

LOCALITIES.—*South of Cheluba Island, Burma* ( $17^{\circ} 07' 30''$  N. lat.,  $94^{\circ} 05' 30''$  E. long.); 419 fathoms; bottom temperature  $54^{\circ} \cdot 3$  Fahr.; green mud (Type Locality).—One specimen.

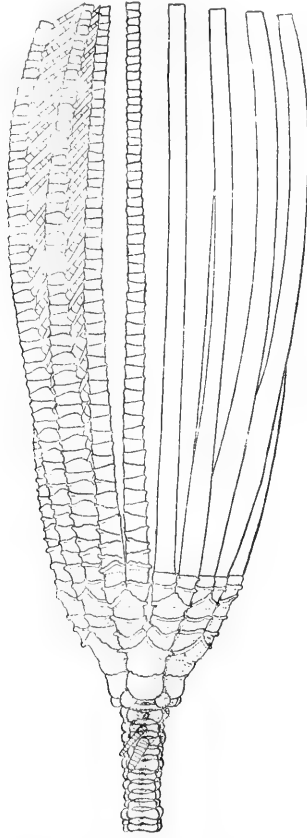


FIG. 50.—*Comastrocrinus ornatus*.  
Lateral view of the crown.

*West of the mouths of the Irrawaddy River; Station No. 323* ( $16^{\circ} 25' 00''$  N. lat.,  $93^{\circ} 43' 00''$  E. long.); 463 fathoms; bottom temperature  $35^{\circ} \cdot 2$  Fahr.; green mud.—Three specimens; one has twenty-seven arms with four of the IIBr series 2; the second has twenty-four arms, three of the IIIBr series being 2 and one



6 (3+4; 5+6); one of the IIIBr series is 4 (3+4), the others 3 (2+3); the stem is 335 mm. long with twenty-two internodes; the third specimen is immature; it has fourteen arms 70 mm. long, the terminal third of which bear only rudimentary pinnules; there are two IIBr 4 (3+4) and one IIIBr 1 series developed; the

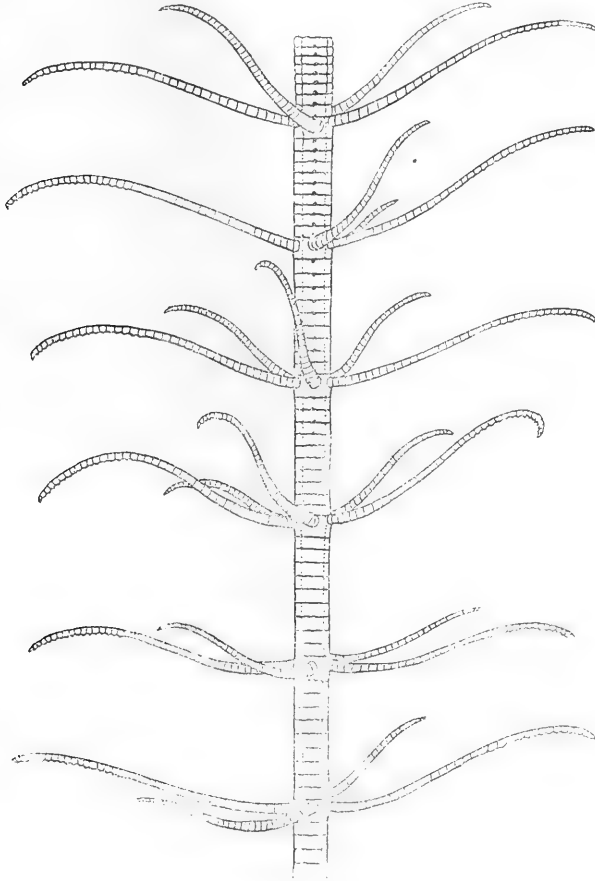


FIG. 51.—*Comastrocrinus ornatus*.  
The stem.

stem is 140 mm. long with twelve internodes. The stem of this specimen resembles that figured in the small specimen of *Isocrinus decorus* shown by P. H. Carpenter in the "Challenger" report on the Stalked Crinoids (pl. xxxv, fig. 1), but the cirri are more slender; in the most distal internodes the columnars

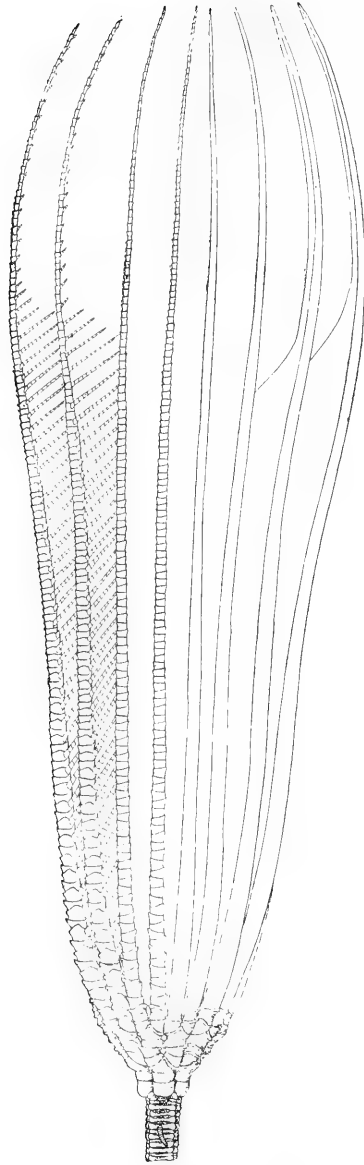


FIG. 52.—*Comastocrymus liliaceus*.  
Lateral view of the crown.

are slightly longer than broad, the articular faces having two ligament fossæ separated by a strong transverse bar or ridge, just as I have shown them to be in the very young stems of *Isocrinus decorus*; the crown is similar to that figured by Carpenter for very young *Hypalocrinus naresianus* (*T. c.*, pl. 30a, fig. 1); there is the same production of the edges of the IBr series.

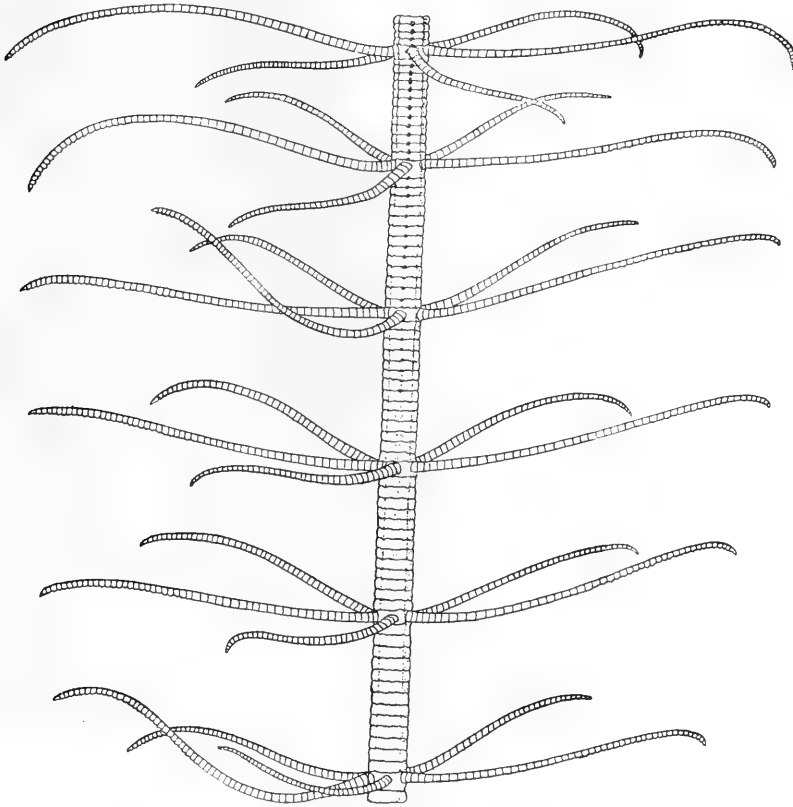


FIG. 53.—*Comastrocrinus lilaceus*.  
The stem.

Genus HYPALOCRINUS.

*Hypalocrinus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, p. 152;  
Proc. U. S. Nat. Mus., vol. 35, p. 129 (*Pentacrinus naresianus* P. H.  
Carpenter, 1882 (1884)).

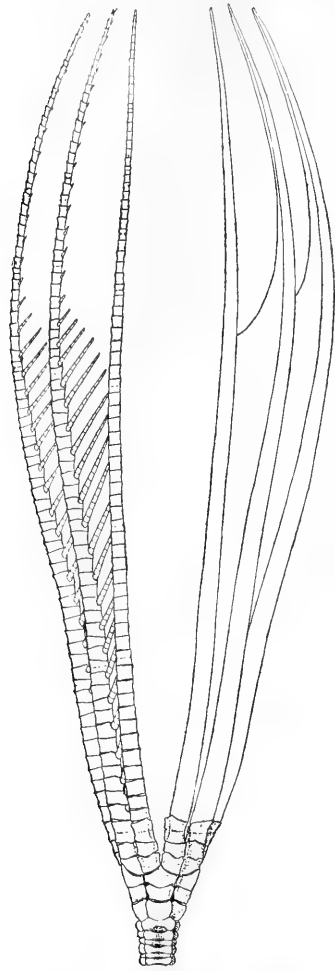


FIG. 54.—*Comastrocrinus liliaceus*.  
The crown of a very young specimen.

#### HYPALOCRINUS NARESIANUS.

*Pentacrinus balfouri* WYVILLE THOMSON, MS.

*Pentacrinus naresianus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11,  
Zoölogy, p. 324, pl. xxvii, figs. 11-13; pls. xxviii-xxx.

*Hypalocrinus naresianus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 152.

HABITAT.—Kermadec Islands; Meangis Islands; Fiji; Philippines; Celebes.

DEPTH.—375-1350 fathoms.

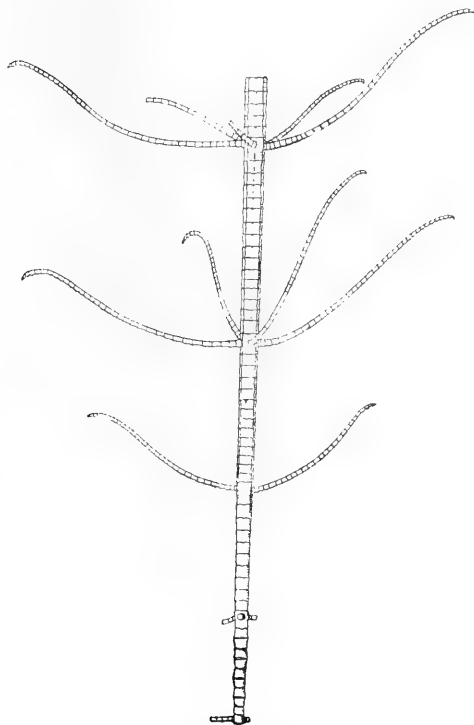


FIG. 55.—*Comastrocrinus liliaceus*.

The distal part of the stem of the specimen represented in fig. 54.

#### Genus ENDOXOCRINUS.

*Endoxocrinus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 151  
(*Encrinus parræ* Gervais,<sup>1</sup> 1835).

<sup>1</sup> Incorrectly given as Guérin in the reference cited; the original paper is signed merely "G."

## ENDOXOCRINUS SIBOGÆ.

*Isocrinus sibogæ* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 18, pl. ix, fig. 1; pl. xiii, fig. 12.

*Endoxocrinus sibogæ* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 152.

HABITAT.—Near Timor.

DEPTH.—520 meters.

## ENDOXOCRINUS ALTERNICIRRA.

*Pentacrinus alternicirra* 1882. P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. **10**, No. 4, p. 167.

*Pentacrinus alternicirrus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 321, pl. xxv; pl. xxvi; pl. xxvii, figs. 1-10.

*Endoxocrinus alternicirrus* 1908. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **21**, p. 151.

HABITAT.—Kermadec, Meangis, and Philippine Islands.

DEPTH.—375-600 fathoms.

## Genus METACRINUS.

*Metacrinus* 1882. P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. **10**, No. 4, p. 167.—1884. "Challenger" Reports, vol. **11**, Zoölogy, p. 339.—1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 527 (*Metacrinus wyvillii* P. H. Carpenter, 1884).

## METACRINUS ACUTUS.

*Metacrinus acutus* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 35, pl. x, figs. 1-16; pl. xi, figs. 6-8; pl. xii, figs. 6-13; pl. xiv, figs. 3, 11, 12; pl. xv; pl. xix, fig. 1; fig. 7b, p. 21.

HABITAT.—Ki Islands.

DEPTH.—204-310 meters.

## METACRINUS ANGULATUS.

*Metacrinus angulatus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 345, pl. xxxviii; pl. xxxix.

HABITAT.—Ki Islands to southwestern Japan.

DEPTH.—140 fathoms.

## METACRINUS BATHERI.

*Metacrinus batheri* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. **22**, p. 85.

DESCRIPTION.—Stem stout, 7 mm. in diameter, strongly stellate in cross section, with the produced interradial angles broadly rounded instead of sharp; cirrus sockets confined to the nodals, transversely oblong, the shorter diameter equal to the height of the nodals; nodals produced at the interradial angles into

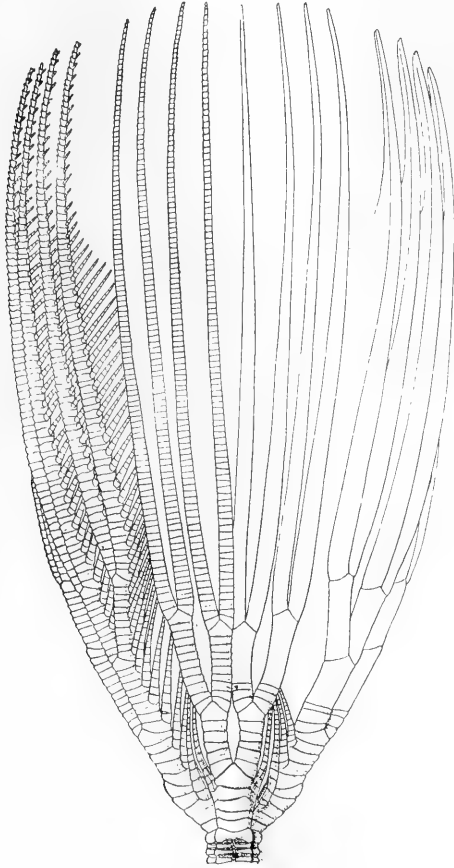


FIG. 56.—*Metacrinus bathevi*.  
Lateral view of the crown.

high dorsoventrally elongate tubercles which occupy their entire lateral edges; internodals six or seven, alternating in size, the longer with the angles produced into dorsoventrally elongate tubercles resembling those on the nodals, but somewhat smaller; radial faces of the internodals with low broad rounded ridges

which show a tendency to break up into tubercles, between the produced inter-radial angles.

Cirri 45 mm. to 50 mm. in length (about seven times the diameter of the stem) with from forty-eight to fifty segments, the first four very short, subequal, the following gradually increasing to the ninth, which is nearly or quite as long as broad, then remaining similar for five or six segments and very gradually decreasing in length distally so that the later segments are about twice as broad as long; cirri at first transversely oval in cross section, gradually becoming circular and after the first six or seven segments laterally compressed; on the terminal six or

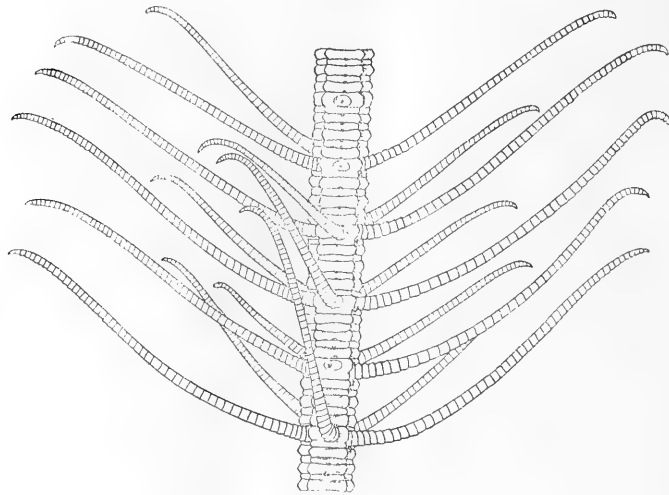


FIG. 57.—*Metacrinus batheri*.  
The stem.

seven segments there are indications of a median tubercle; terminal claw as long as the two preceding segments, conical, only slightly curved.

Basals very prominent, shield-shaped, in lateral apposition all around the calyx, strongly produced downward over the angles of the stem; radials narrow and band-like, of equal height all around the calyx, four or five times as broad as long in the median line; IBr 4 (1+2); IBr 5-11 (usually about 7); arms dividing four or five times, with usually one more axillary exteriorly than interiorly (in reference to the IBr series); arms as far as the IBr axillary robust, the articular tubercles rather strongly indicated, the dorsal surface perfectly smooth; beyond the IBr axillary the brachials have prominent finely spinous distal ends and are rough to the touch.

The pinnules are essentially like those of *M. acutus*.



The colour in spirits is white.

LOCALITY.—*Malay Archipelago*; 160 fathoms.—One specimen.

METACRINUS BATHERI var. GRACILIS, var. nov.

DESCRIPTION.—The stem is 6 mm. in diameter, and in general presents a more delicate and a smoother appearance than that of typical *M. batheri*; it differs from the stem of the typical form in having the columnars all of very

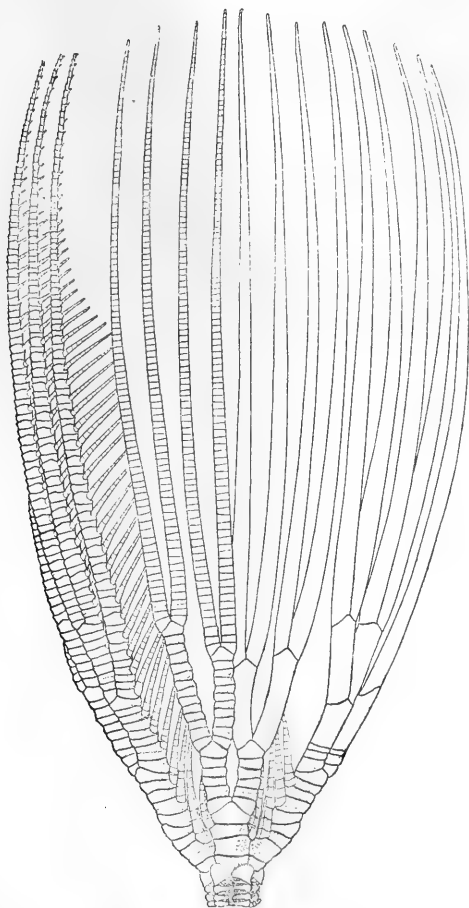


FIG. 58.—*Metacrinus batheri*, var.  
Lateral view of the crown.

nearly the same size instead of large and small alternating, and in having the low broad rounded ridges reduced to a single laterally elongate median tubercle, which may be more or less divided in the centre; the produced angles also are a trifle more produced and less strongly rounded. The internodals number eight or nine. The entire stem is 215 mm. long with nineteen internodes. The cirri are 45 mm. long.

The arms appear to resemble those of typical *M. batheri*, but are rather stouter: the IBr series are all 4 (1+2); the arms are about eighty in number

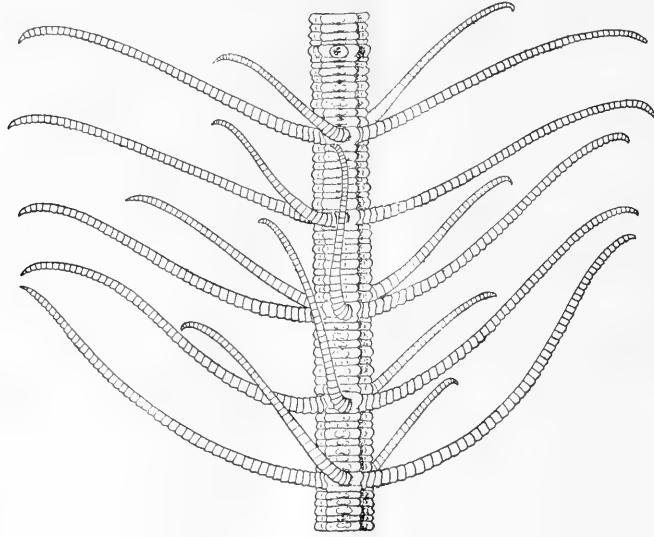


FIG. 59.—*Metacrinus batheri*, var.  
The stem.

(eight on the only perfect IBr series) and are approximately 140 mm. long from the radials, or 50 mm. long from the radials to the axillaries of the outer IVBr series.

The colour in spirits is white.

LOCALITY—*Gaspar Strait*; 30 fathoms.—One fragmentary specimen.

#### METACRINUS CINGULATUS.

*Metacrinus cingulatus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 347, pl. xI; pl. xli, figs. 1-4.

HABITAT.—Ki Islands; Timor.

DEPTH.—204-520 meters.

## METACRINUS COSTATUS.

- Metacrinus costatus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 360, pl. xlvii, fig. 13; pl. xlix.  
 HABITAT.—Meangis Islands.  
 DEPTH.—500 fathoms.

## METACRINUS INTERRUPTUS.

- Metacrinus interruptus* 1884 P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 367, pl. lii.  
 HABITAT.—Philippine Islands; ? Sahul Bank.  
 DEPTH.—95 fathoms.

## METACRINUS MOSELEYI.

- Metacrinus moseleyi* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 355, pl. xlv; pl. xlvi.  
 LOCALITY.—Meangis Islands.  
 DEPTH.—500 fathoms.

## METACRINUS NOBILIS var. TYPICA.

- Metacrinus nobilis* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 351, pl. xli, figs. 5—11; pl. xliii.  
*Metacrinus nobilis* var. *typica* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 43.  
 HABITAT.—Ki Islands.  
 DEPTH.—140 fathoms.

## METACRINUS NOBILIS var. MURRAYI.

- Metacrinus murrayi* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 349, pl. xli, figs. 12—17; pl. xlii.  
*Metacrinus nobilis* var. *murrayi* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 43.  
 HABITAT.—Ki Islands; Timor.  
 DEPTH.—204-520 meters.

## METACRINUS NOBILIS var. TIMORENSIS.

- Metacrinus nobilis* var. *timorensis* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 43.  
 HABITAT.—Timor.  
 DEPTH.—520 meters.

## METACRINUS NODOSUS.

*Metacrinus nodosus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 364, pl. 1; pl. li.

HABITAT.—Kermadec Islands.

DEPTH.—630 fathoms.

## METACRINUS ROTUNDUS.

*Pentacrinus* sp. 1883. DÖDERLEIN, Archiv für Naturgesch., vol. xlix, I, p. 119.

*Metacrinus rotundus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 344.—1885. Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 436, pl. 1; pl. li, figs. 1-7.

HABITAT.—Southern Japan.

DEPTH.—63-406 fathoms; most common between 70 and 140 fathoms.

## METACRINUS SERRATUS.

*Metacrinus serratus* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 37, pl. xi, fig. 5; pl. xii, figs. 3-5; pl. xiv, fig. 10; pl. xvii, fig. 2.

HABITAT.—Sulu (Jolo) Archipelago.

DEPTH.—522 meters.

## METACRINUS STEWARTI.

*Metacrinus stewarti* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 344.—1885. Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 443, pl. lii, figs. 13-18.

HABITAT.—Singapore.

## METACRINUS SULUENSIS.

*Metacrinus suluensis* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 47, pl. xi, fig. 10; pl. xiii, fig. 6; pl. xvii, fig. 1.

HABITAT.—Sulu (Jolo) Archipelago.

DEPTH.—564 meters.

## METACRINUS SUPERBUS var. SUPERBUS.

*Metacrinus superbus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p. 344.—1885. Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 440, pl. li; pl. lii, figs. 8-12.

HABITAT.—Singapore; Ki Islands.

DEPTH.—204-310 meters.

## METACRINUS SUPERBUS var. BOREALIS.

*Metacrinus superbus* var. *borealis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **35**, p. 130.

HABITAT.—Southwestern Japan.

DEPTH.—103–152 fathoms.

## METACRINUS SUPERBUS var. TUBERCULATUS.

*Metacrinus superbus* var. *tuberculatus* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **35**, p. 130.

HABITAT.—Southwestern Japan.

DEPTH.—103–152 fathoms.

## METACRINUS TUBEROSUS.

*Metacrinus tuberosus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 369, pl. liii, figs. 1–6.

HABITAT.—Ki Islands.

DEPTH.—140 fathoms.

## METACRINUS VARIANS.

*Metacrinus varians* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 353, pl. xliv; pl. xvii, figs. 6–12.

HABITAT.—Kermadec Islands; Meangis Islands.

DEPTH.—500–630 fathoms.

## METACRINUS WYVILLII.

*Metacrinus wyvillii* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 358, pl. xvii, figs. 1–5; pl. xviii.

HABITAT.—Meangis Islands; Kermadec Islands; Philippine Islands.

DEPTH.—494–630 fathoms.

## METACRINUS ZONATUS.

*Metacrinus zonatus* 1908. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **52**, part 2, p. 200.

HABITAT.—Philippine Islands.

DEPTH.—80–110 fathoms.

## Family APIOCRINIDÆ.

*Apiocrinida* 1858. D'ORBIGNY, Hist. nat. des Crinoïdes vivans et fossiles, p. 25.

## Genus PROISOCRINUS.

*Proisocrinus* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **38**, p. 387 (**Proisocrinus ruberrimus**, sp. nov.)

## PROISOCRINUS RUBERRIMUS.

*Proisocrinus ruberrimus* 1909. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **38**, p. 387, figs. 1-3, pp. 388-390.

HABITAT.—Philippine Islands.

DEPTH.—940 fathoms.

## Genus CARPENTEROCRINUS.

*Carpenterocrinus* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 319 (**Pentacrinus mollis** P. H. Carpenter, 1884).

## CARPENTEROCRINUS MOLLIS.

*Pentacrinus mollis* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 338, pl. xxxiii, figs. 7-10.

*Carpenterocrinus mollis* 1908. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **34**, p. 319.

HABITAT.—Southern Japan.

DEPTH.—565 fathoms.

## Family HYOCRINIDÆ.

*Hyocrinidæ* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 217.

## Genus CALAMOCRINUS.

*Calamocrinus* 1890. A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. **20**, No. 6, p. 165 (**Calamocrinus diomedæ**, sp. nov.).

## CALAMOCRINUS DIOMEDÆ.

*Calamocrinus diomedæ* 1890. A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. **20**, No. 6, p. 165, —1892. Mem. Mus. Comp. Zoöl., vol. **17**, No. 2, pp. 1-95; pls. i-xxviii.

HABITAT.—Galápagos Islands; west coast of Central America.

DEPTH.—392-782 fathoms.

## Genus PTILOCRINUS.

*Ptilocrinus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **32**, p. 551 (**Ptilocrinus pinnatus**, sp. nov.).

## PTILOCRINUS PINNATUS.

*Ptilocrinus pinnatus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **32**, p. 551, pl. liii, fig., p. 552.

HABITAT.—Queen Charlotte Islands, British Columbia.

DEPTH.—1588 fathoms.

## PTILOCRINUS ANTARCTICUS.

*Ptilocrinus antarcticus* 1908. BATHER, Bull. de l'Acad. roy. de Belgique (Classe des sciences), mars 1908, p. 296, fig., p. 299.

HABITAT.—South of Tierra del Fuego (70° 23' S. lat., 82° 47' W. long.).

DEPTH.—About 480 meters.

## Genus THALASSOCRINUS.

*Thalassocrinus* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 474 (*Thalassocrinus pontifer* sp. nov.).

## THALASSOCRINUS PONTIFER.

*Thalassocrinus pontifer* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **39**, p. 474.

HABITAT.—Philippine Islands.

DEPTH.—1262 fathoms.

## Genus HYOCRINUS.

*Hyocrinus* 1877. WYVILLE THOMSON, The Atlantic, vol. **2**, p. 96 (*Hyocrinus bethellianus*, sp. nov.).

## HYOCRINUS BETHELLIANUS.

*Hyocrinus bethellianus* 1877. WYVILLE THOMSON, The Atlantic, vol. **2**, p. 96.

HABITAT.—Near the Crozet Islands.

DEPTH.—1600 fathoms.

## Family PHRYNOCRINIDÆ.

*Phrynocrinidæ* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **32**, p. 510.

## Genus PHRYNOCRINUS.

*Phrynocrinus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **32**, p. 507 (*Phrynocrinus nucus*, sp. nov.).

## PHRYNOCRINUS NUDUS.

*Phrynocrinus nudus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 32, p. 507, fig. 1, p. 508.

HABITAT.—Southern Japan.

DEPTH.—649 fathoms.

## Family BOURGUETICRINIDÆ.

*Bourgueticrinidæ*. 1882. DE LORIO, Paléontologie française, Terrain jurassique, vol. 11, p. 74.

## Genus BATHYCRINUS.

*Bathycrinus* 1872. WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, p. 772 (*Bathycrinus gracilis*, sp. nov.).

## BATHYCRINUS WOODMASONI.

*Bathycrinus woodmasoni* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 150.

DESCRIPTION.—This species is nearest to *B. equatorialis* from between the Marquesas Islands and Central America but, though considerably larger, it is of a more delicate build.

The type specimen consists of a stem lacking the topmost columnars.

Stem (without the proximal portion) smooth and slender, enlarging very gradually toward the root, the distal columnars with the articulations not especially swollen, the radicular cirri confined to the terminal columnar; length 327 mm., with one hundred and six columnars. Topmost columnar present twice as long as broad, the following increasing to two and one half times as long as broad on the fourth, then more gradually to three times as long as broad on the fourteenth, and nearly four times as long as broad on the twenty-third and following; length very slowly decreasing after about the fiftieth, the fourteenth from the distal end (root) and following being about as long as broad; last seven or eight with the articulations slightly swollen; periphery of the articular faces finely marked with radiating lines except at the ends of the transverse ridge; proximal columnars quite cylindrical, the articulations becoming slightly enlarged after the thirtieth; squarish distal columnars slightly constricted centrally as in the species of *Rhizocrinus* which have squarish columnars; radicular cirri stout, but only the bases preserved. The topmost columnars are 1 mm. long by 0.5 mm. in diameter; those in the middle of the stem are 4 mm. long by 1 mm. in diameter, while the squarish ones at the distal end are 2 mm. long; the last seven or eight are 3 mm. long with oval ends the faces of which measure 3 mm. by 1 mm., the two faces of each columnar being approximately at right angles to each other.

The colour in spirits is white.



LOCALITY.—*West of the Nicobar Islands* ( $6^{\circ} 18' N.$  lat.,  $90^{\circ} 40' E.$  long.); 1520 fathoms.

REMARKS.—This is the largest recent species of the family, surpassing even the gigantic *Rhizocrinus weberi* recently described by Döderlein from the East Indies.

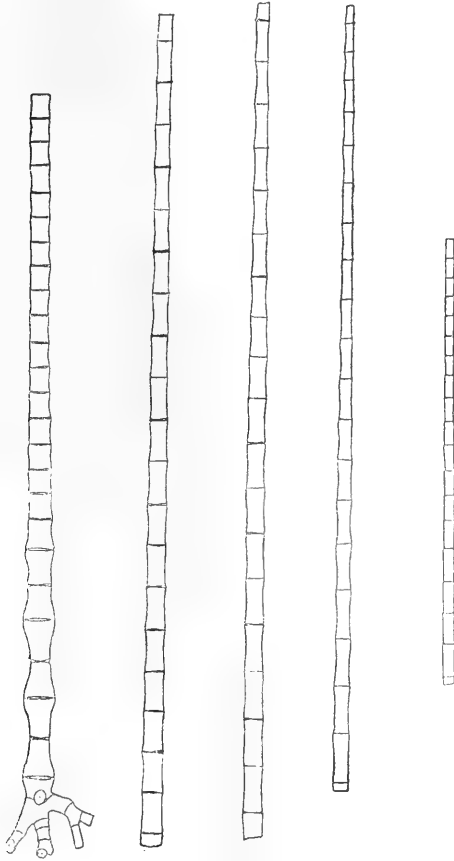


FIG. 60.—*Bathycrinus woodmasoni*.  
The type.

#### BATHYCRINUS EQUATORIALIS.

*Rhizocrinus* 1906. A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. 33, p. 49.

*Bathycrinus equatorialis* 1908. A. H. CLARK, Bull. Mus. Comp. Zoöl., vol. 51,  
No. 8, p. 233, pl. 1, fig. 1.

HABITAT.—East central mid-Pacific.

DEPTH.—2320 fathoms.

#### BATHYCRINUS AUSTRALIS.

*Bathycrinus aldrichianus* 1884. P. H. CARPENTER, "Challenger" Reports, vol. **11**, Zoölogy, p. 241, pl. vii; pl. viia, figs. 1-21; pl. viib; pl. viiaa, figs. 4, 5 (not of Wyville Thomson).

*Bathycrinus australis* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **22**, p. 553.

HABITAT.—Near the Crozet Islands.

DEPTH.—1375-1600 fathoms.

#### BATHYCRINUS COMPLANATUS.

*Bathycrinus complanatus* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. **50**, part 3, p. 337, fig. 123, p. 338.

HABITAT.—Near the Commander Islands, Kamchatka.

DEPTH.—1567 fathoms.

#### BATHYCRINUS PACIFICUS.

*Bathycrinus pacificus* 1907. A. H. CLARK, Proc. U. S. Nat. Mus., vol. **32**, p. 510, fig. 2, p. 511.

HABITAT.—Southern Japan.

DEPTH.—905 fathoms.

#### BATHYCRINUS NODIPES.

*Bathycrinus nodipes* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 9, pl. i, figs. 2-4; pl. iii, figs. 1, 2; pl. iv, figs. 1-5; pl. v, figs. 1-4; pl. vi, figs. 1-3.

HABITAT.—Banda; southern Celebes; Straits of Macassar.

DEPTH.—1158-1570 meters.

#### BATHYCRINUS POCULUM.

*Bathycrinus poculum* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 12, pl. i, fig. 4f; pl. ii, figs. 2-2d; pl. vi, fig. 4.

HABITAT.—Banda.

DEPTH.—1570 meters.

#### BATHYCRINUS MINIMUS.

*Bathycrinus minimus* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 8, pl. i, fig. 1; pl. ii, figs. 1-1f; pl. vi, fig. 5; fig. 1, p. 8.

HABITAT.—Straits of Macassar.

DEPTH.—1301 meters.

#### BATHYCRINUS PARADOXUS.

*Bathycrinus paradoxus* 1909. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, p. 151.

DESCRIPTION.—Stem very slender; longest columnars of smaller stem 2.5 mm. in length, of larger stem 3 mm.; columnars of middle of larger stem 0.7 mm. broad at the ends, 0.4 mm. broad in the middle.

Basals five, not anchylosed, forming a basal ring which expands slightly anteriorly and is about as long as the breadth at the top of the stem; radials forming a ring expanding rather rapidly outward from the basals; the sides evenly concave, two and one half times as broad distally as proximally, half again as broad distally as long; IBr<sub>1</sub> trapezoidal, nearly twice as long as broad proximally; IBr<sub>2</sub> trapezoidal, nearly twice as broad as long.

Arms ten, all broken off near the base, smooth, apparently similar to those of other species of the genus; IBr series and lower brachials with a broad thin produced border; distal two-thirds of the IBr<sub>1</sub>, and the following segments, with a sharp median keel.

LOCALITY.—*Bay of Bengal*; 1300 fathoms.

REMARKS.—The material examined consisted of two broken specimens; one stem, apparently lacking merely the topmost discoidal columnars, 67 mm. in length (thirty-eight columnars), broken into five parts; part of a larger stem, including the root and twenty-one columnars, and a crown without the distal portion of the arms probably belonging to the latter.

This interesting species is nearest to *Bathycrinus recuperatus*, originally described by Professor E. Perrier, and more recently redescribed and figured by Professor K  hler and M. Vaney.<sup>1</sup> Perrier's species was so different from the other species of the genus known at that time that he was inclined to regard it as a possible monstrosity. Later, for some reason not quite clear, he referred it to *Hyocrinus*. This species has never received the attention it deserves, possibly as a result of P. H. Carpenter's somewhat severe criticism of Perrier's work, and especially of his misconception of the genus *Bathycrinus*, which he confused with the so-called *Ilyocrinus* ("Ilyocrinus"), and of *Rhizocrinus*, which he renamed *Democrinus*.

*Bathycrinus paradoxus* agrees with *B. recuperatus* in possessing separate basals; but in *B. recuperatus* the IBr<sub>1</sub> and <sub>2</sub> have a perfectly smooth dorsal surface, and the columnars are not quite twice as long as broad. The basals also are very nearly as long as the radials.

In 1896 Dr. Camillo Crema of Turin published a description of a minute crinoid from the lower Muschelkalk near Roveglia, east of Recoaro, in the

<sup>1</sup> Bull. du Mus. d'hist. nat., 1910, No. 1, p. 28.

Vincentian Alps, under the name of *Apiocrinus recubariensis*. The specimen was later submitted to Dr. F. A. Bather, who redescribed and refigured it in detail under the name of *Millericrinus recubariensis*, considering it a primitive species

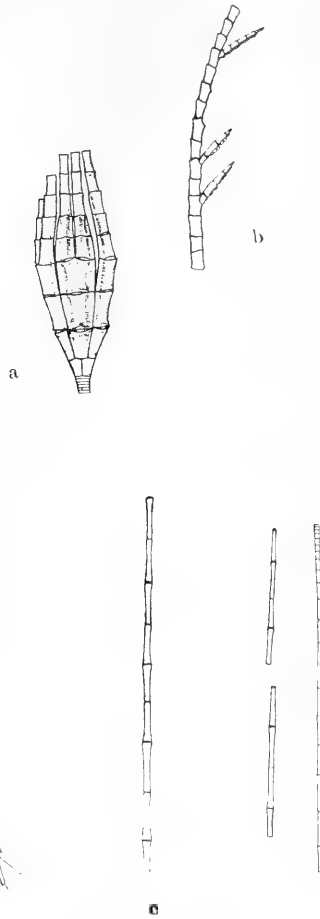


FIG. 61.—*Bathycrinus paradoxus*.

- (a) Lateral view of the crown.  
 (b) Lateral view of part of an arm.  
 (c) The stem.

of that genus. It resembles *Bathycrinus recuperatus* very closely, the most obvious differences being that the radials are very slightly less than the basals in height while the  $1Br_1$  and  $_2$  are very short, about three times as broad as the lateral length. The upper part of the stem is also somewhat more flaring. I

believe that the species should be referred to the genus *Bathyerinus* and be placed near the species *paradoxus* and *recuperatus*.

## Genus RHIZOCRINUS.

*Rhizocrinus* 1864. M. SARS, Forhandl. Vidensk. Selsk., 1864, p. 127 (**Rhizocrinus lofotensis**, sp. nov.).

## RHIZOCRINUS WEBERI.

? *Rhizocrinus* 1886. KOROTNEFF, Bull. de l'Acad. roy. de Belgique, (3), vol. 12, p. 558.

*Rhizocrinus weberi* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 15, pl. i, figs. 6-11; pl. ii, figs. 3-5; pl. vi, figs. 7-11; pl. vii, figs. 1-4; pl. viii, figs. 1-4; fig. 5a, b, p. 14.

HABITAT.—Sulu (Jolo) Archipelago; Timor; Ceram Laut.

DEPTH.—112-2050 meters.

## RHIZOCRINUS CHUNI.

*Rhizocrinus* sp. nov. 1900. DÖDERLEIN, in CHUN, Aus den Tiefen des Weltmeeres, p. 487, fig., p. 488.

*Rhizocrinus chuni* 1907. DÖDERLEIN, Die gestielten Crinoiden der Siboga-Expedition, p. 14, pl. i, fig. 5; pl. vi, fig. 6; fig. 6, p. 14.

HABITAT.—Coast of Somaliland, East Africa.

DEPTH.—1644-1668 meters.

## LIST OF UNIDENTIFIABLE SPECIES AND OF INDEFINITE REFERENCES.

## CAPUT-MEDUSÆ CINEREUM.

*Caput-Medusæ cinereum* 1733. LINCK, De Stellis Marinis, pl. xxi, fig. 33; copied in BRUGIÈRE, Encyclopedie méthodique, pl. cxxv, figs. 1, 2 (1792).

Professor Johannes Müller has identified this figure with his *Alecto palmata*, and it is quite possible that he is correct in so doing; at any rate it is a species of the genus *Dichrometra*. Linnæus cites it in the synonymy of his *Asterias multi-radiata*.

## CAPUT-MEDUSÆ BRUNNUM.

*Caput-Medusæ brunnum* 1733. LINCK, De Stellis Marinis, pl. xxii, fig. 34; copied in BRUGIÈRE, Encyclopedie méthodique, pl. cxxv, fig. 3 (1792).

Dr. P. H. Carpenter has suggested that this figure represents a species of the Comasteridæ, and this conclusion is undoubtedly justified. One might even go

a step further and say that *Comanthus bennetti* is probably the form depicted. Linnæus included this figure among his citations under *Asterias multiradiata*.

#### STELLA MARINIS POLYACTIS, SEU LUNA MARINA.

*Stella marinis polyactis, seu Luna marina* 1761. SEBA, Thesaurus, vol. 3, pl. ix, fig. 3.

This species is said to have come from Mexico, but probably came originally from some point in the East Indies. Linnæus places it in the synonymy of his *Asterias pectinata*.

#### LUNA MARINA ALTERA.

*Luna marina altera* 1761. SEBA, Thesaurus, vol. 3, pl. ix, fig. 4.

No habitat is given for this form, which appears to be one of the *Comasteridæ*. Linnæus refers it to his *Asterias pectinata*.

#### ALECTO HORRIDA.

*Alecto horrida* 1815. LEACH, Zoöl. Miscell., vol. 2, p. 61, pl. 80.—1819. SCHWEIGER, Beobachtungen auf naturhistorischen Reisen, p. 66, pl. iv, figs. 39, 40, 41, 42.—1829. GUILDING, Zoöl. Journal, vol. 4, p. 173.—1833. LEUKART, Zeitschr. für organ. Physik, vol. 3, Heft 4, p. 385 (footnote).—1837. ANONYMOUS, Penny Encyclopedia, vol. 7, p. 391.—1879. P. H. CARPENTER, Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 4.

*Comatula horrida* 1840. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., apr. 1840, p. 6.—Archiv für Naturgesch., 1840, i, p. 311.

*G. horrida* 1840. J. MÜLLER, L'Institut, 17 sept. 1840, p. 394.

This species is founded upon an inadequate description coupled with an equally inadequate (coloured) figure. The type has been lost.

#### COMATULA sp.

*Comatula* sp. 1822. MITCHILL, American Journal of Science and Arts, vol. 5, pp. 46, 47.

“ My friend Mr. Covert, on a voyage from Canton to New York, during 1821, cast anchor with eighteen fathoms of line (one hundred and eight feet) in the straits of Gaspar, situated to the eastward of the island of Banca.

“ On hauling up the deep-sea lead, two marine productions which adhered, were brought on board the ship; one attached to the weight below, and the other clinging to the cord about ten feet from the bottom, or above the lead.

“ Both the specimens were brought home in good condition, and presented to me. Though they seem to be individuals of the same species, it was observed that when they were taken out of water, one of them appeared for a while yellow, and the other blue. This was probably, while the polypes were living, for after

death, the colour became a purplish brown, or of the hue belonging to many of the gorgonias.

“According to the modern classification, this singular and elegant production belongs to that tribe of the polypes which makes floating or movable habitations.

“The Comatulas are the most remarkable members of this family. They have a calcareous or corneous axis. They are not located in a spot, or fixed in a particular place, but move or swim about.

“The one now presented, instead of a *single feather*, as usual, consists of ten branches, proceeding from a common base or centre, and diverging outwards with an easy slope, makes a display like a coronet of plumes. Each is about eight inches long, and tapers gradually upward. The fringe-like appendage is on the inside, forming a row of offsets, about half an inch in length. The feathers articulated from the bottom to the top, are composed of parallel circles or rings.

“From the receptacle or point, where the receptacle exists, at which all the plumes unite, or from which they issue, a set of arms or feelers proceed or project in an opposite direction. These arms or feelers have some resemblance to the antennæ of lobsters; though from their disposition to clasp the things which come into contact with them, they resemble the tendrils of plants. They are nearly of the size of small crow-quills; and vary from half an inch to an inch in length. They are articulated and coloured like the plumes. They are twenty in number; and the extremity of each is armed with a claw like that of a bird or of a cat. Several of the joints or articulations near this terminal claw are also armed on the inner side, with claws of a like organization, but of smaller make. The arms or feelers, undoubtedly, possess the power of expansion or groping, and of seizing or embracing any object they may find. In one of the individuals I possess, a five-rayed *asterias* is firmly held, and indissolubly bound, by the embrace of the Comatula.

“This production of the Indian Ocean connects the *polypes* and *radiates* with the *sepias*, and all of them with the *ten-footed crustaceans*.”

#### ? COMATULA SOLARIS.

? *Comatula solaris* 1830. (LEACH), Catalogue of the Contents of the Museum of the Royal College of Surgeons of London, part iv, fasc. i, p. 14, No. 85 J. B.

A preparation of a comatulid which was brought by Sir Joseph Banks from the Society Islands is here recorded.

#### COMATULES.

*Comatules* 1831. FERUSSAC, Bull. des sci. nat. (2), vol. 26, p. 183.

Ferussac records that M. Lemare-Picquot brought home numerous comatulids from his voyage to the East Indies and South Africa.

## COMATULA POLYARTHRA.

- Comatula polyarthra* 1840. J. MÜLLER, Archiv für Naturgesch., 1840, i, p. 311.  
*Comatula polyartha* 1840. J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss.,  
 apr. 1840, p. 6.—L'Institut, 17 sept. 1840, p. 394.  
*Alecto polyarthra* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 144.—  
 1843. Abhandl. d. k. preuss. Akad. d. Wiss., 1841, p. 216.—1862. DUJARDIN  
 and HUPÉ, Hist. nat. des Zoophytes, Échinodermes, p. 203.  
*Alecto polyarthra* 1841. J. MÜLLER, L'Institut, 21 oct. 1841, p. 357.

This supposed species was found on the detached arms of some comatulid  
 with an unusually long intersyzygial interval.

## ALECTO TESSELLATA.

- Alecto tessellata* 1841. J. MÜLLER, Archiv für Naturgesch., 1841, i, p. 144.—  
 Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 184.—1843. Abhandl. d.  
 k. preuss. Akad. d. Wiss., 1841, p. 224.  
*Comatula tessellata* 1849. J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss.,  
 1847, p. 251.—1862. DUJARDIN and HUPÉ, Hist. nat. des Zoophytes, Échi-  
 nodermes, p. 202.—1879. P. H. CARPENTER, Trans. Linn. Soc. (Zoöl.), (2),  
 vol. 2, p. 29.  
*Antedon tessellatus* 1865. WYVILLE THOMSON, Phil. Trans. Roy. Soc., vol. 155,  
 p. 537.  
*Antedon tessellata* 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26,  
 Zoölogy, p. 193.—1907. HAMANN, Bronn's Klassen und Ordnungen des  
 Tier-Reichs, vol. 2, Abt. 3, p. 1580.  
*Himerometra tessellata* 1907. A. H. CLARK, Smiths. Miscell. Coll. (Quarterly  
 Issue), vol. 50, part 3, p. 356.

Müller's description is as follows: "10 Arme. 20–25 Ranken mit 45 Gliedern, die kaum so lang als breit, die letzten 24 mit Dörnchen. Das unterste der 3 Radialia des Kelches sehr niedrig. Zwischen der Syzygien der Arme 7–10, seltener bis 14 Glieder, die Glieder sehr niedrig, schüsselförmig, dachziegelförmig, ohne Kiel. Die zweite, dritte, auch wohl vierte aussere Pinnula sind die grössten. Haut der Schiebe mit kleinen Knochenplättchen bedeckt. Farbe überall violett. Grosse 1–1½ Fuss. Indien."

## PENTACRINUS GUETTARDI.

## PENTACRINUS ARNDTI.

- Pentacrinus guettardi*; *Pentacrinus arndtii* 1858. SHULZE, Bericht über der Versammlung. deutsch. Naturf. in Karlsruhe, 1858, p. 293.—1864. LÜTKEN, Vidensk. Medd. fra den Naturhist. Forening i Kjöbenhavn, 1864, p. 209.—1884. P. H. CARPENTER, "Challenger" Reports, vol. 11, Zoölogy, p.



427.—1907. HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, p. 1572.

One of these species (which are merely mentioned by name) is said to have come from Amboina; Dr. P. H. Carpenter suggests that it is probably a *Metacrinus*.

COMATULA MONILIS, C. POLYACTINIA, C. MONILIFORMIS, C.  
INSERTA, C. ACTINODES.

*Comatula monilis* etc. 1862. DUJARDIN and HUPÉ, Hist. Nat. des Zoophytes, Échinodermes, p. 208.

MM. Dujardin and Hupé list these species as being contained in the collection of the Paris Museum. The names are *nomina nuda*, and none of the supposed species have ever subsequently been described under them. I looked for these names during my visit to the Paris Museum, but was unable to find them; they appear to have been removed from the specimens and lost.

COMATULA TRIQUETA.

*Comatula triqueta* 1877. VON GRAFF, Das Genus Myzostoma, pp. 12, 13, 14, 15, 16, 18, 22, 23, 72, 79.

Professor von Graff refers to some East Indian comatulid under a MS. name proposed by Professor C. F. Lütken.

ANTEDON sp

*Antedon* 1882. BELL, Ann. and Mag. Nat. Hist. (5), vol. 10, p. 255.

Professor Bell says "Indications, the first within my knowledge,<sup>1</sup> of a comatula from Ceylon are presented by a specimen with thirty-nine arms, only a few cirri with about thirteen joints, the penultimate spine obsolete, with syzygies in the axillary distichals, axillary palmars, and third brachial; the next syzygy is in the eleventh brachial. The absence of a terminal comb from the proximal pinnules induces me to suppose that the specimen belongs to the genus *Antedon*, and it would appear to be undescribed. The dried condition of the specimen and the possession of only a single example forbid my describing it fully, or giving a fresh specific name."

ANTEDON ADEONÆ.

*Antedon adeonæ* 1884. BELL, Rep. Zoöl. Coll. H.M.S. "Alert," p. 156 (part).

Among the "Alert" collections at London there are some curious comatulids from Port Molle (12-20 fathoms) and from "Alert" Station No. 87, recorded

<sup>1</sup> The first comatulid was described from Ceylon in 1846, and a second was recorded three years later.

under the name of "*Antedon adeonæ*," which represent a very distinct new species, possibly belonging to the genus *Tropiometra*.

#### ACTINOMETRA CUMINGII.

*Actinometra cumingii* 1887. BELL, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645.

Professor Bell records under this name an "*Actinometra*" from Ceylon with more than ten arms. He says "This is typically a ten-armed species, but injury and subsequent repair frequently lead to the development of a larger number of arms."

I have recently examined this specimen, which is preserved in the British Museum, and I find it to be an example of the common *Comanthus parvicirra*.

#### ACTINOMETRA sp.

*Actinometra* sp. 1887. VON GRAFF, "Challenger" Reports, vol. 20, Zoölogy, pp. 3, 9.

Professor von Graff here describes the *Myzostoma* which he found on an undetermined black "*Actinometra*" from the Moluccas.

#### ANTEDON sp.

*Antedon* sp. 1887. VON GRAFF, "Challenger" Reports, vol. 20, Zoölogy, pp. 5, 7, 11.

Professor von Graff here describes the *Myzostoma* from five undetermined species of "*Antedon*" from the Moluccas.

#### ANTEDON IMPINNATA.

*Antedon impinnata* 1884. VON GRAFF, "Challenger" Reports, vol. 10, Zoölogy, pp. 15, 16, 18 (*nomen nudum*).—1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 206.

The only description which Carpenter gives is: "The third, fourth and fifth brachials have no pinnules; eight or ten cirri of twelve joints;" which would now be expressed:  $P_a$ ,  $P_2$  and  $P_b$  absent; cirri VIII-X, 12.

The locality is North Bay, Mauritius; 15 fathoms.

#### ANTEDON sp.

*Antedon* sp. 1888. P. H. CARPENTER, "Challenger" Reports, vol. 26, Zoölogy, p. 27.—1889. BATHER, Quart. Journ. Geol. Soc., vol. 45, p. 169.—1894. BATESON, Materials for the study of Variation, p. 436, No. 65 f.

Dr. Carpenter here records a tetraradiate specimen of some Japanese species of "*Antedon*" which was obtained by Professor Döderlein.

## ANTEDON spp.

*Antedon* 1890. MACMUNN, Quart. Journ. Micros. Sci. (N.S.), vol. 30, p. 58.

The following are referred to under this general heading: from "Challenger" Station No. 192:

<i>Adelometra angustiradia</i>	<i>Cyllometra manca</i>
<i>Parametra compressa</i>	<i>Strotometra parvipinna</i>
<i>Gephyrometra discoidea</i>	<i>Pachylometra patula</i>
<i>Pachylometra flexilis</i>	<i>Perometra pusilla</i>
<i>Asterometra longicirra</i>	<i>Stenometra quinquecostata</i>
<i>Pachylometra robusta</i> :	

From "Challenger" Station No. 214:

<i>Pæcilometra acela</i>	<i>Thalassometra pergracilis</i>
<i>Chlorometra aculeata</i>	<i>Thaumatometra lævis</i>
<i>Pachylometra angusticalyx</i>	<i>Crotalometra valida</i> .

## ACTINOMETRA sp.

*Actinometra* 1890. MACMUNN, Quart. Journ. Micros. Sci. (N.S.), vol. 30, p. 59.

The colouring matter of an "*Actinometra*" from Banda, and of a "large *Actinometra*" from Banda is discussed. These refer to one or two of the following species:

<i>Capillaster sentosa</i>	<i>Comanthus parvicirra</i>
<i>Capillaster multiradiata</i>	<i>Comanthus annulata</i>
<i>Comantheria briareus</i>	<i>Comaster multibrachiata</i>
<i>Comanthina schlegelii</i>	

## EUDIOCRINUS sp.; ANTEDON sp.

*Eudiocrinus*; *Antedon* 1891. WOOD-MASON and ALCOCK, Ann. and Mag. Nat. Hist. (6), vol. 8, p. 443.

"On muddy bottoms in the Andaman Sea some small and rather damaged specimens of two species of Comatulæ were trawled. These were *Eudiocrinus* (i.e., *Pentametrocrinus*) from 922 fathoms, and *Antedon* (?)—a ten-armed species—from 188–220 fathoms."

## ANTEDON BIFIDA.

*Antedon bifida* 1893. BELL, Cat. Brit. Echinoderms in Brit. Mus. (1892), p. 56.

Professor Bell, in discussing the distribution of *Antedon bifida*, says: "If the last views of Carpenter (Journ. Linn. Soc. xxiv (1891), p. 68) are correct this protean species [i.e. *Antedon bifida*] is represented off Bengal, for it would appear that *A. duebeni* is probably a synonym."

The author intended to say Brazil; *Antedon duebeni* was described from Rio de Janeiro and has not been found elsewhere.

## ANTEDON sp.

*Antedon* sp. 1892. SAVILE-KENT, The Great Barrier Reef of Australia; its Products and Potentialities, p. 43, pl. xi, figs. 7, 7A.

“Two other members of the same echinodermatous, or sea urchin and starfish class, observed on the Palm Island reefs, are depicted in the same coloured plate. These are the two Feather-starfish, *Antedon* sp., represented by figs. 7 and 7A, clinging to the corallum of the Gorgonia in the right hand upper corner. In general form they resemble the English Feather-star, *Comatula rosacea*; but they possess about forty, in place of the ten, pinnate arms of the European type. The variety of hues exhibited by the Barrier Reef species are legion, running through every gradation of tint from pale yellow to rose-pink, deep crimson and black, and including every conceivable intermixture of those colours. One especially handsome racial variety of this feather-star, obtained at Thursday Island, had its fern-like arms resplendent with shades of old-gold and bronze-green.”

## ANTEDON FIELDI.

*Antedon fieldi* 1894. BELL, P.Z.S., 1894, p. 401.

Bell's description is as follows: “Allied to *A. moorei* (see p. 287) but distinguished from it by the broad spine on the cirrus joints. Cirri about 20, with 18 joints, almost completely covering the centrodorsal. No syzygy on radials or distichals: the first on the third brachial.

“Colour bright purple with lighter cirri.

“Macclesfield Bank, 22–30 fathoms.

“I offer a brief diagnosis of this species, as the peculiarity of the broad spines on the cirrus joints ought to be known.”

I have examined the type specimen of this species in the British Museum, but have not been able to determine what it really is; it appears to be immature.

There is a second specimen in the British Museum, also from the Macclesfield Bank, taken in 13 fathoms.

## ANTEDON spp.

*Antedon* 1894. BELL, P.Z.S., 1894, p. 396.

Professor Bell lists two “*Antedon* sp. n. inq.” from the Macclesfield Bank, taken at unknown depths.

## ANTEDON sp.

(*Antedon* sp.) 1894. BELL, P.Z.S., 1894, p. 401.

Professor Bell says: “There is yet another bidistichate species which is altogether too much broken for description (from the Macclesfield Bank, in 13 fathoms) which has about 30 cirri and 20 smooth cirrus joints.”

## ACTINOMETRA sp.

*Actinometra tridistichata* BELL, MS.

*Actinometra* sp. 1894. BELL, P.Z.S., 1894, p. 402.

"Mention must also be made of an *Actinometra* to which I think it would be wrong to give a specific name, so broken is it, but of which it would be more wrong not to say something. It will be remembered that the late Dr. H. Carpenter divided the tridistichate species of this genus into those in which there is a syzygy on the second brachial and into those that have it on the third. In the specimen now before me there is no signs of any syzygy on either the second or the third brachial."

I examined this specimen at London and found it to be an example of the *Comaster gracilis* described by Hartlaub in 1890.

## ANTEDON MOOREI.

*Antedon moorei* 1894. BELL, P.Z.S., 1894, p. 401.

"This species is probably most nearly allied to *A.* (i.e., *Parametra*) *compressa*, P.H.C., but it has only faint spinous processes on the cirrus-joints. Cirri 25 to 30, with 25 joints. Centrodorsal bare in the middle. No syzygies on radials, distichals, or palmars. There may be post-palmars. The third brachial syzygial; arm-joints iii-vi, squarish, the succeeding triangular, and the more distal gradually overlapping.

"Colour purplish, with the free ends of the arms white.

"Macclesfield Bank, 13 fms.

"The single specimen is a good deal broken, but it is interesting as belonging to a series of the group of which Dr. Carpenter knew only one type."

In the type specimen, which I examined at London, the cirri are XVIII, 21, 21, 23, 25, 17 mm. long; the longest segments are about one third longer than broad; the thirteen outer segments are slightly broader than long and bear moderate spines.

The thirty-two arms are 60 mm. long; the IIBr and IIIBr series are 2, and are in close lateral apposition through lateral extensions.

$P_2$  is the longest, long and evenly tapering as in *Dichrometra protectus*, enlarged and slightly stiffened, with 16, 18, or 21 segments which become squarish on the third and twice as long as broad distally; the pinnule is about one third longer than  $P_1$ ;  $P_1$  is similar, but not quite so long or so stout, and tapering somewhat more rapidly;  $P_3$  is about as long as  $P_1$ , but is slightly stouter and tapers less rapidly, its character being more like that of  $P_2$ ; it has sixteen segments; the following pinnules are small and weak;  $P_2$  is considerably larger on the outer than on the inner arms.

This is an immature specimen of the species called *similis* by Carpenter; it is rather doubtfully distinct from *D. protectus*.

## ANTEDON sp.

*Antedon* 1894. THURSTON, Madras Government Museum Bulletin, No. 1, p. 28.

An undetermined species of "*Antedon*" is here recorded from two miles north of Muttuwartu Par, in 8 fathoms.

## ACTINOMETRA sp.

*Actinometra* 1894. WALTHER, Einleitung in die Geologie als historische Wissenschaft, p. 298.

Walther records an "*Actinometra*" as very common at Somerset, Queensland, in 15-22 meters.

## RHIZOCRINUS sp.

*Rhizocrinus* 1894. WALTHER, Einleitung in die Geologie als historische Wissenschaft, p. 300.

Walther mentions a "*Rhizocrinus*" from 20-21 fathoms which I am unable to place; probably it is some species of *Bathycrinus*.

## ACTINOMETRA sp.

*Actinometra* 1898. BELL, P.Z.S., 1898, p. 849.

"The only crinoid obtained was an *Actinometra* from the outer part of the reef at Rotuma which I have not been able to specifically determine."

I have examined the specimen labeled "the only crinoid seen at Rotuma or Funafuti" at the British Museum, and find it to be a specimen of *Comatella maculata*.

## PENTACRINUS (? METACRINUS) sp.

*Pentacrinus* 1898. (BATHER), Natural Science, vol. 13, p. 7.

A perfect specimen, recorded under the name of *Pentacrinus*, though probably a *Metacrinus*, is stated to have been taken on Jahal Bank, 90 miles south of Timor, in 110 fathoms, and to have been deposited in the Raffles Museum at Singapore.

## COMATULIDA.

*Antedonida* 1898. (BATHER), Natural Science, vol. 13, p. 7.

On the coral reefs at Blaking Mati "the most striking forms are numberless *Antedonidæ*." Doubtless this refers to all the littoral families of comatulids.

## PENTAMETROCRINUS sp.

*Eudiocrinus* sp. nov. 1900. DÖDERLEIN, in Chun, Aus den Tiefen des Weltmeeres, p. 488.

Professor Chun records the discovery by the "Valdivia" of a sulphur yellow *Pentametrocrinus* representing a new species (as determined by Professor Döderlein) in 1289 meters off the coast of Somaliland.

## CRINOID.

*Crinoid* 1901. IJIMA, Zoöl. Coll., Japan, vol. 16, p. 27.

Dr. Ijima records that a small stalked crinoid was taken from the carapace of a specimen of the giant crab (*Macrocheira kæmpferi*) caught in Sagami Bay.

## ANTEDON LEVISSIMA.

*Antedon levissima* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

“Dredged eight times in seven atolls between 20 and 37 fathoms, usually from a hard sand or shell bottom with some weed. In one dredging, 37 fathoms, in the middle but just within the N. passage of Suvadiva, some adults and thousands of the immature forms of this species of crinoid—and no other—were obtained.”

## ANTEDON spp.

*Antedon* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224.

“Genus *Antedon* immature forms—not identifiable—were dredged on ten occasions, sometimes in considerable numbers, between nineteen and thirty-seven fathoms, and a few were also secured by diving off the west reef of Hulule (Male Atoll, Maldives). They seem to especially frequent the inner ends of the passages where they embouch into the lagoons; in all cases the bottom is recorded as having rubble or coral, with perhaps sand or weed.”

## CRINOIDS.

*Crinoids* 1902. H. L. CLARK, Zoöl. Anzeiger, vol. 25, p. 670.

Dr. Clark refers here to the entire collection of crinoids made by the “Albatross” off southern Japan in 1900.

## ACTINOMETRA spp.

*Actinometra* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225.

“Genus *Actinometra*. Young forms were obtained off the coral masses of the west reef of Hulule. It is noticeable that neither this genus nor *Antedon* was found in the lagoon nor on the reefs of Minikoi.”

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In the following list are included, in chronological order, all the works mentioned in the foregoing pages, and all the additional works of interest to the student of the crinoids of the Indian Ocean of which I have knowledge. In many of them Indian crinoids are mentioned only incidentally, while in a few the classification only is discussed.

I have also included all the works upon the crinoids of Africa, or in which African crinoids are mentioned. Most of these contain references to Indian crinoids, though a few do not. It has seemed best to include these on account of the close relationship between the faunas of the coasts of Africa and those of the Indian Ocean.

It has not seemed necessary to include reference to works of a general nature, such as encyclopedias, dictionaries or general zoological treatises. Many such works include much original matter, and many are very excellent compilations.

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## APPENDIX.

During the work upon the Indian Museum collections specimens from time to time were found which for some reason or other could not be satisfactorily identified. These were mostly small, broken, or aberrant individuals; but among them were several which appeared to be representatives of new species, related most nearly to species of which I had no examples at hand for comparison.

These specimens were set aside in the hope that material would come to hand from other sources which would assist in their determination. The study of the enormous "Siboga" collection, received soon after the return of the proof of the first half of this monograph, enabled me to solve practically all of the problems presented, though unfortunately too late for the insertion of the species involved in their proper places. They are therefore included here in the form of an appendix.

Seven specimens, all very small, resisted all attempts at identification. They represent the ten-armed young of certain multibrachiate forms of quite different appearance. In order to make this report a complete catalogue of all the specimens studied these are listed at the end of this appendix.

## CAPILLASTER MULTIRADIATA.

LOCALITIES.—*Southwest of the mouths of the Irrawaddy River: "Investigator" Station 387 (15° 25' N. lat., 93° 45' E. long.); 49-40 fathoms.—Three specimens.*

*Two miles off Great West Torres Island.—One small specimen.*

*Southern portion of Malacca Strait.—One specimen.*

*Malay Archipelago: 160 fathoms.—One specimen.*

REMARKS.—One of the specimens from Station 387 has fifteen arms: one of the five HBr series is 2 instead of the usual 4 (3+4). One of the other specimens has thirty-eight arms 80 mm. long, and the third has forty-two arms 90 mm. long; both of these approach in their general character *C. sentosa*.

The specimen from Great West Torres Island has thirteen arms, and is undergoing adolescent autotomy.

The example from the southern portion of Malacca Strait is typical of the species; it has twenty arms 75 mm. long; all ten HBr series are present, all being 4 (3+4); the arms and division series are typically stout, and the brachials are typically short: the distal edges of the brachials are more strongly everted than usual, finely spinous, and the distal edges of the elements of the division series are similarly everted and spinous.

The individual from 160 fathoms in the Malay Archipelago is most extraordinarily irregular. It has thirty-six arms about 70 mm. long; the arms are comparatively stout; the division series are stout and are in close lateral appo-

sition; like the arm bases they are more or less flattened against each other; the brachials are of the typical short-discoidal type, and have strongly produced distal edges; the distal edges of the ossicles of the division series are also slightly produced, and are finely spinous.

The details of the arm division are as follows:—

Ray 1: Two IIBr 2 series; that to the left (viewed dorsally) bears outwardly (on the left) a IIIBr 2 series and inwardly (to the right) an undivided arm; both of the undivided arms arising from the IIIBr series have the first syzygy between the second and third brachials, but the (internal) undivided arm arising from the IIBr series has the first syzygy between the third and fourth brachials; the IIBr series to the right bears inwardly (toward the left) an undivided arm in which the first syzygy is between the third and fourth brachials, and outwardly (toward the right) a IIIBr 5 (4+5) series, the two derivatives from which have the first syzygy between the second and third brachials. The total number of arms on this ray is six, arranged in 2, 1, 1, 2 order.

Ray 2: Two IIBr 2 series; that to the left bears two undivided arms in which the first syzygy is between the third and fourth brachials; that to the right bears inwardly (to the left) a IIIBr 4 (3+4) series, both derivatives from which have the first syzygy between the second and third brachials, and outwardly (to the right) an undivided arm in which the first syzygy is between the third and fourth brachials. The total number of arms on this ray is five, arranged in 1, 1, 2, 1 order.

Ray 3: Two IIBr 2 series; that to the left bears externally (to the left) an undivided arm in which the first syzygy is between the second and third brachials, and internally (to the right) two IIIBr series, all four derivatives from which have the first syzygy between the second and third brachials; the IIBr series to the right bears two undivided arms in which the first syzygy is between the second and third brachials. The total number of arms on this ray is seven, arranged in 1, 4, 1, 1 order.

Ray 4: IIBr series to right 4 (3+4); IIBr series to left 2; the IIBr 4 (3+4) series bears two IIIBr 3 (2+3) series; in the four derivatives from these the first syzygy is between the second and third brachials in all cases except on the innermost (furthest to right) arm where it is between the fifteenth and sixteenth brachials; the IIBr 2 series bears two IIIBr 2 series; of these the inner (to the left) bears two IVBr 3 (2+3) series; the outer (to the right) bears inwardly (to the left) a IVBr 3 (2+3) series and outwardly an undivided arm; in all the derivatives from this IIBr 2 series the first syzygy is between the second and third brachials. The total number of arms on this ray is eleven, arranged in 2, 2, 4, 3 order.

Ray 5: Two IIBr 2 series; that to the left bears externally (to the left) an undivided arm, and internally (to the right) a IIIBr 3 (2+3) series; that to the right bears internally (to the left) an undivided arm and externally (to the right) a IIIBr 2 series which bears internally (to the left) a IVBr 4 (3+4) series and

externally an undivided arm; all the first syzygies in the arms of this ray are between the second and third brachials. The total number of arms on this ray is seven, arranged in 1, 2, 1, 3 order.

On the arms where the first syzygy is between the second and third brachials the first brachials always bear pinnules; but on the arms where the first syzygy is between the third and fourth brachials the first pinnule is on the second brachial.

In this specimen all but one of the IIBr series are 2, while of the ten IIIBr series present five are 2, three are 3 (2+3), one is 4 (3+4), and one 5 (4+5); the six IVBr series are all 3 (2+3). In the thirty-six arms the first syzygy is between the second and third brachials in twenty-nine, between the third and fourth in six, and between the fifteenth and sixteenth in one.

This specimen exhibits an unusual amount of reversional characters; the division series of 2 are the division series of *Comatella*, representing the so-called compound type of arm division, and are not the primitive division series of two ossicles as are found for instance in the genus *Dichrometra*. A large part of this specimen therefore would be unhesitatingly referred to some species of *Comatella* were it studied without regard to the remaining portions. The division series of 4 (3+4) is of the type characteristic of the subfamily Comasterinæ, and in particular of the genus *Comanthus*; it is the simplest type of arm division found in the whole family. The division series of 5 (4+5) is a variant of no particular significance. The syzygies between the second and third brachials are those of the genus *Capillaster*, and are normal for that genus only; those between the third and fourth brachials are normal for the species of the subfamily Comasterinæ only when occurring on the inner arms, but when found on the outer arms are normal both for the species of Comasterinæ and for the species of *Comatella*; the syzygy between the fifteenth and sixteenth brachials is a variant.

Analyzed on the basis of the characters furnished by the division series and the arms, we find this specimen to represent the genus *Capillaster*, the genus *Comatella* and the subfamily Comasterinæ in the following proportions:—

	Arm Division.	Arms.	Total.
<i>Capillaster</i>	38%	75%	56.5%
<i>Comatella</i>	54	6	30.0
Comasterinæ	6	17	11.5
(Variant)	(2)	(2)	(2.0)
	—	—	—
	100	100	100.0

Now the curious arm division of the species of the genus *Capillaster* beyond the IIBr series is in reality exactly the same as that of the species of the subfamily Comasterinæ (and of all the endocyclic families in which the IIBr series are 4 (3+4) except that the first component of the interpolated Z pair (the ossicle corresponding to the first primitive brachial) is omitted in all the division series

and in the free undivided arms. This condition was reached through compound division of the type characteristic of the species of the genus *Comatella*, which in its arm structure is essentially intermediate between the species of the subfamily Comasterinæ and those of the genus *Capillaster*.

The 30% of the characters of the genus *Comatella* found in this specimen therefore represent a reversion from the normal *Capillaster* type of arm structure to the *Comatella* type, through which the genus *Capillaster* passed.

The *Comatella* type of arm structure was derived from the primitive arm structure as seen in the subfamily Comasterinæ; therefore the 11.5% of the comasterine type of arm structure represents a reversion through the *Comatella* type to the most primitive type found in the family Comasteridæ.

The 2% of variant in the structure of the specimen indicates the semi-pathological condition which induced the reversion to the simpler types of structure.

In every species the greatest variation occurs on the borders of its habitat, either geographical or bathymetrical. Individuals from the centre of distribution possess a small coefficient of individual diversity, this increasing outwardly until the limits of the range are reached, where it becomes very large. As this variation is induced by unfavourable environment, it is more or less pathological in its manifestations, and always shows, when analyzed, retrogressive and more or less pathological features (*cf.* American Naturalist, vol. 45, 1911, pp. 372-374; American Journal of Science, vol. 32, 1911, pp. 127-132). Many specimens of *Capillaster multiradiata* from Japan or from the Caroline Islands are extraordinarily variable, in exactly the same way as the specimen under consideration is variable: these occur on the borders of the geographical range of the species. This specimen was dredged at 160 fathoms, a most unusual depth, and its aberrant features, judged on the basis of what we know in regard to other forms, would seem to indicate that this is about the extreme bathymetrical limit at which this form is able to maintain itself.

There is in the British Museum a curious example of this species, unfortunately without a record of the locality at which it was obtained. It has seventeen arms about 40 mm. long; three of the IIBr series are 2, the other two being 4.(3+4); each of the latter bears a IIIBr 3 (2+3) series; the IIBr 2 series may be immediately followed by a syzygial pair (the normal third and fourth brachials) or they may give rise to undivided arms in which the first syzygy is between the second and third brachials. Half of this specimen would certainly be identified as *Capillaster multiradiata*, while the other half would just as certainly be determined as *Comatella maculata*.

#### COMISSIA CHADWICKI, sp. nov.

*Actinometra parvicirra* 1904. CHADWICK, Report Ceylon Pearl Oyster Fisheries, Part 2, Supplementary Report xi, p. 158 (part), pl., figs. 13, 14.

DESCRIPTION.—Centrodorsal thin-discoidal with a large flat dorsal pole

3.5 mm. in diameter slightly excavated in the centre; cirrus sockets arranged in a single irregular marginal row.

Cirri XXIV, 12-14, 10 mm. long; the fourth and fifth cirrus segments are the longest, two to two and one half times as long as broad proximally; the sixth and following segments bear minute subterminal dorsal spines.

The radials are concealed by the centrodorsal; the IBr series are very widely separated laterally.

The ten arms are about 60 mm. long, and resemble those of *Comissia hispida*, but are a trifle more slender.

The terminal combs on the lower pinnules appear to have twenty-six or twenty-eight teeth.

LOCALITY.—Off the northeast coast of Ceylon ( $8^{\circ} 51' 30''$  N. lat.,  $81^{\circ} 11' 52''$  E. long.); 28 fathoms.—One specimen.

REMARKS.—Chadwick's specimen was dredged south of Galle, about 12 miles from land, in about 100 fathoms; judging from his figure the cirrus segments seem to number 13.

This species is most closely related to *C. hispida* from the Philippine Islands, agreeing with that form in the shape and proportionate size of the centrodorsal. It has, however, a greater number of cirrus segments.

#### COMISSIA HARTMEYERI, sp. nov.

DESCRIPTION.—Centrodorsal thin-discoidal, the dorsal pole flat, about 1 mm. in diameter.

Cirri VIII-XIV (usually about X), 10-13 (usually 12 or 13), 4.5 mm. to 6 mm. (usually about 5 mm.) long. The first segment is short, the second about as long as broad, the third from two to three times as long as its median diameter; the fourth segment is the longest, three and one half to four times as long as the median diameter; the fifth is not quite so long; the following segments rapidly decrease in length, so that the ninth and following are about as long as broad; the fifth is a transition segment; the longer proximal segments are oval in cross section and are strongly "dice-box shaped," but the outer short segments have straight sides and are strongly compressed laterally, therefore appearing broad in lateral view. The transition and following segments have the distal dorsal edge everted, forming a minute sharp tubercle in lateral view, at first subterminal but becoming median on the antepenultimate; the opposing spine is represented by a minute median tubercle only slightly larger than the tubercle on the preceding segment; the terminal claw is slightly longer than the penultimate segment, rather stout, and strongly curved, more so basally than distally.

The radials are even with the edge of the centrodorsal in the median line, but extend up interradially and entirely separate the bases of the IBr<sub>1</sub>; the IBr series are widely separated, their sides making nearly a right angle with the sides of the adjacent IBr series. The union of the elements of the IBr series is very close, appearing almost like a syzygy in external view.



The ten slender arms are from 30 mm. to 39 mm. long; the brachials, which are proportionately long, have strongly produced and overlapping spinous distal ends.

The mouth is marginal and the anal tube subcentral; the anal area is completely covered with small thin calcareous plates.

LOCALITY.—*Eig Tor, Gulf of Suez, Red Sea.*—Eight specimens, collected by Dr. Robert Hartmeyer.

#### COMATULA MICRASTER.

LOCALITY.—*Southwest of the mouths of the Irrawaddy River; "Investigator" Station 387 (15° 25' N. lat., 93° 45' E. long.); 49-40 fathoms.*—One specimen with arms about 45 mm. long; two cirri remain on the centrodorsal, which is much reduced.

#### COMASTER PARVUS.

LOCALITY.—*Andaman Islands.*—One specimen with twenty-eight arms, the IIIBr series being arranged in 1, 2, 2, 1 order; one of the derivatives from a IBr axillary is undivided.

Two arms from a fully grown specimen.

One ten-armed young, with arms 23 mm. long.

#### EUDIOCRINUS GRACILIS, sp. nov.

DESCRIPTION.—Centrodorsal as in *E. indivisus*.

Cirri X, 15-16, 9 mm. long; first segment about three times as broad as long, second about twice as broad as long, third about as long as the diameter of the expanded distal end; fourth and fifth segments about twice as long as their proximal diameter, the fifth slightly longer than the fourth; the following segments are about as long as their distal diameter; the cirri taper gradually to the fifth segment, which is a well-marked transition segment, and are more delicate from that point onward; the longer earlier segments are strongly constricted centrally with prominent flaring distal ends; beyond the fifth the ventral profile of the segments becomes straight, but the distal dorsal edge is produced so that the dorsal profile of the cirrus as a whole is strongly serrate; the antepenultimate segment is slightly longer than broad, without any production of the distal dorsal edge; the penultimate segment is wedge-shaped, about as long as the greater (ventral) length; the opposing spine is prominent arising from the entire dorsal surface of the penultimate segment, the apex terminal, the spine being equal in height to about one half of the distal diameter of the segment; the terminal claw is about as long as the penultimate segment, rather stout, strongly curved proximally but becoming more slender and straighter distally.

The arms are essentially like those of *E. indivisus*, and measure 55 mm. in length.

$P_c$  is 3.5 mm. long with nine or ten segments; it is small and weak, rounded, prismatic, and tapers evenly from the base to the tip; the segments, at first short, become about as long as broad on the third and twice as long as broad, or even longer, terminally.  $P_1$  is 4.5 mm. long with nine or ten segments, resembling  $P_c$  but proportionately larger and stouter.  $P_a$  is 7 mm. long, much larger and stouter than the preceding or succeeding pinnules, with ten segments of which the first is slightly over twice as broad as long, the second is about half again as broad as long, and the third is half again as long as broad; the following gradually increase in length and become about three times as long as broad distally; the pinnule is much more slender than the corresponding pinnule in the other species of the genus; the second and following segments have rather strongly produced distal edges which are armed with fine spines.  $P_2$  is similar but slightly longer and larger;  $P_b$  is 5 mm. long, slender, with twelve segments, in general resembling the preceding pinnules;  $P_c$  is 3 mm. long with nine or ten segments, which after the third become much elongated, small and weak. The distal pinnules are very slender, 6 mm. long.

The colour in spirits is a uniform dark purple, the cirri beyond the transition segment being nearly white.

LOCALITY.—*Southwest of the mouths of the Irrawaddy River; "Investigator" Station 387 (15° 25' N. lat., 93° 45' E. long.); 49-40 fathoms.*—Two specimens.

REMARKS.—A second specimen from the type locality has the cirri XIII, 16-18 (usually 18), 10 mm. to 12 mm. long; the sixth is a transition segment;  $P_c$  is 4 mm. long with ten segments;  $P_a$  is 9 mm. long with eleven segments;  $P_b$  is 6.5 mm. long with fourteen segments.

The slenderness and proportionate great length of  $P_a$  and  $P_2$ , which have very long segments distally, distinguishes this species from all the previously described species of the genus.

#### AMPHIMETRA PHILIBERTI.

LOCALITY.—*Andaman Islands.*—One small specimen.

#### AMPHIMETRA MOLLERI.

LOCALITY.—*Yé, Burma.*—Two specimens.

REMARKS.—These are typical specimens, and resemble the type (in the Copenhagen Museum), which was collected in the "East Indies." The synarthrial tubercles are small, but very prominent. The arms are 100 mm. long.

#### CRASPEDOMETRA ANCEPS.

LOCALITY.—*Andaman Islands.*—One immature specimen with fourteen arms about 100 mm. long.

## HETEROMETRA REYNAUDII.

LOCALITY.—*Northeastern Ceylon; Entrance to Palk Straits, Point Pedro bearing SSE., distant about three miles; 6–8 fathoms; sandy bottom.*—Ten specimens. One of these has fourteen arms, four IIBr series being present, all 4 (3+4); one has sixteen arms, five of the six IIBr series being 4 (3+4) and one 2; two have twenty arms, eight of the ten IIBr series being 4 (3+4) and two 2; one has twenty arms, seven of the ten IIBr series being 4 (3+4) and three 2; one has twenty-one arms, all the IIBr series being 4 (3+4), and all the IIIBr series, which are internally developed, 2; the remaining four are badly broken.

## HETEROMETRA PULCHRA, sp. nov.

DESCRIPTION.—Centrodorsal low-hemispherical, the dorsal pole slightly convex, finely pitted, 3.5 mm. in diameter; the cirrus sockets are arranged in two irregular rows.

Cirri XX, 32-39 (usually nearer the latter), 25 mm. long; the longest cirrus segments are slightly longer than broad; the short distal segments are but little broader than long; rather small, though sharp and prominent, dorsal spines are developed from the twentieth segment onward.

The radials are just visible beyond the edge of the centrodorsal; the IBr<sub>1</sub> are very short, band-like, about six times as broad as long; IBr<sub>2</sub> nearly three times as broad as long, the lateral edges slightly more than half as long as those of the IBr<sub>1</sub>; the division series are well rounded dorsally, in lateral apposition and laterally flattened as far as P<sub>D</sub>, with the sides slightly produced outward; the ossicles of the IIBr and IIIBr series are interiorly in lateral apposition through slightly produced edges. Eight IIBr series are present, six of which are 4 (3+4) and two of which are 2; there are six IIIBr series, all 2, and all developed internally except one, which is developed externally by the side of an internal series.

There are twenty-four arms (in the type) about 85 mm. long, perfectly smooth, and well rounded dorsally.

P<sub>D</sub> is 6 mm. long with twenty-two short segments, none of which are longer than broad; the second-fifth segments are strongly carinate dorsally, and from the sixth segment onward the pinnule is rather strongly prismatic. P<sub>1</sub> is 12 mm. long with twenty-seven segments, all of which are short, the distal being scarcely twice as long as broad; the second-sixth are strongly carinate, and the pinnule is prismatic from the seventh onward. P<sub>2</sub> is 13 mm. long with twenty-five segments, resembling P<sub>1</sub> but with more elongate segments distally; the second-sixth segments are carinate. P<sub>3</sub> is the largest and longest pinnule, 14 mm. long, slightly stouter throughout than P<sub>2</sub>, with twenty-two segments, of which the second-seventh are carinate; a supplementary carination extends along the pinnule from the sixth segment to the tip. P<sub>4</sub> is 9 mm. long with eighteen seg-

ments;  $P_5$  is 6 mm. long. The carination of the earlier segments is very strong on  $PP_{5-7}$ , but nearly or quite obsolete from that point onward.

The colour is flesh-colour, purple at the articulations; the cirri are yellow.

LOCALITY.—*Southwest of the mouths of the Irrawaddy River; "Investigator" Station 387 (15° 25' N. lat., 93° 45' E. long.); 49—40 fathoms.*—One specimen.

REMARKS.—This new species, while in general habitus perhaps most nearly resembling *H. savignii*, differs markedly from that form in the strong carination of the earlier segments of the lower pinnules, and in the smaller dorsal spines on the cirri, which begin much further from the centrodorsal.

It differs from *H. compta* in its more slender cirri which have more prominent spines, beginning further out, and in the comparatively large size of  $P_5$ .

From *H. bengalensis* it differs in its longer and more slender cirri which have longer segments, not developing spines until much further from the centrodorsal. The number of cirrus segments is somewhat greater than in any of these species.

From *H. brockii* it differs in the smoothness of the lower pinnules, and from *H. singularis* it may readily be distinguished by the large size of  $P_3$  as well as by the greater number of cirrus segments.

#### HETEROMETRA BENGALENSIS.

LOCALITIES.—*Off Gopalpore; 25—28 fathoms.*—Five specimens.

*Off Gopalpore; 30—38 fathoms.*—Ten specimens.

? *India.*—Two specimens.

REMARKS.—Of the five specimens dredged in 25—28 fathoms off Gopalpore one has fourteen arms 80 mm. long; one of the four IIBr series is 2, the other three being 4 (3+4); the cirri have 34-41 segments; the colour is white, the articulations banded with purple; the cirri are white, the distal part purple dorsally. Three of the specimens have each seventeen arms 80 mm. long, seven IIBr series being present in all cases; one has all the IIBr series 4 (3+4); the cirri have 31 segments; the colour is white with a row of small brown spots, in pairs, on the sides of the proximal third of the arms; another has one of the IIBr series 2, six being 4 (3+4); the cirri have 30—33 segments and are 20 mm. to 25 mm. long; the colour is white, with occasional blotches of brown on the arms; the third has two of the IIBr series 2, five being 4 (3+4); the colour is white, the cirri and well separated regular narrow bands on the arms being purple. The fifth specimen has nineteen arms 80 mm. long; one of the IIBr series is absent; the cirri are XVIII, 28—32, 20 mm. long; the dorsal pole of the centrodorsal is flat, 3 mm. in diameter; the colour is white, the cirri, narrow bands on the arms, and a series of small regular spots on the proximal third of the arms, brown.

Of the ten examples dredged in 30—38 fathoms off Gopalpore two have seventeen arms, three have eighteen arms, three have twenty arms, and two

have twenty-one arms. Of the seventeen armed specimens one has the arms 75 mm. long; all seven of the IIBr series are 4 (3+4); the cirri are 18 mm. long and have 26-28 segments; the colour is white; the other has the arms 85 mm. long; the calyx and arm bases are white, the arms being light yellow brown. Of the eighteen armed specimens one has the arms about 75 mm. long; all the IIBr series are 4 (3+4); one IIIBr 2 series is developed internally on one of the rays; the cirri have 32-36 segments and are 23 mm. long; the colour is light yellow brown; another has the arms 90 mm. long; the cirri are 23 mm. long and are composed of 30 segments; the colour is white; the third has the arms 110 mm. long; one of the IIBr series is 2, the remaining seven being 4 (3+4); both of the missing IIBr series are absent from the same ray; the cirri have 30-33 segments and are 23 mm. long. One of the twenty armed specimens has the arms 70 mm. long; in colour it is white, becoming yellow brown on the arms; the pinnules are purple; another has the arms 85 mm. long; all of the IIBr series are present, and all are 4 (3+4); the cirri are 20 mm. long, and are composed of 25-27 segments; the colour is white, the proximal part of the arms laterally spotted and the remainder of the arms narrowly banded with purple; the cirri are brown; the third has the arms 115 mm. long; all ten of the IIBr series are present, and all are 4 (3+4); the cirri are XIV, 33-34, 25 mm. long; the colour is white, with faint purplish blotches on the arms; the cirri are purple. One of the twenty-one armed specimens has the arms 75 mm. long; all of the IIBr series are present, all 4 (3+4); the single IIIBr series is 2, developed internally; the colour is white, the cirri deep purple; the other twenty-one-armed specimen has the arms 80 mm. long; all of the IIBr series are present, and all are 4 (3+4); the single IIIBr series, which is developed internally, is 2; in colour the calyx and arm bases are white, the arms yellow brown, and cirri purple.

Both the specimens from "(?) India" are small, the larger having twelve arms 25 mm. long.

#### DICHROMETRA CILIATA, sp. nov.

DESCRIPTION.—Centrodorsal moderate, the dorsal pole concave, 2 mm. in diameter.

Cirri XXVII, 29—35 (usually about 33), 30 mm. long; small but prominent dorsal spines are developed from the tenth to thirteenth segments onward.

Thirty-four to forty-two arms 110 mm. to 120 mm. long; the division series and arms resemble those of *D. flagellata*, but are more smooth, and have no trace of synarthrial tubercles.

$P_1$  is 11.5 mm. long, very slender, with twenty-nine segments, of which the second and third are about as long as broad, the fourth tapers somewhat distally, and the fifth and following are half again as long as broad, soon becoming twice as long as broad and three times as long as broad distally.  $P_2$  is

17 mm. long, no stouter than  $P_1$  basally but tapering more gradually, very slender, slightly stiffened, with thirty-four segments, of which the third is about as long as broad, the fifth is half again as long as broad, the tenth twice as long as broad, and the terminal three times as long as broad.  $P_3$  is 18.5 mm. long with thirty-one segments, resembling  $P_2$  but just perceptibly stouter.  $P_4$  is 11.5 mm. long with twenty-one segments, as stout basally as  $P_1$  but tapering more evenly.  $P_5$  is 6.5 mm. long with sixteen segments.  $P_6$  is 5 mm. long with twelve segments.  $P_7$  is 4.5 mm. long with twelve segments, not stiffened like the preceding pinnules; the following pinnules are similar; the distal pinnules are 7 mm. long with eighteen segments.

The rays and division series are moderately separated.

In colour the dorsal pole of the centrodorsal and the division series and arm bases as far as the third brachial are light greyish, thickly sprinkled with minute spots of white; the first syzygial pairs and the adjacent portions of the second and fifth brachials are blackish brown; the remainder of the arms is white, with narrow black bands at intervals of about 5 mm.; the entire ventral perisome is olive green with numerous small white spots; the cirri are white.

LOCALITY.—*Off Gopalpore; 30—38 fathoms.*—Five specimens.

REMARKS.—The five specimens have thirty-four, thirty-six, thirty-nine, forty and forty-two arms.

This species appears to be most nearly related to *D. flagellata*, from which it may be easily distinguished by the much longer and much more slender proximal pinnules, which are composed of very much longer segments, the small size of  $P_4$ , which is as small as  $P_1$  instead of being as large as  $P_2$  or  $P_3$ , and by the entire absence of the rugose appearance so characteristic of *D. flagellata*.

#### DICHROMETRA PROTECTUS.

LOCALITIES.—*Cinque Island, Andamans.*—One specimen.

“*Investigator*” *Station 91; 28 fathoms.*—One specimen.

*Northeastern Ceylon; Entrance to Palk Straits, Point Pedro bearing SSE., distant about 3 miles; 6—8 fathoms; sandy bottom.*—Four specimens.

REMARKS.—All the specimens recorded above are small and immature; that from Cinque Island has fifteen arms; the colour in life is recorded as having been in the “centre whitish, outer half of arms deep orange brown.” The example from Station 91 has twelve arms 35 mm. long. Of the four specimens from Palk Straits one has nineteen arms about 50 mm. long, with cirri 15 mm. long; one has twenty-one arms about 45 mm. long, and cirri XII, 15 mm. long; another has twenty-six arms, two of which spring directly from IBr axillaries; all the extra axillaries are external; the fourth has twenty-nine arms; IIIBr series are developed externally on all but one of the IBr series; the arms measure 45 mm. and the cirri 12 mm. in length.

## CENOMETRA HERDMANI.

LOCALITY.—*Off Gopalpore; 25—28 fathoms.*—Two specimens.

REMARKS.—The two specimens have twenty-eight and twenty-nine arms, about 100 mm. long. The three specimens in the type series have twenty-three, twenty-four and twenty-five arms, and the specimen recorded from the Ganjam coast has twenty-four.

## COLOBOMETRA DISCOLOR.

LOCALITY.—*Southwest of the mouths of the Irrawaddy River; "Investigator" Station 387 (15° 25' N. lat., 93° 45' E. long.); 49—40 fathoms.*—One specimen.

REMARKS.—This is a large example with the arms 110 mm. and the cirri 22 mm. long. It differs from the other specimens at hand in having  $P_2$  and  $P_3$ , though enlarged and stiffened, recurved instead of being straightened as usual.

The cirri are XVII, 34; one of them has a regenerating tip.

$P_1$  is 6 mm. long, weak and delicate, with sixteen segments;  $P_2$  is 10 mm. to 12 mm. long, stiff, but recumbent, with sixteen segments;  $P_3$  is 9.5 mm. to 11.5 mm. long, similar to  $P_2$ , with seventeen segments;  $P_4$  is 10 mm. long with sixteen segments which are slightly shorter than those of the preceding pinnules; the pinnule is slightly less stiff than those preceding;  $P_5$  is 8 mm. long with fifteen segments, and is less stiff than  $P_4$ ;  $P_6$  is 8 mm. long with fourteen segments, slightly weaker than the preceding pinnule;  $P_7$  and the following pinnules have slightly broader segments; the distal pinnules are slender, 11.5 mm. long.

## PROMETRA, subgen. nov.

GENOTYPE.—*Colobometra chadwicki* A. H. Clark, 1911.

DIAGNOSIS.—Similar to *Colobometra* as restricted (including the species *perspinosa*, *diadema*, *vepretum*, *suavis* and *discolor*); but the cirri are short with less than twenty-five segments, all of which are subequal and all, or at least the outer, about as long as broad.

RANGE.—Red Sea to southern Japan.

DEPTH.—10—55 fathoms.

## COLOBOMETRA (PROMETRA) BREVICIRRA, sp. nov.

DESCRIPTION.—Centrodorsal broad and flat as in *C. (P.) chadwicki*, the cirri arranged in a single marginal row.

Cirri XIV, 21—23 (usually the latter), 8 mm. long; the majority of the cirrus segments are about twice as broad as long, but in the outer half of the cirri the segments very slowly increase in length so that the antepenultimate is nearly or quite as long as broad. The earlier segments have thickened distal edges; on the fifth this production of the distal edge begins to divide, the lateral portions becoming swollen and a notch developing in the crest; on the ninth

this interrupted transverse ridge has resolved itself into two very small and very sharp tubercles situated side by side, which on the fifth segment preceding the penultimate themselves give place to single median dorsal spines; at all points these dorsal processes are practically median; they are exceedingly minute, and very sharp.

The radials project very slightly beyond the edge of the centrodorsal; their distal angles are slightly separated so that the bases of adjacent  $IBr_1$  are not in contact; the  $IBr_1$  are short, oblong, nearly four times as broad as long, with a low, though distinct, broad rounded median carination; the  $IBr_2$  are broadly pentagonal, half again as broad as long, the lateral edges as long as those of the  $IBr_1$  and making with them a broadly obtuse angle; in their proximal two-thirds they bear a broad rounded median carination similar to that on the  $IBr_1$ .

The ten arms are about 35 mm. long, their structure resembling that of the arms of *C. (P.) chadwicki*; the proximal oblong brachials have a slight trace of a rounded median carination.

$P_1$  4.5 mm. long with thirteen segments, evenly tapering to a delicate tip, somewhat stiffened, rounded prismatic; the first two segments are short, the third is slightly longer than broad, the fourth half again as long as broad, the following slowly increasing in length so that the distal are about twice as long as broad; beginning on the third very small but very sharp spines are developed on the distal ventral angles and in the middorsal part of the distal edge of each segment;  $P_2$  is 6 mm. long with twelve or thirteen segments, resembling  $P_1$  but larger, stouter and stiffer with slightly longer spines at the distal edges of the segments;  $P_3$  is 3 mm. long, more slender than  $P_1$  though essentially similar to it but without the spines on the distal edges of the segments; it is slightly stiffened;  $P_4$  and the following pinnules are slightly shorter than  $P_3$ , and apparently are not stiffened, at least distally; the distal pinnules are slender, 5 mm. long, with fifteen much elongated segments.

LOCALITY.—(?) *India*.—One specimen.

REMARKS.—This new species is most nearly related to *C. (P.) chadwicki*, with which it agrees in the relative proportions of its lower pinnules, though these are as a whole much shorter. It is a smaller form than *chadwicki* with proportionately shorter cirri which are composed of much shorter segments.  $P_2$  is much less elongate than the same pinnule in *chadwicki*, and is more slender with fewer segments, which do not become so elongate distally. In *C. (P.) brevicirra* the cirri, though short, are one-third again as long as  $P_2$ , while in *C. (P.) chadwicki*  $P_2$  and the cirri are about of the same length.

The only other species with which this needs comparison is *C. (P.) owstoni* of Japan (*Oligometra japonica* A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, p. 308; not *Antedon japonica* Hartlaub, 1890), which also has short cirri resembling those of *Oligometra serripinna*. In *owstoni*, however, the first three pinnules are all approximately equal in length and similar, though  $P_1$  is a trifle more



slender than the others, and all the cirrus segments beyond the second are about as long as broad.

It is only within a very few months that these little species which compose the subgenus *Prometra* have been recognized at all. It was in 1908 that the first two known species were recorded, both misidentified, and both referred to previously described species of *Oligometra*. Chadwick listed *Oligometra serripinna* from Suez Bay in 10 fathoms, and I recorded a supposed second specimen of *Oligometra japonica* from Sagami Bay in 55 fathoms. I received in exchange a specimen of Mr. Chadwick's *Oligometra serripinna* from Suez, and immediately recognized it as a new species of *Colobometra*, describing it as such. Later I compared my supposed specimen of *Oligometra japonica* with Hartlaub's type (in the Berlin Museum) and for the first time noticed the absence of  $P_a$  in my example. The type of *C. (P.) brevicirra* I for a long time thought was an aberrant individual of *Oligometra serripinna*; it did not quite agree with any of the other specimens at hand, and was therefore put aside awaiting the receipt of additional material which might throw some light upon it. The discovery that my supposed *Oligometra japonica* was really a *Colobometra* led me to re-examine this specimen, and I found that in reality it was a *Colobometra* and not an *Oligometra* at all. It is very evident, therefore, that the greatest care must be used in the identification of the species of *Oligometra* for, though all the species of that genus differ widely from the species of *Prometra* in minute detail, the species of the latter are superficially so very similar to those of the former as to be in danger of reference not only to that genus but to particular species in it.

A further complication has recently come to light; one of the specimens in the type series of *Oligometra serripinna* var. *erinacea* lacks  $P_a$  on both arms of one of the rays, and two specimens of *Oligometra gracilicirra* which I have recently examined lack  $P_a$  on all the arms, though all the specimens I had previously seen, including the type, had it present in all cases.

Taking other recent discoveries into consideration it has now become evident that the genera of the Colobometridae, all very distinct in their typical forms, in their more generalized types grade so insensibly into each other as to be with difficulty distinguishable.

#### OLIGOMETRA SERRIPINNA.

LOCALITY.—Off Gopalpore; 25—28 fathoms.—Two specimens.

Same Locality; 30—38 fathoms.—Two specimens.

REMARKS.—The two specimens from 25—28 fathoms have the lateral processes on the segments of the lower pinnules long, curved and hook-like; the segments of the lower pinnules other than those which are enlarged are produced and spinous. One of the specimens has an arm length of 65 mm.; the other is slightly smaller.

Both of the specimens from 30—38 fathoms have an arm length of 60 mm.

In one of them the distal ends of the segments of the lower pinnules are all produced and finely spinous, in addition to the production of the distal corners.

OLIGOMETRA SERRIPINNA var. ERINACEA, var. nov.

DESCRIPTION.—Centrodorsal as in typical *O. serripinna*, thin-discoidal, the dorsal pole flat, usually with a slightly raised rim, 2 mm. in diameter.

Cirri XV—XVII, 21-24 (usually 23), 10 mm. to 12 mm. long; the cirri are a trifle more slender than those of typical *O. serripinna*, and usually have a slight, though perceptible, distal taper after the proximal half; the segments are all short, most of them about half again as broad as long, not becoming as long as broad until the second or third before the penultimate; the dorsal processes resemble those of the cirri of typical *O. serripinna*, but the transverse ridge toward the middle of the cirri shows a more or less marked division into two halves, accompanied with a more or less deep and angular notch in the crest, and in the outer part resolves itself into two laterally elongate tubercles placed side by side.

The structure of the arms and of the arm bases is in general as in *O. serripinna*: the synarthrial tubercles on the joints between the elements of the IBr series and between the first two brachials are enormously developed as in *Perometra diomedea* or in *Amphimetra ensifer*, but their apices, though they may be smooth as in those species, are usually blunted and spread out laterally, bifurcated, or armed with several blunt spines; each (proximal and distal) half of the synarthrial tubercle may be at the tip armed with a sharp tubercle, the two tubercles pointing away from each other at a considerable angle, or the proximal half of the synarthrial tubercle may be distally laterally spread out and fan-like or dentate, and the distal half almost or quite unmodified. The synarthrial tubercle between the first two brachials as a rule departs more widely from the normal than that between the ossicles of the IBr series. The IBr axillary has a usually very long and prominent tubercle on either side of the anterior apex.

The second and following brachials have the distal edge everted, standing out at right angles to the dorsal surface as a very high finely spinous crest; on the earlier segments this crest is laterally narrow so that it appears as a high tubercle which may be slightly broadened or chisel-shaped at the tip, or may be bifurcate or coarsely dentate; after the first syzygy this process gradually broadens laterally so that after the second syzygy it comes to involve the whole distal border of the brachials, which stand out as very high more or less irregularly scalloped or dentate finely spinous vertical frills. The earlier narrow projections are usually divided up into a few large tubercles, but the broad later ridges are more uniform and more regular.

The pinnules in general resemble those of typical *O. serripinna*, but they are very much more ornate.  $P_1$  is 5 mm. long, very slender, with fourteen segments of which the outer are considerably elongated and the outer five or six

have high carinate processes involving the distal third or half of the median dorsal line;  $P_2$  is 7 mm. long with fourteen segments, which in the outer part are rather longer than is usual in typical *O. serripinna*; the processes in the middorsal line are much longer and larger than in the typical form, after the first four or five segments being a high uniform carination of the whole outer edge of the segment of which the crest is parallel with the longitudinal axis of the pinnule, and in the outer six or seven, though not involving so much of the segment, bifurcated; the ventrolateral edges of the pinnulars are as in typical *O. serripinna*. The following pinnules have the distal edges of the segments beyond the second greatly produced, especially in the middorsal line, this production in lateral view appearing like long overlapping spines such as are seen in the distal part of the arms of the species of *Asterometra* or of *Stylometra*. The distal pinnules, so far as they are preserved, do not appear to differ in any way from those of typical *O. serripinna*.

The size of this variety is the same as that of typical *O. serripinna*.

LOCALITY.—*Northeastern Ceylon; Entrance to Palk Straits, Point Pedro bearing SSE., distant about three miles; 6—8 fathoms; sandy bottom.*—Eighteen specimens.

#### NOT IDENTIFIABLE.

LOCALITIES.—*N. Cheduba; 10 fathoms (One specimen).—6° 01' N. lat., 81° 16' E. long.; 34 fathoms (One specimen).—Arrakan Coast (One specimen).—Andaman Islands (One specimen).—(?) India (Three specimens).*



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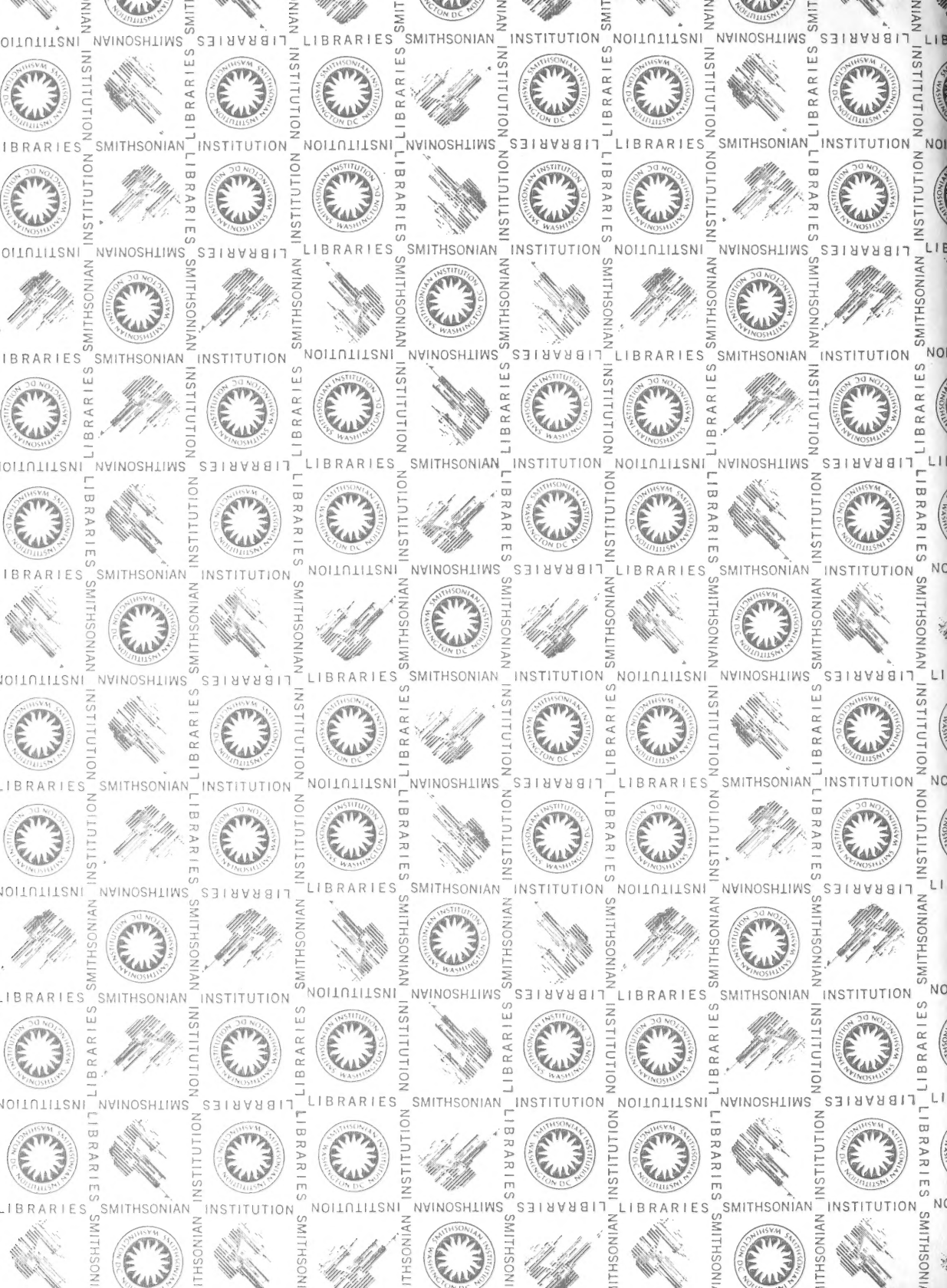
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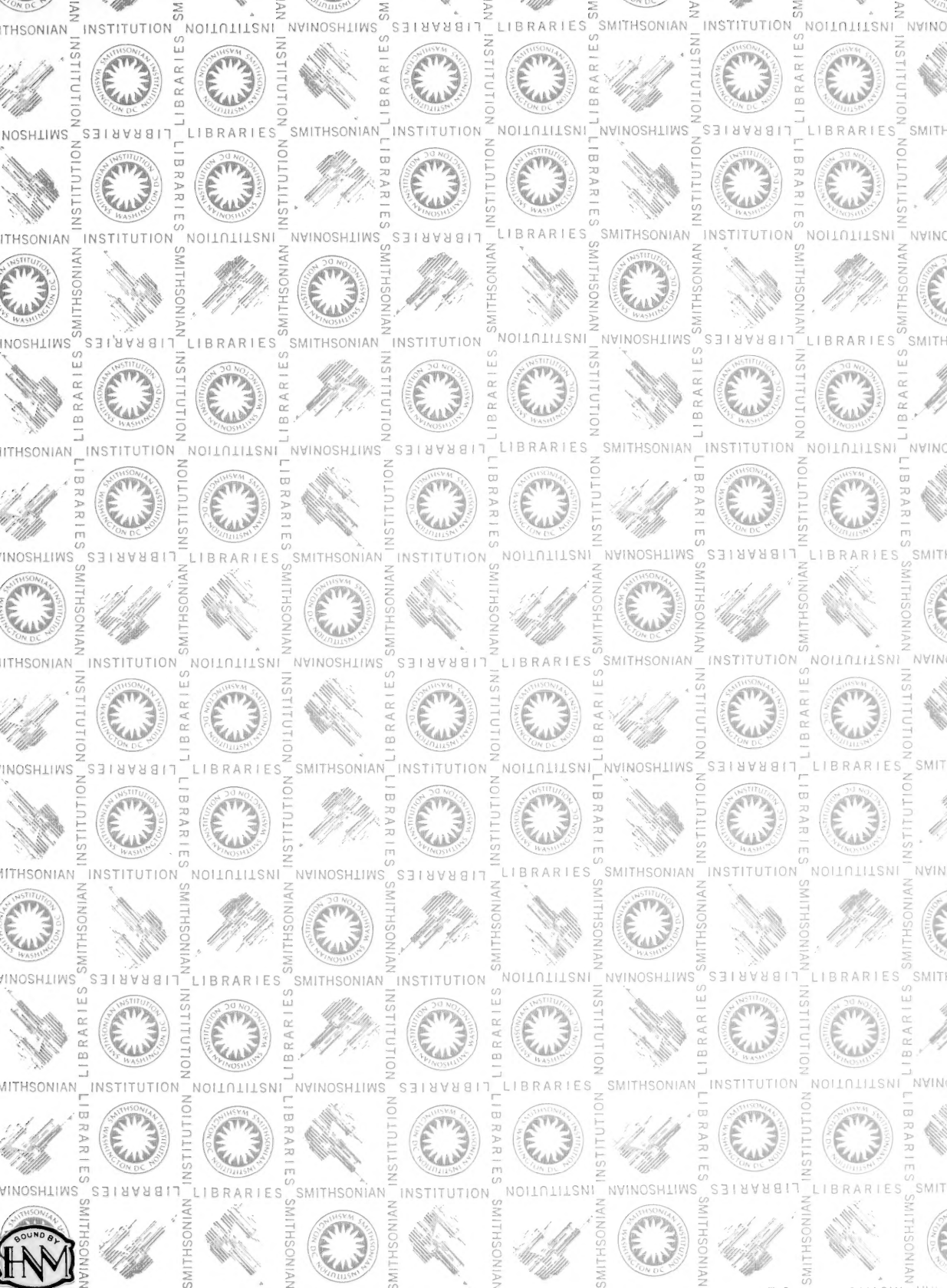












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