

MEMOIR

ON

THE SEA STARS

COLLECTED IN THE CARIBBEAN SEA AND THE GULF OF MEXICO

DURING THE EXPEDITIONS OF DREDGING MADE UNDER THE DIRECTION OF

ALEXANDER AGASSIZ

BY

EDMOND PERRIER

Professor administrator at the Muséum d'Histoire naturelle de Paris

NOUVELLES ARCHIVES

DU MUSÉUM

D'HISTOIRE NATURELLE

DEUXIÈME SÉRIE

TOME SIXIÈME

1884

Translated by John M. Lawrence

MÉMOIRE

SUR

LES ÉTOILES DE MER

RECUEILLIES DANS LA MER DES ANTILLES ET LE GOLFE DU
MEXIQUE DURANT LES EPÉDITIONS DE DRAGAGE FAITES SOUS LA DIRECTION

DE M. ALEXANDRE AGASSIZ

PAR

EDMOND PERRIER

Professor-administrateur au Musèum d'Histoire naturelle de Paris

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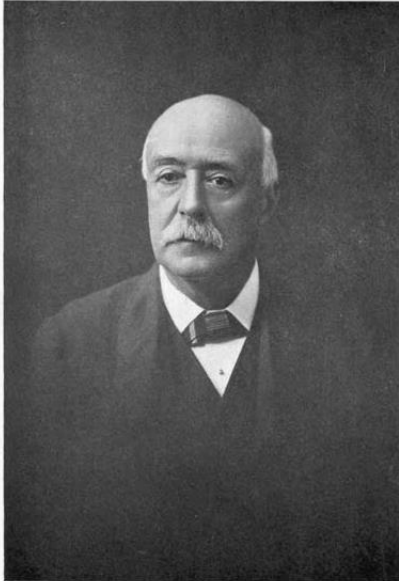
1884

Perrier, E. 1844. Memoir on the sea stars collected in the Caribbean Sea and the Gulf of Mexico during the expeditions of dredging made under the direction of Alexander Agassiz. *Nouvelles Archives du Muséum d'histoire naturelle. Deuxième Série. Tome Sixième.* 127–276.

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Jean Octave Edmond Perrier (9 May 1844 – 31 July 1921) He studied sciences at the École Normale Supérieure, where he took classes in zoology from Henri de Lacaze-Duthiers He was a schoolteacher for three years at a college. In 1869 he obtained his doctorate in natural sciences. In 1876 he attained the chair of Natural History (mollusks, worms and zoophytes) at the Muséum national d'histoire naturelle. In 1879 became chairman of the Société zoologique de France. In the early 1880s he participated in a series of sea expeditions. He became known as a specialist of marine fauna.



A. Agassiz

Alexander Emanuel Agassiz was born at Neuchatel, Switzerland, December 17, 1835. He came to the United States to join his father, Louis Agassiz, when he was thirteen years old. Among his other activities, he was director of the scientific staff of the United States Coast Survey steamer "Blake". He made three cruises in the Blake in the Gulf of Mexico, the Caribbean Sea, and along the lower east coast of the United States. Agassiz died March 27, 1910.

USC&GS *George S. Blake*, in service 1874-1905. It was named after United States Naval Academy Superintendent George S. Blake.

George S. Blake, a steam and sail schooner, was built in 1874 with dimensions of 148 feet 0 inches (45.11 m) length with 26 feet 6 inches (8.08 m) beam and draft of 11 feet 8 inches (3.56 m).

The Blake Plateau lies in the western Atlantic Ocean off the southeastern United States coasts of North Carolina, South Carolina, Georgia and Florida. It is named for the Blake that first used steel cable for oceanographic operations in deep-ocean and Gulf Stream exploration.

TRANSLATOR'S NOTE

Perrier used stellerides for the asteroids. I have translated “stelleride” as “asteroid” except for taxonomic names, e.g., “Stelleridæ Forcipulatæ”.

There are errors, inconsistencies in format, spellings and use of terms, incorrect use of italics, and capitalization of Perrier's taxonomic terms. For example:

In the list of species collected at the stations, Station 26 appears twice.

In the list of species collected by depth, specimens collected at 316 fathoms are in the category of specimens collected from 400 to 500 fathoms.

For *Pteraster caribbæus*, Perrier gives: “R = 30 mm; R = 15 mm; r = 2 r”.

In plate II, Perrier gives the author of the new species as T. P., not E. P.

Zoroaster Sigsbei and *Zoroaster Sigsbeei*.

Anthenoides and *Anthenoides*.

Perrier refers to ambulacral plates and adambulacral plates. “Ambulacral” is often used when the context indicates the word should be “adambulacral.” This results in incongruities:

“Ambulacral spines arranged in two rows, equal between them. In front of this double row is a double row of small straight pedicellariae, emerging from the bottom of the ambulacral groove.”

The context indicates this should read “Adambulacral spines arranged in two rows....”

Asterias angulosa ; “In the dried specimen that is our type, the spines of the internal row are inclined toward the ambulacral groove. The spines of the internal row are to the contrary inclined toward the ventral surface of the arms.”

The context indicates this should read “In the dried specimen that is our type, the spines of the internal row are inclined toward the ambulacral groove. The spines of the external row are to the contrary inclined toward the ventral surface of the arms.”

I have not changed these or other similar instances.

The taxonomy is understandably obsolete.

I thank Michel Jangoux for assistance with some of the more curious and difficult of Perrier's terms.

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INTRODUCTION — GENERAL RESULTS

This purpose of this work is to make known the asteroids collected by Alexander Agassiz during the dredging expeditions done in the Caribbean Sea and the Gulf of Mexico by the U.S. Steamer *Blake*. Alexander Agassiz has kindly conferred to me the study of these animals to which I prepared a long and detailed revision of the asteroids of the Museum that we published in 1875 and 1876¹. Alexander Agassiz has, in addition, authorized keeping duplicates of the specimens collected for the collections of the Museum of Paris. Our first word in writing this memoir must be an expression of deep recognition to the tireless scientist who thus asked us to take a double share of this precious collection he has made.

¹ *Archives de Zoologie expérimentale*, V. IV, 1875 and V, 1876 and reprinted in one volume of 384 pages.

The first *Blake* expedition was commanded by First Lieutenant Sigsbee. The investigations made from December 1877 to March 1878 extended from Key West to Havana, from Havana towards the west, the length of the north coast of Cuba, from Key West to Tortugas, from the extreme north of the Yucatan bank to Cape Catoche, to Cape San Antonio and, towards the north, to the mouth of the Mississippi.

In the second expedition that lasted nearly as long as that of the first, from December 1878 to March 1879, the *Blake* had First Lieutenant Barthlett as commander. Leaving Key West, the expedition went toward Havana to reach Jamaica by the Bahama Channel, the Windward Passage. Then to Saint Thomas, along the south coast of Haiti and Puerto Rico. Leaving Saint Thomas, the *Blake* visited Santa Cruz, the Saba bank, Monteserrat, Saint Kitts, Guadeloupe, Dominica, Martinique, Saint Lucia, Saint Vincent, the Grenadines, Grenada, to dredge to a depth of up to 100 fathoms², along the Trinity to return to Saint Vincent and end operations at Barbados.

During these two long cruises, 289 dredges were made, to depths varying from 14 to 2,412 fathoms. It was impossible that the results of such a campaign would not be remarkable.

For the sea stars along, the dredges collected a total of 54 species of which 46 are new. At the moment when the investigations of Alexander Agassiz began, the class of asteroids had only 450 species. Today, the number of known species is nearly 500. It is nearly a tenth that the investigations of the American scientists have increased the numbers of the class.

Until now, the region explored by Alexander Agassiz had collected 27 species of asteroids, most along the coast. The 46 new species that we will enumerate later, increases the number to 73. This number is triple, and we can say that the echinoderm fauna of the deep regions is, for the same region, incomparably richer and more varied than that of the coast.

The importance of this result appears still greater if we consider that, among the new species, a large number established unexpected relations between groups that seemed until now completely separated, while others provide interesting documentation on the general morphology of echinoderms.

Among the collected species, those that predominate in a decisive way belong to the families GONIASTERIDÆ and ARCHASTERIDÆ, i.e., to families that up until now, appeared to have especially prospered during the Cretaceous. This predominance is principally marked when we consider not only the number of species collected but especially the number of individuals taken per dredge. It is in the hundreds of individuals collected of one of the new species of *Archaster*, *Archaster mirabilis*. We can state, at the same time, that the variability of this species is extreme. We find *Archaster mirabilis* in the most diverse conditions at depths from 56 to 1,920 fathoms

Many species are difficult to place in the old generic divisions. The new genera that it is necessary to create establish between the already existing genera transitions all the more remarkable because they tend to remove delimitations that seem to exist between certain well characterized families. It is thus that *Goniopecten* will show us numerous intermediaries between *Pentagonaster*, *Archaster* and *Astropecten* that we have until now greatly separated, that *Anthenoides* has a place between *Anthenea* and *Pentagonaster*, that *Centaster* is like *Ctenodiscus*, while their marginal plates approach *Goniasteridae* and by their dorsal skeleton to some *Echinasteridae* such as *Solaster* and *Acanthater*. *Radiaster* reclaims, in turn, a place between *Solaster endeca* and the *Astropectinidæ* so that it becomes necessary to establish on new bases the characteristics of these diverse families.

We add that some types, such as *Hymenodiscus*, very little different from *Brisinga*, leads to a much more rigorous determination that we have been able to have until now on the relative value,

² The English fathom referred to here is 1.820 m.

from the morphological point of view, of the various pieces composing the skeleton of an asteroid. It is a study that we will have to resume before we engage in a detailed description of the species.

Among the interesting results from the point of view of the geographical distribution of the types, it is appropriate to cite the existence in the Gulf of Mexico of types first discovered in the cold regions of the globe, such as *Cribrella*, *Pedicellaster* and *Brisinga*.

The cribrellids are represented by a form with five arms and a form with six arms, having the ability of reproducing, like *Asterias tenuispina*, *Asterina cehea* and some other species, by the division of its disk into two equivalent halves. *Pedicellaster* gives us an interesting form, *Pedicellaster Pourtalesi*, with five arms. Near *Brisinga* is the remarkable *Hymenodiscus* that would be a true *Brisinga* if it had a dorsal skeleton. We mention again a new *Pteraster*, *Pteraster Caribbæus*.

Zoroaster, reported for the first time by the *Challenger*, has been found in the regions explored by the *Blake* and in two different forms. One, *Zoroaster Sigsbeeii* is like *Zoroaster fulgens* of the *Challenger*. The other, *Zoroaster Ackleyi*, is further away from the known forms and nearer, at least from the external appearance, to *Linckiadae* and notably *Chaetaster*.

The cribrellids have been found from 101 to 734 fathoms; *Pedicellaster* from 127 to 250 fathoms; *Hymenodiscus* from 391 to 450 fathoms; *Pteraster* from 151 to 422 fathoms. The temperature varies at these depths from 62 to 40 degrees Fahrenheit, i.e., from 16.6 to 4.4 degrees Centigrade.

In the various regions explored, the richness of the fauna in species can be calculated by dividing the number of dredges in each region by the number of species collected. The following results indicate the number of dredges necessary to find a species:

Below 100 fathoms		2.7 dredges
From 100 to 200	—	3.6 —
From 200 to 300	—	3.15 —
From 300 to 400	—	3.9 —
From 400 to 500	—	4.6 —

From 500 fathoms, the number of dredges being less numerous for each depth range, the results become irregular. But up to there, we see a continuous decrease in the number of species with an increase in depth. We can thus say that, apart from any other cause, *the fauna of asteroids becomes less and less varied with increasing depth*.

It is interesting to investigate now what are the depths that are richest in individuals and we can establish with the averages similar to those we just used. But the contrast between the number of individuals collected up to a certain depth and the number of individuals collected above is such that the calculation is nearly useless.

Less than 100 fathoms	41 dredges have obtained	141 individuals
From 100 to 200	76 — —	267 —
From 200 to 300	41 — —	66 —
From 300 to 400	34 — —	12 —
From 400 to 500	23 — —	9 —
From 500 to 600	13 — —	0 —

The numbers then become irregular. Thus, from 200 fathoms, the average number of individuals collected for each dredge is 3; from 200 to 300 fathoms, less than 2; from 300 fathoms, it is much less than 1. If we compare this result with that we have given for the calculation relative to the species, we see that the number of individuals collected decreases more rapidly with depth than the number of species. Thus up to a certain zone, specifically distinct individuals, collected under the same conditions, are proportionally more numerous with depth. This law seems to be maintained over depth, because a dredge at 1,930 fathoms collected 7 individuals belonging to 4 different species. Another at 1,131 fathoms had 2 individuals of different species. This result indicates either that with an increase in depth, individuals of a species become less reproductive or that the conditions necessary for simultaneous development of a large number of individuals of each species are more rarely met. It is not necessary to believe, at least for asteroids and this region, that the great depths of the sea would be privileged regions where life has an exceptional variety and intensity.

Making all allowances, the abyssal region is less rich than coastal regions in living animals. The species there are even less varied. But they are greatly different from species of shallow waters. They change greatly from one zone to another. The abundance and variety of new forms the dredge encountered from very different depths in a relatively short time is amazing.

The nature of the bottom does not appear to have affected greatly the number of species and individuals collected. We find, moreover, in the list of species relative to each locality, the nature of the bottom corresponding to each locality and the associations of asteroid species that are there. The bottom was nearly always sand or silt, sometimes pure, sometime variously mixed. Sometimes the sand was formed of debris of millepores, shells and coral. This is the coarse sand that on the coasts of Brittany is called *marl*. Finally, the bottom can be completely solid. Species were collected in all conditions. Unfortunately, it would be rash, no matter how well done the collections were made, to assign species to a particular station.

Such are the most general results that can be obtained from the study of the American collections regarding the geographical and bathymetric distribution of the sea stars. Later we shall give: 1° a list of species collected arranged in zoological order; 2° a list of species collected in each locality with all indications of depth, temperature and nature of the bottom of the locality; 3° a list of species according to depth, grouped by 100 fathoms. Finally, the description of each species is preceded with all information we know about them. We hope to facilitate, as much as possible, the incorporation of the results of this beautiful collection that we have. As we carefully cite all the documents that Alexander Agassiz has so kindly given us, everyone can interpret them differently than we have done and make conclusions that have eluded us.

In addition, it is important to add that the ways the dredges were made could make the results especially variable. An operation made at the greatest depths has much less chance of success than one of 100 or 200 fathoms. In the case where the dredges were not numerous, the state of the sea, which is considerable, can greatly alter the results. It is with these reservations that it is necessary to take the general comment that we have made above.

The first question that now presents itself is that of knowing the classification we should adopt. We are thus led to study the value of the various systems that have been proposed, including those in our preceding works

SYSTEMATIC CLASSIFICATION OF ASTEROIDS

First divisions of the class of asteroids

Müller and Troschel, who were the first to propose a systematic classification of sea stars, first took foremost in their classic book, *Syngtem der Asteriden*, the number of rows of tube feet that could be 4 or 2; then the presence or absence of an anus. The asteroids with 4 rows of tube feet formed only a single genus, *Asteracanthion*. Only *Astropecten* and *Ctenodiscus*, among the asteroids, had 2 rows of tube feet and had no anus. The other genera were united, without little attention to their affinities, into one group.

This division, adopted in 1867 by Gray in his *Synopsis of the Asteriadae*, was improved by the introduction of some characters taken from the skeletal structure. Gray distinguished, in fact, in addition to the two sections of Müller and Troschel, five families: ASTERIADÆ, ASTROPECTINIDÆ, ECHINASTERIDÆ, GONIASTERIDÆ, and ASTERINIDÆ.

In our Memoir of 1869, *Recherches sur les pédicellaires et les tubes ambulacraires des Astéries et des Oursins*, we reached results that seemed, at first, to confirm the primary divisions of Müller and Troschel, based on the number of rows of tube feet. We established in this work, in fact, that the asteroids had two distinct types of pedicellariae: 1° *pedunculate pedicellariae*, with a cylindrical extension of skin at the end containing remarkable muscles, always with three calcareous pieces distinct from the ordinary skeletal pieces, and with two functioning as jaws of the pincers, the third providing the point of fixed motor muscles to the jaws; 2° *sessile pedicellariae*, composed of two, rarely three jaws, forming a pincer directly supported by a skeletal piece differing only slightly from neighboring pieces and furnishing the points of attachment to the very simple muscle of the pincer.

All the asteroids with 4 rows of tube feet described by Müller and Troschel had pedunculate pedicellariae. The asteroids with 2 rows of tube feet of the same authors, which had pedicellariae had only sessile pedicellariae. We found thus the two primary divisions of Müller and Troschel. However, as there seemed to us no necessary link between the number of rows of tube feet and the form of pedicellariae, we observed that the coincidence, interesting from the morphological view, that we emphasized could very well not be absolute. Indeed, Dr. Lütken, better placed that I to study some remarkable species of the Museum of the North, soon objected to our conclusions that *Pedicellaster* and *Labidiaster*, described by Lovén, had both pedunculate pedicellariae and only two rows of tube feet, while *Pteraster multipes*, lacking pedicellariae, had no more than two rows of tube feet. It became necessary to choose, to determine the primary groups, between the characters furnished by the pedicellariae and those furnished by the rows of tube feet. Now, *Pteraster multipes* does not differ in anything essential from other *Pteraster* with two rows of tube feet. *Pedicellaster*, in spite of the small number of their tube feet, does not differ in anything essential from the *Asteracanthion* of Müller and Troschel. The characters furnished by the tube feet thus have only a secondary value. Those furnished by pedicellariae are more general. Accordingly, we kept them in 1875, in our Revision des Stellérides, while indicating the remarkable extent of their coincidence with the characters adopted by Müller and Troschel.

In 1879, in the course of research undertaken to establish the bases of the morphology of the skeleton of the asteroids and to determine the value of characters furnished for classification by the structure of the skeleton, Dr. Camille Viguier, now professor at the École supérieure des sciences d'Alger, obtained results of the greatest interest, establishing the importance of the arrangement of the mouth pieces relative to determining the affinities of the various genera of asteroids.

The mouth of sea stars is constructed in two different types that Viguier named *ambulacral type* and *adambulacral type*. In the ambulacral type, present in the *Asteracanthion* of Müller and Troschel, the ambulacral pieces have a special form, are more prominent than the adjacent pieces and, although they are not true masticatory organs, can be considered as representing the mouth of the animal. In all other asteroids, the mouth is constructed in the adambulacral type. They are, in fact, the first adambulacral pieces that are elongated into a wedge and make up the properly called masticatory apparatus. It seems thus that there is a concordance between the mode of the structure of the mouth, the form of the pedicellariae and the number of rows of tube feet. This coincidence of three categories of characters that have no directly physiological link between them seems to indicate that the class of stelleroids should be divided into two sub-classes. This is explained by recognizing the different forms of asteroids belonging to one of the two sub-classes; the first, asteroids with an ambulacral mouth, pedunculate pedicellariae and quadriserial tube feet and the second, asteroids with an adambulacral mouth, sessile pedicellariae and biserial tube feet.

Professor Viguier indeed thus characterized the two sub-classes into which he divided the asteroids.

1st Sub-class. — Ambulacral asteroids.

Ambulacral mouth. — *Pedunculate pedicellariae, straight or crossed.* — *Most usually quadriserial tube feet.*

2nd Sub-class. — Adambulacral asteroids.

Adambulacral mouth — *Sessile pedicellariae, pincer or valvular.* — *Nearly always biserial tube feet.*

At the time when he published his work, Viguier had been able to study only ambulacral asteroids, sea stars with quadriserial tube feet. He expressed regret he had not had the opportunity to examine the singular *Pedicellaster* and having known *Brisinga* only by the beautiful figures published by Ossian Sars. These remarkable forms are lacking in the collection of the Museum of Paris that had furnished Viguier the elements of his works. They were also lacking in the British Museum when I examined the collection. Hoping to fill this lack, we wrote to Ossian Sars, sending him the series of our works on echinoderms. Unfortunately, our letter and our package are without doubt lost because we never, to our regret, received a response.

Today we are happier. We have been able to study several species of *Pedicellaster* and, thanks to the expeditions of *Travailleur* and *Talisman*, organized by the French government under the direction of Milne Edwards, the collections of the Museum of Natural History of Paris can count among those that possess the largest number of specimens of *Brisinga*. It is thus possible to complete, in this regard, the investigations of Professor Viguier.

The particular character of *Brisinga* is that none of the ambulacral or adambulacral pieces that contribute to form the solid ring of their disk has a predominance over the others sufficient to be considered a mouth frame. These pieces are modified in a way to form a kind of projecting calcareous ring on which are attached the arms and that support the dorsal integuments. But none advances towards the center of the buccal orifice, and cannot be employed as a masticatory organ. In *Hymenodiscus*, very near *Brisinga*, the pieces of the ring scarcely differ from the other ambulacral and adambulacral pieces. The BRISINGIDÆ, not having well characterized mouth

frame pieces, the type of their mouth remains in some way indifferent. We cannot attach it to either of the two types, correctly stated by Dr. Viguiet as the immediate result of his research.

Pedicellaster has furnished us a result contrary to that which seemed to have resulted from investigations made on other types. Their mouth is clearly constructed on the adambulacral type. The first adambulacral pieces are still small, it is true, but they have already the form of a wedge that we observe in *Echinaster* and the neighboring types, and advance very clearly onto the buccal membrane. This fact is moreover more remarkable that in *Brisinga*, while the ambulacral pieces are clearly outside the oral circle, the first adambulacral pieces, while remaining obtuse, make, to the contrary, a slight projection and have a certain resemblance to the adambulacral mouth of asteroids of the second sub-class.

If one considers these results, we see that the coincidence between the three orders of characters invoked to establish the first divisions of the class of asteroids can be characterized in a precise fashion. We can say, in a general way, that *all sea stars with biserial tube feet, have an ambulacral mouth, and that all sea stars with quadriserial tube feet, at least at the base of the arms, have an ambulacral mouth.* The mouth frame of asteroids, being an immediate dependence of the skeleton of the ambulacral groove, it is easy to explain that all major modification in the constitution of this groove, reflects the mode of construction of the mouth. The concordance of the character put first by Dr. Viguiet with the character put first by Müller and Troschel thus find its origin in some morphological necessity. It appears to be notably due to this that the quadriserial arrangement of the tube feet and their multiplication requires the ambulacral pieces to develop very transversally, the adambulacral pieces can keep the same relative dimensions. As a result, the ambulacral pieces take a greater part in the constitution of the peristome and are consequently found in the more favorable condition than the adambulacral pieces, relatively reduced and very close together, to constitute the masticatory apparatus.

But nothing like this can be evoked for the pedicellariae and, in fact, the modifications do not agree at all with those of the ambulacral groove and the mouth. The pedicellariae of *Brisinga*, those of *Pedicellaster*, are clearly and frankly the same type as those of *Asterias*, *Stichaster*, *Pycnopodia* and *Heliaster*, and they differ greatly from those of the *Echinasteridae* and *Goniasteridae*. This raises the question: In the determination of the affinities of the different genera of asteroids, is it necessary to give more importance to the characters of the pedicellariae or those of the ambulacral groove and the mouth? We can already observe, in favor of preferring the pedicellariae that in some genera of asteroids, obviously close to *Asterias* such as *Zoroaster*, the quadriserial tube feet at the base of the arms are biserial at the tip, that in very young *Asterias* the tube feet are biserial and become quadriserial during development while the pedicellariae appear from the beginning with their characters. Finally, their anatomical characters, and especially in the composition of their skeleton, *Brisinga* and *Pedicellaster* are closely allied to true ASTERIDÆ, But the importance of the characters of the pedicellariae can be appreciated only if one is fixed on the morphological importance of these organs. We must thus, before all, investigate carefully their importance.

Morphological importance of pedicellariae

The functions of the organs in echinoderms designated as pedicellariae today are still problematic. Pedicellariae are found only in the urchins and asteroids. We know nothing that resembles them, even remotely, in holothuroids, ophiuroids and crinoids. Any comparison between them and anchors of synaptids, hooks or attachment organs of some ophiuroids can be only very

remote. The question whether there is a true homology between the pedicellariae of an urchin and those of a sea star merits examination.

Pedicellariae nearly always are present in urchins. They have a very complicated structure and there are several kinds on each individual. They are always carried at the end of a thin calcareous stem that articulates with granules of the test around which it can move like spines on the tubercle that supports them. *Ophiocephalous pedicellariae* on the buccal membrane of *Echinus* and related genera appear to make an exception to this rule. But a more attentive examination shows that these organs are located around five pairs of large buccal tube feet and supported by the calcareous plates they surround them, like rings, of these tube feet. We can consider these isolated ambulacral plates like on the rest of the test, so that the ophiocephalous pedicellariae conform to the general rule. This general arrangement of pedicellariae of urchins has led them to be considered modified spines, an opinion more sustainable than the spines can have, in the same the same individual, very diverse sizes, as in *Echinothrix* and other *Diademidae*. Many of them become nearly as fine as the peduncles of the pedicellariae. We can however make major objections to this point of view. We do not know, in fact, any intermediary form between ordinary spines and pedicellariae. When a pedicellaria develops, it appears immediately with the characters of pedicellariae and these are the diverse constitutive pieces of its prehensile part that are the first formed. Finally, pedicellariae form very early in urchin embryos, well before having spines.

We can conclude from the first two categories of facts that: 1° the pedicellariae of urchins are not identifiable with ordinary spines; 2° they are, at most, comparable to an ensemble composed, e.g., of a spine and scales arranged nearly like we see in *Cidaris*, the central spines corresponding to the stem of the pedicellaria and the scales to the prehensile jaws. But the precocious appearance of the pedicellariae seems to indicate, on the other hand, that they are very ancient organs, before the spines even, and having nothing to do with them, without reversing the terms of the proposition generally accepted, we cannot consider the spines of urchins as degenerate pedicellariae. This would coordinate some facts, but would not be accepted without more positive arguments. The morphological nature of pedicellariae remains doubtful.

Despite very numerous investigations of pedicellariae, their physiological role is not very clear. Alexandre Agassiz has seen them in *Echinus* seize foreign bodies that fall between the spines and to reject excretory debris far from the test. His observation is correct. But the role of cleansing organs would not be appropriate for all pedicellariae. It is shown the large ophiocephalous pedicellariae that surround the ten buccal tentacles do not function this way. On the other hand, the pedicellariae of *Cidaris*, whose head can incline only weakly or even not at all on the stalk that directly supports it, would only with difficulty explore the test, while they easily seize all that floats in the water surrounding the animal. They do not have the function that Alex. Agassiz has seen in the pedicellariae of urchins. They would be even incapable of passing captured prey from one to another to the mouth as proposed by other observers. Moreover, most urchins live on algae that they eat with their mouth and not on prey captured from the water. Geddes and Beddard have described recently gemmiform pedicellariae of echinoids with glands they considered as venomous. But these glands are not found in all pedicellariae, and consequently can give us only incomplete information on the role of the organs.

In spite of these uncertainties, it is none the less accepted that pedicellariae are essentially part of the plan of organization of urchins and the study of types in which they are found corroborates indications from embryology relatively to their ancientness. They are, in fact, absolutely constant in regular urchins. There they show the greatest degree of complexity. They are much less developed in spatangoids and missing in clypeasters. Now these two orders are precisely the most

recent of the class of echinoids. Regular urchins and especially the cidaroids, in which the pedicellariae are particularly robust, being to the contrary the most ancient. Thus the pedicellariae tend to disappear in the recent types of echinoids, as if their importance was greatest in primitive types and began today to weaken. If their complexity does not justify considering them as rudimentary organs, the uncertainty regarding their function shows that this function is not important in the lower types of urchins. All these facts are, to the contrary, in relation to the hypothesis that pedicellariae, important organs in ancient types of echinoderms, have today lost the greater part of their functions and are conserved only by heredity, a kind of survival.

If this conclusion is correct, the various modifications present in pedicellariae are conserved, like the pedicellariae themselves by heredity, and indicate by that the nearest relative of types to which they are identical. The pedicellariae and the organs that, like them, outlive their functions are, in some way, family papers permitting reconstruction of the ancestry of the animals in which we see them. If they are not important from the physiological point of view, they have great importance to determine affinities and this is, in fact, one of the most interesting results that we published in 1869 on these organs. We effectively showed in our work that the pedicellariae of urchins can be used to characterize clearly the principal orders of these animals, such as cidarids, diadematids, echinids and even some secondary groups. In the theory of the fixity of the species, it is inexplicable that organs without physiological importance have a great taxonomic importance. We just showed how this paradox is explained, to the contrary, in the hypothesis of descendance.

We shall apply these considerations to asteroids. The facts that we just repeated are, in this class, still more clear than in the echinoids. Among the asteroids, we observed pedicellariae in nearly all the families and notably in that of the ASTERIADÆ, ECHINASTERIDÆ, LINCKIADÆ, GONIASTERIDÆ, ASTERINIDÆ, and ASTROPECTINIDÆ. In each of these families, the pedicellariae have constant or very nearly constant forms for each family. They differ from one family to another that is sufficient, as we showed elsewhere, to call attention to their taxonomic value. But in addition, the form of the pedicellariae and their presence or absence results in some interesting remarks.

In the first place, if one considers the genera *Hymenodiscus*, *Brisinga*, *Pedicellaster*, *Asterias*, *Stichaster*, *Zoroaster*, *Pycnopodia*, *Heliaster* and related genera, we recognize that all the species of these different genera have pedicellariae. These pedicellariae are all much more complicated than those of other asteroids. They are pedunculate pedicellariae. Two distinct forms are nearly always found on the same individual, the *straight pedicellariae* and the *crossed pedicellariae*. Two forms but one can be absent. According to the descriptions that have been given, *Labidiaster* has only straight pedicellariae. To the contrary, *Brisinga*, *Hymenodiscus* and some true *Asterias* have only crossed pedicellariae. The crossed pedicellariae are more complicated. They are also the most abundant on each individual and those that occur most commonly. In the class of asteroids, the most ancient genera are precisely the closest genera to those that we just enumerated and, among the latter, it is those such as *Brisinga* that have an ensemble of clear characters to consider them as the nearest relations to the first asteroids. We thus find here, as in the class of echinoids, this remarkable law that the most complicated pedicellariae are found in the most ancient of the class and that, in these forms, there is also a style that is more constant than in the others.

Can one, from the morphological point of view, relate the pedunculate pedicellariae of *Asteriadæ* with those of urchins? The answer to this question is delicate and cannot be made in a rigorous manner, than if we had previously resolved a more general problem of which it is only a particular case, that of assimilation of the various pieces of the skeleton of a sea star with those of the skeleton of an urchin. It is very difficult to establish the degree the spines of these animals

correspond with each other. But we know, at least, in that which concerns the genera of asteroids that concern us at this time, that we would not include their pedicellariae with the spines. This results from the mode of distribution of the crossed pedicellariae.

In rare species, such as *Asterias rugispina*, *Calvasterias*, *Asterinoïdes*, etc. these pedicellariae are isolated and haphazardly distributed. This is the usual arrangement that affects the straight pedicellariae when they occur on the dorsal surface of *Asterias*, but the straight pedicellariae have, in general, a particular location. This is the usual arrangement that affects the straight pedicellariae when they occur on the dorsal surface of *Asterias*, but the straight pedicellariae have, in general, a specific location. They are found on the ventral surface of the arms near the ambulacral groove and most often between the spines that border it. Such an arrangement would not imply a difference in morphology between the pedicellariae and the spines. But it is the exception, for the crossed pedicellariae ordinarily form a multiple corona around the spines supported by a special sac. This sac, in *Asterias glacialis*, can move up around the spine and nearly cover it completely or, to the contrary, return to its base to completely expose it. In this case, the pedicellariae appear obviously as a dependency of the integument of the spines and cannot be, as a consequence, attached to the spine itself. The fact is still more evident and the demonstration more complete in *Brisingidae*. Consider *Hymenodis Agassizii* for example (Pl. 1, fig. 1). Only crossed pedicellariae occur there and their mode of distribution is very striking. Each of the first adambulacral pieces that are, for us, buccal pieces, has two spines. Each of the other adambulacral pieces have one long pointed spine. These are the only spines of the animal. All these spines are entirely covered with an integument (Pl. 2, fig. 1). A fibrous layer, probably muscular, constituting the deep layer of their covering (Pl. 2, fig. 3), is immediately attached to their surface. Each buccal spine had near the middle of its length only one large crossed pedicellaria. A bundle of muscle fibers leaves the layer that envelops the spine and extends to the peduncle of the pedicellaria and goes to attach to the basal piece of the latter. On the adambulacral spines, the integument forms beyond the spines a swollen mass. On this mass and on the integument that covers the entire length are numerous crossed pedicellariae. Each corresponds to a muscular bundle inserting on a part of the basal piece. The other part of the fibrous layer that envelops the spine itself (Pl. 2, fig. 3). There, the pedicellariae are very clearly dependencies of the integument that cover the spine and no one can consider them as homologues to this spine. Moreover, it seems that the spine is nothing other than a calcareous piece that supports the ensemble of pedicellariae and serves as the point of attachment of the muscles that move them. Far from being modified spines, the pedicellariae would be the reason for the spines themselves. The arrangement of the straight pedicellariae on the back of the arms of asteroids seems to indicate that the pedicellariae preexist the spines and confirm consequently the interpretation that we give of the latter. Another fact, indicated by the crossed pedicellariae, supports this point of view. We can see on the dorsal integument of *Hymenodiscus* and young *Brisinga* a whole series of transverse sacs, regularly arranged, each corresponding to an adambulacral piece and forming arcs that together unite the symmetrical pieces. These sacs are always covered with a multitude of crossed pedicellariae. Later, when the gonads appear, the calcareous plates appear in the thickness of some or all of them in *Brisinga Edwardsii*. Spines on these plates thus form the spiny rings that gives the arms of the animal a ringed appearance. There again the pedicellariae appear before the spines, well before even the pieces that make up the dorsal skeleton. It is thus that all evidence indicates they are not transformations of the spines and that we should consider them as integumentary procures of a particular nature whose appearance in the group of echinoderms must have been very early. On the other hand, it is remarkable that the only regions where spines and a dorsal skeleton of the arms form in *Brisinga* are precisely those that

are absolutely covered with pedicellariae, as if the presence of these organs had really determined the appearance of solid pieces that would serve as the point of support.

We note now that if we consider *Brisinga* a form very close to the most ancient, we should find in them the explanation of peculiarities shown by more recent forms. It is evident that the fasciculated arrangement of the crossed pedicellariae around the dorsal spines is explained very simply if we accept that the integuments that primitively covered the entire spine have acquired the ability to fall back to expose them. Only crossed pedicellariae occur in *Brisinga*. They occur even in the places where the more recent asteroids have straight pedicellariae. The ancientness of *Brisinga* makes one think that the crossed pedicellariae represent the oldest form of these organs, more typical than the simple straight pedicellariae. We understand how they remain the most numerous and the most constant in asteroids. We come to consider the straight pedicellariae as representing a form derived from crossed pedicellariae, resulting without doubt from a special adaptation, because their large size seems to exclude the idea of a degeneration pure and simple.

But what could be the function of such numerous pedicellariae in *Brisinga*, *Asterias* and related genera? We are in this regard as ignorant as we are with urchins. The arrangement of these organ is opposed moreover that we would suppose either cleans the body wall or transports objects they have captured step by step to the mouth. They are of course organs of prehension and the only thing we can suppose with any possibility is that they catch the innumerable embryos that swim in the sea water that might be tempted to settle down on the back of the asteroid. But this function cannot be accepted for the sea stars remaining to be considered.

We find three kinds of sessile pedicellariae.

The most complicate of the pedicellariae are those of LINCKIADÆ. Each is supported by a special ossicle, embedded in two symmetrical cavities separated by a transverse blade and forming exactly a pit.

Two opposed valves can lie down exactly into these pits or meet to make a prehensile organ. Instead of being in all the genera of the family as those of ASTERIADÆ, these pedicellariae occur only in the single genus *Ophidiaster* and, here again, they are far from having the same importance in all species. Well developed in *Ophidiaster Germanni*, *O. pusillus* and some others, they are very reduced and deformed in *O. pyramidatus*, where their inutility is obvious. The valves, simple linear scales, cannot even oppose each other. Finally, they are totally lacking in *Ophidiaster ophidianus* and many other species. We can state the pedicellariae of LINCKIADÆ are organs often and perhaps always without evident function, even in the process of disappearance.

The same conclusion extends to the valvular pedicellariae of GONIASTERIDÆ. These pedicellariae are extremely developed in some types of this family, such as *Hippasterias*, *Anthenea*, and *Goniaster* where they are especially remarkable on the ventral surface. Each is placed on one of the ossicles of the ventral surface and fill nearly the entire extent. Nearly all the ossicles have them. In the culcitids, the *Pentaceros*, some pedicellariae are very large and have a nearly constant arrangement. They are those of the adambulacral plates. They are located in the internal angle of each of them and implanted in a special alveolus. These pedicellariae have jaws elongated vertically. They seem consequently to be pincers. But, despite their special form, they do not differ essentially from valvular pedicellariae of other GONIASTERIDÆ. On the dorsal surface and sometimes on the ventral surface are interspersed, in these animals, a large number of other pedicellariae in which all are intermediate pincer and valvate forms. The jaws of these organs that are located in the poriferous areas are implanted in a special cupule that makes part of the cutaneous skeleton. We can consider the two jaws and the cupules as forming only one and the same organ. But all this is so small that we cannot conceive the function that such reduced organs

with such limited mobility could have. We can accept, as we have said, that these organs that close at the least contact are apt to capture infusorians or very small embryos that seek to settle on the test of sea stars, as they are often on the shells of molluscs. They could clog the papulae that cover the dorsal surface of the animals. It is incontestable that this happens necessarily. But this function of the pedicellariae, supposing that it exists, is not itself very useful to the animal because we cannot see that species lacking pedicellariae are more infested with parasites than those in which pedicellariae are better developed. Moreover, we find these pedicellariae more consistently in regions where establishment of parasites is scarcely detrimental in the sea star. E.g., on the dorsal and ventral marginal plates or on the ossicles that form the dorsal skeleton. It is there that we observe them nearly always in *Pentagonaster* and *Goniodiscus*. Their physiological unimportance is shown here clearly. Nearly always their number on the ossicles is very variable, their orientation there is absolutely in any way, and often they are completely absent. Sometimes they are completely replaced by small projecting tubercles as if the constituent parts were fused. Often, their place is then simply filled with a general granulation.

We wanted to conclude from this that the pedicellariae are only a simple modification of this granulation. We do not think so, because the granulation in question is totally lacking in types where the pedicellariae are the most developed, as in *Asterias*. On the other hand, in the GONASTERIDÆ where they reach their maximum development, it is minimal and scarcely leaves an indication in the true skeletal ossicles while the pedicellariae there are, to the contrary, deeply embedded and leave, in their place when they are lost, a deep aveolus in which it had been implanted. The pedicellariae of GONIASTERIDÆ, like the others, appear to us thus organs of a special nature. We see them, moreover, in the LINCKIADÆ completely rudimentary without being replaced by granulations. This is what we show in *Pentagonaster pulchellus*, in which the alveolus of the pedicellariae have the form of a very narrow slot, but very elongated relative to the dimensions of the arms of the pedicellaria that are very small, incapable of joining and consequently play no role. Thus the pedicellaria appears to us again, like in the LINCKIADÆ, as an organ with no function, but that still indicates its ancientness and its past importance by its persistence even though it is no longer useful for anything. Consequently the common characters that these organs can show in the different groups of asteroids are necessarily an indication of an ancestor, very ancient among the animals that have them and should serve in a rational classification to establish the most general sections in the class. They are not due, in fact, to similarities more or less recently acquired as the result of certain common conditions of life, but to the ancient similarities conserved by inheritance and become all the more important as the organs become non-adaptive in some way and lose all function. The hypothesis of descent explains quite simply this fact, an apparent paradox, that the organs that in each family have this constancy of form to which we recognize important characters, show at the same time, the instability of the organs whose physiological functions are nearly none.

Without doubt, the use we make of pedicellariae to reach the determination of the affinities of asteroids would be considered a grave infraction of the adopted rules of taxonomists who think the importance of a character depends especially of its degree of generality. But the embryological studies have for a long time accustomed naturalists to give the greatest importance to characters that are far from being general in groups where they are present and that are not due, as those of pedicellariae, as a hereditary phenomenon. Such are the characters indicated by the different larval forms, characters that nearly always merge in the higher forms of each group and that, however, have given the greatest service. But embryological studies, which have been emphasized for a long time by naturalists, are far from being general in the groups in which they arise and are due only

to heredity. Such are the characters given by the different larval forms, characters that almost always disappear in the higher forms of each group that, however, have been of great use. The higher annelids do not have the trochosphere; the highest crustaceans do not have the nauplius; several molgulids do not have the tetrad. That does not prevent placing after the worms all animals that have a trochosphere, among the crustaceans all those that have a nauplius, among the tunicates all those that have a tetrad. In the same way, although pedicellariae are lacking in many species, we must place *Brisinga* with *Asterias* because of the form of their prehensile organs.

In the family ASROPECTINIDÆ, a relatively recent family, there are organs that have always been associated with pedicellariae but that may not have the same origin. In *Luidia*, they are formed of a calcareous stalk with three moveable jaws that can open or close like the jaws of the pedicellariae of urchins. If we consider that, in this family, there are *paxillae* formed of a stalk and small spines radiating around the top, we are bound to see in the pedicellariae of *Luidia* only a simple modification of the ordinary skeletal elements and that we can scarcely see, in fact, anything other in the remarkable organs that we see in *Archaster mirabilis*, a new species we will describe later. In this asteroid some of the ossicles of the ventral surface have the form of an arc. Pairs of these arcs are opposite each other like a parenthesis. These arcs are immobile and surrounded by other ossicles distinguished only by size and form. But they have very long mobile spines that together form a kind of comb that can fall back into the interior of the parenthesis. The frame of each comb meet those of the opposite comb. The entire organ functions either as a prehensile organ or as a kind of box to imprison animals that had entered it. There is obviously a great analogy, from the physiological point of view, between such an organ and a pedicellaria. From the morphological point of view, this organ is only a slight modification of the ventral armature of *Archaster*, a slight modification but of the same kind as that we have attributed to the pedicellariae of *Luidia*. These pedicellariae, as in those of GONIASTERIDÆ, contain a skeletal ossicle as a basal piece. But it is not at all obvious that the spines of the ventral surface of *Archaster* or *Luidia* can be compared to valves enclosed in the skeletal ossicles of GONIASTERIDÆ and no fact supports this association in an absolute way. So we cannot extend to GONIASTERIDÆ the conclusions that seem so obvious from the study of *Archaster* and *Luidia*. To the contrary, the affinities of the pedicellariae of GONIASTERIDÆ and LINCKIADÆ are obvious despite differences in detail. But between the valvate or excavate pedicellariae of the sea stars and the straight or crossed pedicellariae of ASTERIIDÆ, the associations again become more difficult. All that we can say is that both are evidently ancient organs of prehension that today lack important functions and are in the way of disappearing.

Finally, there are in some diverse ASTERIIDÆ and ECHINASTERIDÆ rudimentary pedicellariae that are, as in *Luidia*, only a modification of spines that overlap the skeletal ossicles.

If thus we keep the same name for the organs whose physiological analogy is incontestable, but whose morphological identity and homology are still less well established in the different groups of asteroids than in the different groups of echinoids, we can say that there are four types of pedicellariae in sea stars. Two of these types are evidently ancient and characteristic. These are those of the ASTERIIDÆ, on the one hand, and of the LINCKIADÆ and GONIASTERIDÆ on the other. Two others appear of more recent formation and being only a character, in some way accidental, which appears to have less importance from the point of view of classification and are evidently only an adaptation of dermal spines peculiar to some species. These are the pedicellariae of *Acanthaster*, *Asterina*, *Archaster mirabilis*, *Archaster typicus* and *Luidia*.

The pedicellariae oppose our bringing closer, as Ossian Sars has proposed, *Brisinga* and *Acanthaster* and consequently *Solaster* that is so near to it. They separate no less these latter sea

stars from *Pycnopodia*, *Labidiaster* and *Heliaster* that have nearly the same general form. To the contrary, *Labidiaster*, *Pycnopodia*, *Heliaster* and *Brisinga* are brought closely together by the pedicellariae and make a very natural group with the other ASTERIADÆ with five arms. *Brisinga* should be placed at the head of this group because of their clearly archaic characters as well as traits that connect them to ophiuroids, more perhaps than Ossian Sars thought, and in another way than Absjornssen and with him most naturalists believed. These considerations lead to a major modification of the latest general classifications of asteroids that have been published, notably that in the second French edition of *Traité classique de zoologie* of Professor Claus. In this work, the scholarly professor of Vienna adopts the general divisions we have based on pedicellariae. The families are also those in our *Revision des Stellérides du Muséum* with the exception that our family GONIASTERIDÆ has been detached to form two special families, *Culcites* and *Pentaceros*. These modifications are little justified because the affinities of *Pentaceros* and *Culcites* are of the greatest and they, when young, can be taken for true *Pentagonaster*. But the order of the families has nothing natural, because the ASTERINIDÆ are intercalated between the LINCKIADÆ and the CULCITIDÆ with which they have nothing to do and which belong, to the contrary, to related families. On the other hand, the family BRISINGIDÆ, instead of being placed after the ASTERIADÆ is placed after the ASTROPECTINIDÆ to make the connection to the *ophiuroids*. This is obviously inadmissible today as *Brisinga* is well known.

The study of pedicellariae leads, in conclusion, to distinguishing four primary groups of asteroids, four *orders* that are the following:

1° — FORCIPULATÆ.

Pedunculae pedicellariae, straight or crossed.

Families: BRISINGIDÆ, PEDICELLASTERIDÆ, ASTERIADÆ, HELIASTERIDÆ.

2° — SPINULOSÆ.

Pincer pedicellariae, resulting from modifications of the spines.

Families: ECHINASTERIDÆ, PTERASTERIDÆ, ASTERINIDÆ.

3° — VALVATÆ.

Valvate or excavate pedicellariae.

Families: LINCKIADÆ, GONIASTERIDÆ, ASTEROPSIDÆ.

4° — PAXILLOSÆ.

Pedicellariae formed by a skeletal ossicle and spines that cover it.

Families: ARCHASTERIDÆ, ASTROPECTINIDÆ.

We shall see later what characters of these subdivisions of this large group can be established. But the frequent absence of pedicellariae makes it necessary to investigate what can be the importance for taxonomy of some skeletal parts of the body. This what we are now going to try to do.

Morphological importance of different pieces of the skeleton, other than the buccal pieces.

When we compare the different forms of asteroids, we remain struck by the contrast between the nearly constant composition of the skeleton of the ambulacral groove and the extreme variability of the pieces that make up the dorsal skeleton. While the ambulacral groove, regardless of the number of rows of tube feet it has, is always composed of four series symmetrical ossicles two to two with little variation in form. The other parts of the skeleton have nothing that is constant. Of the four orders that we just established, two have however an important peculiarity: it is the presence, on each side of the arms, of two rows of superimposed plates, larger than the others and that form a perfectly regular border around the entire body. These *marginal plates*, as they are called, are never absent in the STELLERIDÆ, VALVATÆ and PAXILLOSÆ. This common character is not the only one that we must report between the two orders and we will soon see that they appear nearer to each other than we had believed up until now. Truthfully, the skeleton of VALVATÆ is generally composed of granulose hexagonal plates. But *Necria* and especially *Chataster* show us a transformation of the plates into voluminous paxillae and, on the other hand, in numerous species of *Archaster*, *Astropecten* and *Luidia*, the paxillae are replaced by granulose plates. One can designate the sea stars that form these two orders under the name *Stelleridæ marginatæ*, in contrast to the two first orders that never have marginal plates and whose skeleton is formed of imbricated ossicles, either as a network or a continuous covering, and form regular rows only in a small number of cases, in *Stichaster* and *Zoroaster*, for example. The arrangement of the skeletal pieces into a network is the dominant arrangement here. The sea stars of the two first orders can appropriately receive the name STELLERIDÆ RETICULATÆ. But in spite of the degree of generality greater than one would be tempted to attribute to them, the characters of the skeleton does not appear to us to take priority over those furnished by the pedicellariae and the affinities that they suggest between the ASTERIIDÆ and ECHINASTERIIDÆ, for example, are very doubtful.

The history of the BRISINGIDÆ permits, indeed, to establish the significance of the dorsal skeleton of asteroids, to show that its appearance is after that of the pedicellariae and to prove that this skeleton makes essentially no part of the typical organs of a sea star. In a new *Brisinga* dredged by the *Travailleur* that we have named *B. Edwardsi*, this skeleton is very developed to entirely cover the arms with imbricated plates. In *B. endecacnemos* and *coronate* it is much less complete and only forms arcs, variable spaces that are present only in the swollen part of the arms. In young *Brisinga*, these arcs are little developed. They are total lacking in these animals when they are very young. One sees no trace of them in *Hymenodiscus Agassizii*, whose description will be given later, although one of our specimens is nearly a decimeter in diameter. However, in all the individuals, each adambulacral ossicle has a corresponding transverse fold of skin that is absolutely covered with very well developed crossed pedicellariae. It is, as we have seen, in these folds that appear the pieces that will later constitute the skeletal arcs. In this regard, *B. Edwardsi* is no exception. It differs especially from the other species because, in the latter, the skeletal arcs appear only in three folds while in it, not only are all the folds the site of development of skeletal pieces, but again, the adambulacral ossicles being very short, these arcs are nearer to each other than they usually are. The pedicellariae, appearing earlier than the skeletal pieces, should be considered as more ancient organs and consequently more important than the latter from the point of view of classification. In *Brisinga*, when they appear, the skeletal pieces do not occur the entire length of the arms. They are limited to the swollen part of the arms that contains the genital glands. One can thus consider the dorsal skeleton of *Brisinga* as being nothing but an apparatus to protect

genital glands. This conclusion naturally extends to the skeleton of the other asteroids that is evidently of the same nature as that of *Brisinga*. This skeleton thus has nothing typical.

It is not the same with the skeleton of the ambulacral groove. Although the skeletal pieces of the dorsal skeleton have not appeared, the skeleton of the BRISINGIDÆ is reduced to the four rows of ossicles of the ambulacral groove. These pieces are never missing. They can, in some cases, represent the entire skeleton of these asteroids. They are thus essentially typical and should be mentioned as characteristic of the class of echinoderms that concerns us. They are, in particular, the only ones that one must consider if one wants to establish morphological comparisons between the asteroids and echinoderms of other classes, notably the crinoids that seem to be the most ancient echinoderms, from which the others are truly derived. The links between crinoids and asteroids is also indicated in other parts of the skeleton. These various modifications take on a great importance and their primitive relationships are especially seen at a young age.

Morphological importance of the odontophore

In his beautiful memoir on the echinoids³, Lovén established that in *Asterias*, immediately after the resorption of the brachiolaria, the skeleton of the disk is exclusively formed by a central plate surrounded by two circles, each composed of five alternating calcareous plates, the first corresponding to the interradial plates of a crinoid, the following to the radials. These calcareous plates, as shown in the figures published by Alexander Agassiz in his *North American Starfishes*⁴, constitute the entire skeleton of a young star that is exactly comparable to a cystoid. The arms develop only later. These plates have thus a very special importance and, as one does not find their characteristic arrangement in the adult asteroid, it is interesting to know what they become and if it is possible to reconstitute them in the adult and to ask what would be the importance of the characters that they produce. One already knows, from the research of Lovén, that the radial plates are subsequently moved to the end of the arms and form the unpaired terminal plate. But the fate of the interradial plates is still unknown. We have been happy to follow all their transformations in a series of very young *Brisinga* collected during the dredging expeditions of the sloop *Travailleur*. We shall publish our observations *in extenso* in a memoir presently in preparation of the echinoderms collected during these expeditions. But it is necessary to indicate here the results⁵. In young *Brisinga*, the plates of the first skeleton are equally arranged in two circles as in *Asterias* and the number in each circle is precisely equal to those of the future arms. This already has an importance because one can suppose that in sea stars that have more than five arms, the number of arms can increase with age by intercalation of new arms between the old as occurs for the tentacles of actinarians. One sees, to the contrary, that the arms of *Brisinga* appear from the beginning with their normal number. As a result, the number can occasionally provide specific characters, as accepted for *Brisinga* and *Solaster*. But it should not be concluded however that it is necessarily invariable in all individuals of the same species, not even for the duration of the life of given individual, because after mutilation, two arms can grow where they had been one and in the arms of species with multiple arms that reproduce by division, the number of arms produced from each of the two halves, from the moment of regeneration of the star, is not the same for the two halves as shown by *Asterias tenuispina* and *calamaria* or *Asterina Wega*.

³ *Études sur les Echinoïdées* by S. Lovén, 1874, p. 87.

⁴ Alex. Agassiz, *North American Starfishes*, 1876, pl. VI, fig. 3 and 4 and pl. VII, fig. 1.

⁵ See, for more details, *Comptes rendus de l'Académie des Sciences*, 1882, v. XCV, p. 61. E. Perrier, note on *Brisinga*.

As in *Asterias*, the radial plates, forming the calycinal plates of the external circle in *Brisinga*, are carried to the end of the arms when they develop. As for the interradial plates, they also leave the centro-dorsal plate, but stop at the edge of the disk, at the angle of the arms. There, their relative size slowly decreases and one finally sees them make up the projecting plates that, united to two lateral pieces, occupy in *Brisinga* exactly the position of the odontophore, the ubiquitous piece in all asteroids. Examination of figures 257, 259, and 260 of Plate LII of the cited memoir of Lovén and their comparison with that we have observed in young *Brisinga* leaves no doubt that the things occur in the same fashion in the two genera, and we can from them confirm that the radial pieces of very young *Asteriadæ* become, in this order of asteroids, the odontophores. One understands now the importance that is attached to, from the nomenclatural point of view, to characters provided by the odontophores. This importance was clearly emphasized by Professor Viguier in his complete and precise memoir on the skeleton of asteroids⁶. One of these radial pieces is quick to show the characteristic grooves of the madreporite. The other is the middle piece of the odontophore. Effectively, in all asteroids, the sand canal is in immediate contact with one of the odontophores that has even an anchorage for it.

Are these facts general and can one extend them to the entire class of asteroids? In the GONIASTERIDÆ (*Antehenea*, *Culcita*, *Pentaceros*, *Gymasterias*) and in the ASTERINIDÆ (*Asterina*, *Palmipes*), the odontophores are connected to the dorsal region of the disk by a double row of calcareous pieces, sometimes very voluminous, that form at each interbrachial angle a kind of continuous partition and seem to indicate the odontophore has left the surface to embed itself into the buccal angles, followed, in its descent, by the skeletal pieces analogous to those of the dorsal surface. This is an indentation that occurs in one of the partitions that always has the sand canal. The kind of radial pieces is thus probably the same in the GONIASTERIDÆ and ASTERINIDÆ as in the ASTERIIDÆ. But the study of another young asteroid, likewise collected by the *Travailleur*, raises a new question that concerns the ASTROPECTINIDÆ.

This sea star, to which we have given the name *Caulaster pedunculatus*, has at the center of its dorsal region in a position exactly corresponding to that occupied by the peduncle of a crinoid, a cylindrical appendage nearly as long as the arms themselves. This appendage has no calcareous particles as those that develop in the peduncle of crinoids, but it has a particular significance from the presence at its base of two circles of alternating calcareous pieces, each composed of five plates exactly arranged like the calycinal plates of a crinoid or the apical rosette of an urchin. These ten plates thus seem to correspond to the ten first plates of crinoids, but they obviously do not follow the same changes as the first plates of *Brisinga* and *Asterias*. It is appropriate to ask if the ten first plates of *Brisinga* and *Asterias* are really homologues of the central-dorsal plates of *Caulaster* and, if this is the case, it would be necessary to accept that the latter animals, close to *Ctenodiscus*, have a mode of development different from that of other asteroids.

The fact that a sea star simulates in this regard crinoids, and perhaps fixed at a young age, is nevertheless of great interest. This interest increases more if one recalls that, on one hand *Leptychaster*⁷ is really fixed by its back during their incubatory period to the integument of their mother, and that Lyman just described, in the voyage of the *Challenger*, an ophiuroid that seems to have equally a solid dorsal peduncle around which are arranged calcareous plates whose arrangement simulates that of the plates of the calyx of a crinoid. This ophiuroid, that Lyman calls *Ophiopyrgus Wyville-Thomsoni*, and our *Caulaster pedunculatus* appear at first to establish an unexpected link between fixed crinoids on one hand and the asteroids and ophiuroids on the other.

⁶ *Archives de Zoologie experimentale et générale*, v. VII, 1878.

⁷ Wyville-Thomson, *The Challenger*.

In spite of the superficial resemblance of the arrangement of the plates that surround their peduncle with those that characterize the apical rosette of urchins, we doubt that a relation can be established, as Lovén wants, between the dorsal surface of asteroids and crinoids and the periproct of urchins. Although it is difficult to accept without further examination the opinion of the illustrious professor of Stockholm, and the admiration that we have for his beautiful research on echinoids in particular, it seems to us that in comparing the periproct of regular urchins to the calyx of crinoids, Lovén has attributed to the urchin a position exactly inverse of its normal position. It actually seems very difficult to challenge, in the present state of our knowledge, that the ambulacra of urchins are not strictly homologues of the arms of crinoids. It seems the arms of crinoids are fastened to a voluminous visceral sac and fused with it. The mode of growth of these arms indicates, on the other hand, their end. The arms of crinoids indeed grow mainly at their free end. Now, it is at the end near the periproct where the new plates of the ambulacra of the urchin are formed. This is thus their point; their base is near the mouth as is indicated by the arrangement of all the ambulacral system. But then the homologous pieces of the calcynal plates of crinoids are not the ten plates of the periproct, but the constitutive pieces of the Aristotle's lantern. This interpretation seems so daring that we will examine with all the necessary details in another work. We are persuaded that any mind will be struck by the strict resemblance of a regular urchin with the crinoids, such as *Callicrinus* and especially *Eucalyptocrinus*. But then the back of asteroids would correspond to the buccal region of urchins and not to the anal region. And there would be no reason to look, as we so often have done without any success, to homologize the mouth of an urchin with that of a sea star. We have already made this conclusion in our work on *colonial animals*, when we noted that the mouth of an urchin is the result of a central individual, that of a sea star of rays that make up their arms. We have already established the importance of the mode of constitution of the buccal opening whose differences have been shown by Dr. Viguiet.

We have reviewed all parts of the skeleton that can contribute to systematics. The result of our discussion is that the pedicellariae are still the most important to determine the reciprocal relations of the various genera of asteroids. We shall adopt consequently, at least provisionally, the classification indicated above. We now discuss some secondary characters of other parts of the body and indicate some relations of new species described in this work with known types.

Links between the various families of asteroids; secondary characters indicated by the mouth frame and tube feet.

Among the asteroids that have been described thus far, some clearly belong to established families and orders. Others are more difficult to place in known groups. Others, finally, establish more or less close links between these groups. Those that belong to these two latter categories are particularly interesting.

First, there are three forms whose place is very uncertain, these are *Ctenaster*, *Radiaster* and *Korethraster*.

Ctenaster (Pl. V, fig. 1 and 2) has arms broadly connected at the disk. On the ventral surface are grooves that separate each side of the ambulacral plates, directed towards the border of the arms and having between them a terminal plate supporting a group of elongated spines in the same direction as the ventral groove. This results in the body including arms seeming to be bordered by a single row of plates larger than the others. We do not find, in the asteroids already described, analogous characters as in *Ctenodiscus*. Like them, *Ctenaster* lacks an anus. But the tube feet end in a large disk, contrary to that seen usually in ASTROPECTINIDÆ. *Solaster* and *Crossaster*,

particularly *Solasater endeca*, have an analogous arrangement of marginal plates and, except for the absence of an anus, other general characters that connect the two genera very well. It is thus *Ctenaster* is placed with *Solaster*. But it is not extremely close. The dorsal integument, although having a large number of divergent bunches of small spines, are not supported by a continuous network of calcareous pieces but has only disjointed ossicles.

Radiaster (Pl. IX, fig. 1) has only five arms. This ossicles has bunches of spines like *Solaster*. On the ventral surface, the ossicles are arranged in parallel rows, from the ambulacral groove to the marginal plates, which are larger than the others. The characters recall clearly, at the same time, those of *Solaster* and *Ctenaster*. But the mouth frame is much larger than in these sea stars and recall greatly the mouth frame of ASTROPECTINIDÆ. In spite of these differences, the genera *Crossaster*, *Solaster*, *Ctenaster* and *Radiaster* appear very close make a family SOLASTERIDÆ, near the ECHINASTERIDÆ, but characterized by the presence of one and sometimes two rows of small marginal plates covered with spines.

Lophaster has five arms but, near *Crossaster* by the principal arrangements of their skeleton, is also probably related to this family. And one is thus led very near to asteroids to which we believe can be called *Korethraster*, although it remains uncertain to us of their generic affinities with the true *Korethraster* of Wyville Thomson. Imagining the bundles of dorsal spines of these animals are connected by a membrane in the manner of a marsupial pouch, we pass to *Pteraster*. We think thus that the second order of asteroids, that of STELLERIDÆ SPINULOSÆ, can be arranged in this way:

Order II. — STELLERIDÆ SPINULOSÆ.

Family I. — ECHINASTERIDÆ.

Genera: *Acanthaster*, *Echinaster*, *Cribella*, *Valvaster*.

Family II. — MITHRODINÆ.

Genus: *Mithrodia*.

Family III. — ASTERINIDÆ.

Genera: *Asterina*, *Palmipes*, *Nepanthia*, *Ganeria*, *Disasterina*.

Family IV. — PTERASTERIDÆ.

Genera: *Pteraster*, *Hymenaster*, *Retaster*, etc.

Family V. — SOLASTERIDÆ.

Genera: *Korethraster*, *Lophaster*, *Radiaster*, *Ctenaster*, *Solaster*, *Crossaster*

It should be noted that some types of the family SOLASTERIDÆ seem to lead is towards STELLERIDÆ VALVULATÆ that we characterize by the double rows of the very distinct

marginal plates and their pedicellariae implanted into cavities in skeletal ossicles. We can distinguish in this order the following families:

Order III. — STELLERIDÆ VALVULATÆ.

Family I. — LINCKIADÆ.

Thin, cylindrical or conical arms, connected by sharp angles, indistinct marginal plates, excavate pedicellariae if they occur.

Genera: *Ophidiaster*, *Linckia*, *Chætaster*, *Scytaster*, *Fromia*

Family II. — GYMNASTERIDÆ.

Arms united between interbrachial arcs. — Ossicles of the skeleton covered by a bare skin.

Genera: *Marginaster*, *Gymnasterias*, *Porania*, *Asteropsis*, *Dermasterias*.

Family III. — PENTACEROTIDÆ.

Dorsal skeleton formed of large ossicles arranged in a network; valvulate pedicellariae of the ventral surface of ordinary size.

Genera: *Nidorellia*, *Pentaceros*, *Culcita*, *Asterodiscus*, *Choriaster*.

Family IV. — ANTHENEIDÆ.

Dorsal skeleton form of rounded plates or arranged in a network. — A valvulate pedicellaria occupies the whole extent of each ventral plate.

Genera: *Hippasteria*, *Goniaster*, *Anthenea*.

Family V. — PENTAGONASTERIDÆ.

Rounded, pentagonal or star-shaped skeletal plates.

Genera: *Pentagonaster*, *Dorigona*, *Goniodiscus*.

Most of the species are distributed very clearly in these families. There are some however whose place is less defined. Thus *Anthénoïdes* makes a very clear connection between the 4° and 5° families. But the most remarkable passage is without contradiction that which is indicated by *Goniopecten*. We henceforth designate the asteroids that, while keeping the general aspect of PENTAGONASTERIDÆ, are clearly distinguished by the size of the projecting mouth frame pieces that make a very evident elongated oval at each buccal angle. Nothing like this is seen in *Pentagonaster* or the asteroids of the same order, where the mouth frame pieces are not distinguished from the rest of the body wall of the ventral surface. To the contrary, the same character is clear in *Archaster*, *Astropecten*, *Luidia* and even *Ctenodiscus*. However, the arrangement of the skeletal plates, the granular covering, and the absence of mobile spines on the plates are many characters that force bringing together our *Goniopecten* of the PENTAGONASTERIDÆ. On the other hand, it is not only the mouth frame that establish the relation of these animals with ASTROPECTINIDÆ. It is also the tube feet. These tube feet are

conical and end in a point in *Astropecten* and *Luidia*. In *Goniopecten*, they are likewise conical, but end in a very small sucker, actually rudimentary, that even totally disappears in some species. Furthermore, *Goniopecten demonstrans* (Pl. V, fig. 4) seems to us to be on the way to an arrangement that is realized only in *Astropecten*. In the latter animals, the confounded ventral plates form, in fact, perpendicular bands the length of the arms. Similar bands occur in *Goniopecten demonstrans*, but they are each formed of a double row of polygonal plates that are like the structure of the ventral skeleton of PENTAGONASTERIDÆ. The plates of one band are fused and we find again the arrangement in *Astropecten*.

The order STELLERIDÆ PAXILLOSÆ, although very natural, is closely united with that of STELLERIDÆ VALVULATÆ. The connections of this order with that of STELLERIDÆ SPINULOSÆ are much less evident. It seems however that the LINCKIADÆ on one hand and the SOLASTERIDÆ on the other establish a double trait of union between the two groups. The STELLERIDÆ FORCIPULATÆ constitute an independent group, certainly more ancient than the others and from which, by the intermediary *Brisinga* are probably detached from the ophiuroids.

SYSEMATIC LIST

of the species of asteroids collected during the dredges of the Blake in the Caribbean Sea

Order I. — STELLERIDÆ FORCIPULATÆ.

Family I. — BRISINGIDÆ.

Hymenodiscus Agassizii, sp. nov.

Family II. — PEDICELLASTERIDÆ.

Pedicellaster Pourtalesi, sp. nov.

Zoroaster Sigsbei, sp. nov.

— *Ackleyi*, sp. nov.

Family III. — ASTERIIDÆ.

Asterias contorta, sp. nov.

— *fascicularis*, sp. nov.

— *linearis*, sp. nov.

— *angulosa*, sp. nov.

— *gracilis*, sp. nov.

Family IV. — STELLERIDÆ ECHINULATÆ.

Family I. ECHINASTERIDÆ

Echinaster modestus, sp. nov.

Cribrella Antillalrum, sp. nov.

— *sexradiata*, sp. nov.

Family II. — SOLASTERIDÆ

Lophaster radians, sp. nov.
Korethraster palmatus, sp. nov.
Radiaster elegans, sp. nov.
Ctenaster spectabilis, sp. nov.

Family III. — PTERASTERIDÆ.

Pteraster carribœus, sp. nov.

Family IV. — ASTERINIDÆ.

Asterina Lymani, sp. nov.
— *pilosa*, sp. nov.
— *Wesseli*, Lütken, sp. nov.

Order III. — STELLERIDÆ VALVULATÆ.

Family I. LINCKIADÆ.

Ophidiaster Floridae, sp. nov.
— *Agassizii*, sp. nov.
Linckia nodosa, sp. nov.
Fromia Mexicana, sp. nov.

Family II. GYMASTERIADÆ,

Marginaster pectinatus, sp. nov.
— *echinulatus*, sp. nov.

Family III. — PENTACEROTIDÆ.

Pentaceros reticulatus.

Family IV. — PENTAGONASTERIDÆ.

Pentagonaster parvus, sp. nov.
— *grenadensis*, sp. nov.
— *ternalis*, sp. nov.
— *subspinosus*, sp. nov.
— *arenatus*, sp. nov.
— *Alexandri*, sp. nov.
— *dentatus*, sp. nov.

- affinis, sp. nov.
 - intermedius, sp. nov.
 - pedicellaris, sp. nov.
- Anthenoïdes Peircei, sp. nov.

Family V. — GONIOPECTINIDÆ,

- Goniopecten subtilis, sp. nov.
- intermedius, sp. nov.
 - demonstrans, sp. nov.

Order IV. STELLERIDÆ PAXILLOSÆ.

Family I. — ARCHASTERIDÆ.

- Archaster pulcher, sp. nov.
- mirabilis, sp. nov.
 - echinulatus, sp. nov.
 - simplex, sp. nov.
 - efflorescens, sp. nov.
 - insignis.
- Blakiaster conicus, sp. nov.

Family II. — ASTROPECTINIDÆ.

- Astropecten alligator, sp. nov.
- articulatus, Say.
- Luidia barbadensis.
- convexiuscula.
 - elegans.
 - alternata, Say.
 - clathrata, Say.

Summary: 54 species collected, of which 36 are new.

LIST OF SPECIES BY LOCALITY.

Nº 9. — Sand Key. — Depth, 11 fathoms.

Asterias contorta 4 specimens.

Nº 39. Six miles to the north of Jolbos Island. — Depth, 14 fathoms.

Luidia alternata 2 specimens.

— clathrata 2 —

Astropecten articulatus 4 —

N° 38. — Yucatan Bank. — Lat. 23°10' N, — Long. 88°45'W. Depth, 20 fathoms.

Asterias gracilis 1 specimen.

Astropecten articulatus 1 —

N° 32. — Lat. 23°62'N. — Long. 88°6'W. Depth, 25 fathoms.

Pentagonaster parvus 1 specimen.

N° 11. — Lat. 24°43'N. — Long. 83°35'W. Depth, 37 fathoms.

Pentagonaster Alexandri.

N° 26. — Lat. 24°37'5"N. — Long. 83°36'W. Depth, 40 fathoms.

Luidia Barbadosis 1 specimen.

No. 292. — Off the coast of Barbados. Depth, 56 fathoms.

Temperature: Surface, 80° Fahr.; Bottom, 74° Fahr. — Madroporite sand and broken shells.

Asterias gracilis 1 specimen.

Lophaster radians 1 —

Archaster mirabilis 21 —

Luidia convexiuscula 1 —

N° 264. — Grenada. — Depth, 41 fathoms.

Pentagonaster dentatus 1 specimen.

N° 278. — Barbados. — Depth, 60 fathoms.

Marginaster echinulatus. 3 specimens.

N° 290. — Off the coast of Barbados. — Depth, 73 fathoms.

Temperature: Surface, 80°; Bottom, 70.75°. — Large madreporite sand, broken shells.

Archaster mirabilis 12 specimens.

Luidia convexiuscula 1 —

N° 272. — Off the coast of Barbados. — Depth, 76 fathoms.

Temperature: Surface, 79°; Bottom, 64.75. Large sand and shells, solid bottom.

Archaster gracilis 19 specimens.
Korethraster palmatus 1 —
Archaster mirabilis 1 —

N° 292. — Havana. — Depth, 80 fathoms.

Lophaster radians 1 specimen.

N° 300. — Barbados. — Depth, 82 fathoms.

Luidia Barbadosensis 1 specimen.

N° 296. — Off the coast of Barbados. — Depth, 84 fathoms.

Temperature: Surface, 78°; Bottom 61.5°. — Solid bottom.

Asterias gracilis 1 specimen.
Pentagonaster parvus 1 —
Anthenöides Peircei 1 —
Archaster mirabilis 1 —
Luidia convexiuscula 1 —

N° 36. — Lat. 23°13'N; — Long. 89°16'W. — Depth, 84 fathoms.

Temperature: Surface, 74°; Bottom, 60°.

Pentagonaster Alexandri..... 2 specimens.
Archaster mirabilis..... 2 —
— echinulatus 2 —

N° ?. — Strait of Florida. — 85 fathoms.

Asterias linearis..... 4 specimens.

N° 155. — Off the coast of Montserrat. — Depth, 88 fathoms.

Temperature: Surface, 80°; Bottom, 69°. Nature of bottom: volcanic sand.

Archaster mirabilis..... 4 specimens.
Luidia convexiuscula 1 —
— alternata 1 —

N° 156. — Plymouth. — Depth, 88 fathoms.

Archaster mirabilis 5 specimens.

N° 156. — Plymouth. As 155.

Asterias contorta
Archaster mirabilis

N° 232. Off the coast of Saint Vincent. — Depth, 88 fathoms.

Temperature: Surface, 80°; Bottom, 62°.

Asterias contorta..... 1 specimen.

N° 25. — Grenada. — Depth, 92 fathoms.

Asterias contorta. 1 specimen.
Pentagonaster parvus..... 1 —
Blakiastr conicus..... 1 —

N° 276. — Off the coast of Barbados. — Depth, 94 fathoms.

Temperature: Surface, 79.5°; Bottom, 61°.

Pentagonaster parvus..... 2 specimens.

N° 231. — Off the coast of St. Vincent. — Depth, 95 fathoms.

Temperature: Surface, 80°; Bottom: 61.5°. Large sand and rocks.

Asterias contorta (fragment)..... 1 specimen.
Archaster mirabilis..... 6 —

N° 32. — Lat. 23°32'N. — 88°5'W. — Depth, 95 fathoms.

Marginatus pectinatus..... 1 specimen.
Pentagonaster parvus
— *Alexandri* 1 —
Archaster mirabilis..... 13 —
— *echinulatus*..... 13 —

N° 203, — Off the coast of Martinique. — Depth, 96 fathoms.

Temperature: Surface, 79°; Bottom, 61°. — Nature of bottom: large sand and broken shells.

Fromia mexicana

N° 45. — Lat. 25°33'N. — Long. 84°21'W, — Depth, 101 fathoms.

Temperature: Surface, 75°; Bottom, 64.75°.

Asterias linearis.....	1 specimen.
— gracilis	5 —
Echinaster modestus.....	2 —
Asterina Wesseli.....	1 —
Archaster echinulatus.....	5 —
Luidia convexiuscula.....	1 —

N° 47. Same position.

Cribrella sexradiata..... 2 specimens.

N° 273. — Off the coast of Barbados. — Depth, 103 fathoms.

Temperature: Surface, 79.5°; Bottom, 59.5°. — Calcareous polyps and broken shells.

Asterias contorta (fragments).....	1 specimen.
Korethraster palmatus.....	2 —
Archaster mirabilis.....	3 —

N° 277. — Barbados. — Depth, 106 fathoms.

Archaster mirabilis..... 7 specimens.

N° 7 or 8. — Alligator's Reefs (Florida). — Depth, 110 fathoms.

Asterias linearis..... 1 specimen.

N° 26. — Lat. 24°37'N. — 83°36'W. — Depth, 110 fathoms.

Temperature: Surface, 72°; Bottom, 58.5°;

Luidia Barbadensis.

N° 9. — Seven miles south-southwest of Sand Key. — Depth, 111 fathoms.

Temperature: Surface, 76°; Bottom, 49.5°.

Asterias contorta.

N° 224. — Saint Vincent. — Depth, 114 fathoms.

Asterias contorta..... 2 specimens.

Goniodiscus pedicellaris..... 2 —

N° 132. — Off the coast of Santa Cruz, Frederickstadt. — Depth, 115 fathoms.

Temperature: Surface, 77°; Bottom, 65°, — Nature of bottom: rocks and broken shells.

Archaster mirabilis..... 3 specimens.

N° 177. — Off the coast of Dominica. — Depth, 118 fathoms.

Temperature: Surface, 80°; Bottom, 65°. — Nature of bottom: fine sand and broken shells.

Asterina pilosa..... 1 specimen.

Archaster mirabilis..... 1 —

N° 298. Off the coast of Barbados. — Depth, 120 fathoms.

Temperature: surface, 80.25°; Bottom, 64°. Shells and broken calcareous polyps.

Cribrella sexradiata..... 1 specimen.

Pentagonaster parvus..... 1 —

Asterina Lymani..... 1 —

N° 157. — Off the coast of Montserrat. — Depth, 120 fathoms.

Asterias gracilis..... 1 specimen.

Zoroaster Ackleyi..... 1 —

Archaster mirabilis..... 6 —

Echinaster modestus..... 1 —

N° ? — Sand Key (Florida). — Depth 120 to 129 fathoms.

Asterias gracilis..... 3 specimens.

N° 158. — Off the coast of Monserrat. — Depth, 148. Rocky bottom.

Archaster mirabilis..... 7 specimens.

N° 269. — Off the coast of Saint Vincent. — Depth, 124 fathoms.

Temperature: Surface. 80°; Bottom, 57.5°.

Echinaster modestus..... 1 specimen.

N° 259. — Milligan Key..... 1 specimen.

Archaster mirabilis..... 1 specimen.

N° 238. — Off the coast of Grenadine. — Depth, 127 fathoms.

Temperature: Surface, 79.5°; Bottom, 56°. — Fine coralligenous sand.

Pedicellaster Pourtalesi..... 11 specimens.

Cribrella Antillarum..... 1 —

Archaster mirabilis..... 123 —

N° 299. Off the coast of Barbados. — Depth, 140 fathoms.

Temperature: Surface, 80.5°; Bottom, 56.5°. Coral polyps and corralines.

Asterias contorta..... 1 specimen

Asterina Lymani..... 1 —

N° 301. Off the coast of Barbados. — Depth, 82 fathoms.

Temperature: Surface, 80.5°; Bottom, 60°.

Luidia barbadensis.

N° 146. — Off the coast of St. Kitts. — Depth, 145 fathoms.

Temperature: Surface, 79.5°; Bottom, 52°. — Nature of bottom: Very fine gray sand, silt.

Zoroaster Sigsbei.

N° 224. — Off the coast of Saint Vincent. — Depth, 146 fathoms.

Temperature: Surface, 79°; Bottom, 56°. Fine, black sand.

Asterias contorta..... 1 specimen.

— *gracilis*.....

Goniodiscus.....

N° 148. Montserrat. — Depth, 148 fathoms.

Archaster mirabilis..... 4 specimens.

N° 166. — Off the coast of Guadeloupe. — Depth, 150 fathoms.

Temperature: Surface, 80°; Bottom, 59.75°.

Asterias contorta..... 1 specimen.

Archaster mirabilis..... 12 —

N° 164. — Off the coast of Guadeloupe. — Depth, 150 fathoms.

Temperature: Surface, 80°. Solid bottom.

Archaster mirabilis..... 12 specimens.

N° 143. — Off the Saba bank. — Depth, 150 fathoms.

Temperature: Surface, 79°; Bottom, 63.33°

Archaster mirabilis..... 1 specimen.

N° 166. — Guadeloupe. — Depth, 150 fathoms.

Archaster mirabilis..... 1 specimen.

N° 278. — Off the coast of Barbados. — Depth, 69 fathoms.

Temperature: Surface, 78°; Bottom, 68°. — Coral polyps.

Marginaster echinulatus

N° 219. — Sainte Lucie. — Depth, 154 fathoms.

Goniodiscus pedicellaris..... 2 specimens.

N° 5. — Lat. 24°15' N. — Long. 82°13 W. — Depth, 152 fathoms; 229 fathoms.

Archaster echinulatus..... 5 specimens.

N° 282. — Off the coast of Barbados. — Depth, 154 fathoms.

Temperature: Surface, 81°; Bottom, 56°. Madreporite sand and broken shells.

Archaster mirabilis..... 1 specimen.

N°. 216. — Off the coast of Sainte Lucie. — Depth, 154 fathoms.

Temperature: Surface, 79.5°; Bottom, 54.5°. — Solid bottom and fine sand.

Asterias gracilis..... 1 specimen.

N° 241. — Grenada. — 154 fathoms.

Pedicellaster Pourtalesi..... 1 specimen.

N° ? — Sand Key. — Depth, 138 fathoms.

Pteraster caribbæus..... 1 specimen.

N° 263. — Off the coast of Grenada. — Depth, 159 fathoms.

Temperature: Surface, 80°; Bottom, 53.5°.

Pedicellaster Pourtalesi..... 2 specimens.

N° 5. — Moro Light. — Depth, 229 fathoms; 159 fathoms.

Temperature: Surface, 76°; Bottom, 53.5°. Nature of bottom: soft madreporite mud (soft coralline ooze).

Archaster echinulatus.

N° 259. — Off the coast of Grenada. — Depth, 159 fathoms.

Temperature: Surface, 79.5°; Bottom, 43.5°.

Archaster mirabilis.

N° 241. — Carriacou, off the coast of Grenadine. Depth, 163 fathoms.

Temperature: Surface, 80°; Bottom, 53°.

Asterias contorta..... 1 specimen.

Pedicellaster Pourtalesi..... 1 —

Penagonaster subspinosus..... 5 —

Archaster mirabilis..... 3 —

N° 218. — Off the coast of Saingte Lucie. — Depth, 164 fathoms.

Temperature: Surface, 80°; Bottom, 56°.

Cribrella antillarum (fragment)..... 1 specimen.

N° 254. — Grenada. — Depth, 164 fathoms.

Pentagonaster arenatus..... 1 specimen.

Luidia convexiuscula..... 1 —

N° 233. — Off the coast of Saint Vincent. — Depth, 174 fathoms.

Temperature: Surface, 87°; Bottom, 49.5°. — Rocky bottom.

Asterias gracilis..... 1 specimen.

N° 9. — Tennessee Rocks (Florida). — Depth, 174 fathoms.

Asterias gracilis..... 1 specimen.

N° 167. — Off the coast of Guadeloupe. — Depth, 175 fathoms.

—Temperature: Surface, 80°; Bottom, 55°. — Nature of Bottom: black sand and broken shells.

Archaster mirabilis.

N° 54. — Havana. — Depth, 175 fathoms.

Pentagonaster subspinus..... 1 specimen.

— *Alexandri*..... 2 —

Blakia *conicus*..... 1 —

N° 295. — Offshore Barbados. — Depth, 180 fathoms.

Temperature: Surface, 80°; Bottom, 50.75°.... — Solid bottom.

Goniodiscus pedicellatus..... 1 specimen.

Archaster mirabilis.

N° 171. — Offshore Guadeloupe. — Depth, 183 fathoms.

Temperature: Surface, 80°; Bottom, 55.5°.

Asterias gracillius..... 1 specimen.

N° 295. — Barbados. — Depth, 186 fathoms.

Archaster mirabilis..... 1 specimen.

N° 156. — Montserrat. — Depth. 188 fathoms.

Asterias conporta..... 1 specimen.

N° 291. — Off the coast of Barbados. — Depth, 200 fathoms.

Temperature: Surface, 70.75°; Bottom, 49.75°. Calcareous pebbles.

Korethraster palmatus..... 2 specimens.
 Archaster mirabilis..... 1 —
 Luidia barbadensis..... 1 —
 — elegans..... 1 —

N° 148. — Off the coast of Saint Kitts. — Depth, 208 fathoms.

Temperature: Surface, 79.5°; Bottom, 55.25°. — Nature of bottom: fine sand.

Zoroaster Sigsbei..... 6 specimens.
 Archaster mirabilis..... 2 —
 Luidia convexiuscula..... 1 —

N° 274. — Off the coast of Barbados. — Depth, 209 fathoms.

Temperature: Surface, 79.5°; Bottom, 53.5°. — Fine sand and mud.

Cribrella Antillarum..... 1 specimen.
 Pentagonaster subspinosus..... 5 —
 Luidia barbadensis..... 1 —
 Pentagonaster arenatus..... 1 —

N° 202. — Martinique. — Depth, 210 fathoms.

Archaster mirabilis..... 1 specimen.

N° 208. — Off the coast of Martinique. — Depth, 213 fathoms.

Temperature: Surface, 80°; Bottom, 50.2°. — Solid bottom.

Archaster mirabilis..... 4 specimens.

N° 275. — Off the coast of Barbados. — Depth, 218 fathoms.

Temperature: Surface, 80°; Bottom, 52.5°. — Fine sand with brown patches.

Pentagonaster arenatus, var..... 1 specimen.

No. 11. — Lat. 22°9'30"N. — Long. 82°21'30".

Pentagonaster Alexandri..... 1 specimen.

N° 134. — Off the coast of Santa Cruz, Frederickstadt. — Depth, 248 fathoms.

Temperature: Surface, 81°; Bottom, 54.5°. — Nature of bottom: large sand and broken shell.

Zoroaster Ackleyi..... 11 specimens.
Archaster mirabilis..... 11 —

N° 147. — Off the coast of St. Kitts. — Depth, 250 fathoms.

Temperature: Surface, 79.5°; Bottom, 52.5°. Nature of bottom: fine sand.

Zoroaster Sigsbei..... 6 specimens.
Pedicellaster Pourtalesi..... 1 —

N° 100. — Moro Light. — Depth, 250–400 fathoms.

Pentagonaster dentatus..... 1 specimen.

N° 258. — Off the coast of Grenada.

Temperature: Surface, 79.5°; Bottom, 58.5°. — Madrepores and broken shell.

Pentagonaster parvus.

N° 254. — Off the coast of Grenada. — Depth, 164 fathoms.

Temperature: Surface, 78°; Bottom, 57°. — Madrepores and broken shell.

Luidia convexiuscula.

N° 281. — Barbados. — Depth, 288 fathoms.

Pentagonaster arenatus..... 1 specimen.

N° 154. — Off the shore of Montserrat. — Depth, 208 fathoms.

Temperature: Surface, 80°; Bottom, 49.5°. — Nature of bottom: Volcanic sand.

Archaster mirabilis..... 1 specimen.

N° 170. — Off the shore of Guadeloupe. — Depth, 309 fathoms.

Temperature: Surface, 80°; Bottom, 46.5°. — Nature of bottom: Volcanic sand and silt.

Asterias fascicularis..... 1 specimen.
Echinaster modestus

N° 19. — Bahia Honda, Cuba. — Lat. 23°3'N. — Long. 83°10'30'W. — Depth, 310 fathoms.

Temperature: Surface, 76°; Bottom, 52.5°.

Archaster coronatus..... 1 specimen.

N° 129. — Off the coast of Frederickstadt, Santa Cruz. — Depth, 314 fathoms.

Temperature: Surface, 85°; Bottom, 48.5°. — Bottom formed of gray-blue silt, soft.

Archaster mirabilis..... 1 specimen.

N° 47. — Lat. 28°42'N. — Long. 88°40W. — Depth, 321 fathoms.

Temperature: Surface, 74.5°; Bottom, 46.76°.

Zoroaster Sigsbei..... 1 specimen.

Cribrella sexradiata.

N° 251. — Off the coast of Nevis. — Depth, 355 fathoms.

Pteraster caribbæus..... 2 specimens.

Goniopecten demonstrans..... 2 —

N° 176. — Dominica. — Depth, 391 fathoms.

Hymenodiscus Agassizii..... 1 specimen.

N° 264. — Off the coast of Grenada. — Depth, 416 fathoms.

Temperature: Surface, 80°; Bottom, 41.5°. — Gray silt.

Pentagonaster ternalis..... 1 specimen.

— *dentatus*.

N° 222. — Off the coast of Sainte Lucie. — Depth, 422 fathoms.

Temperature: Surface, 80°; Bottom, 42.75°.

Pteraster caribbæus..... 1 specimen.

N° 227. — Off the coast of Saint Vincent. — Depth, 424 fathoms.

Temperature: Surface, 79.25°; Bottom, 42.5°. — Fine sand and mud.

Archaster pulcher..... 1 specimen.

N° 135. — Off the coast of Santa Cruz, Frederickstadt. — Depth, 450 fathoms.

Temperature: Surface, 81°; Bottom, 42.5°. — Nature of bottom: Sand and gray silt.

Hymenodiscus Agassizii..... 1 specimen.
Goniopegten demonstrans..... 1 —

N° 130. — Off the coast of Frederickstadt, Santa Cruz. — Depth, 451 fathoms.

Temperature: Surface, 84°; Bottom, 44.5°. — Nature of bottom: Soft gray silt.

Pteraster caribbæus..... 2 specimens.
Goniopecten demonstrans..... 1 —

N° 200. — Off the coast of Martinique. — Depth, 472 fathoms.

Temperature: Surface, 80°; Bottom, 41.5°. — Nature of bottom: Solid with a little black-brown sand.

Cribrella Antillarum..... 1 specimen.

N° 227. — Saint Vincent. — Depth, 573 fathoms.

Archaster pulcher..... 1 specimen.

N° 265. — Off the coast of Grenada. — Depth, 576 fathoms.

Temperature: Surface, 79.5°; Bottom, 39.75°.

Pentagonaster granadensis..... 1 specimen.

N° 175. — Off the coast of Dominica. — Depth, 611 fathoms.

Temperature: Surface, 80°; Bottom, 40.5°. — Nature of bottom: brown silt, fine and viscous.

Archaster mirabilis..... 1 specimen.

N° 25. — In sight of Bahia Honda. — Lat. 23°4'N. — Long. 83°12'30"W. — Depth, 635 fathoms.

Temperature: Surface, 78°; Bottom, 30.5°.

Asterias contorta.
— gracilis.
Blakiaster conicus.

N° 173. — Off the coast of Guadeloupe. — Depth, 734 fathoms.

Temperature: Surface, 81°; Bottom, 40°. — Nature of bottom: Fine grey-brown silt.

Pentagonaster ternalis..... 1 specimen.
— arenatus..... 1 —

N° 162. — Off the coast of Guadeloupe. — Depth, 734 fathoms.

Temperature: Surface, 81°; Bottom, 40°.

Cribrella Antillarum..... 1 specimen.

N° 2. — Moro Light. — Depth, 805 fathoms.

Temperature: Surface, 73° F' Bottom, 39.75° F.

Archaster mirabilis..... 1 specimen.

N° 41. — Lat. 23°42'N. — Long. 83°13'W. — Depth, 860 fathoms.

Temperature: Surface, 73°; Bottom, 39.5° .

Asterias contorta..... 1 specimen.
Pentagonaster arenatus 1 —

N° 117. — Lat. 17°47'20"N., — Long. 67°31'20"W. — Depth, 874 fathoms.

Pentagonaster arenatus..... 1 specimen.

N° 174. — Off the coast of Guadeloupe. — Depth, 878 fathoms.

Temperature: Surface, 80°; Bottom, 39.75°.

Archaster mirabilis.

N° 29. — Lat. 24°36'N. — Long. 84°5'W.

Goniopectens intermedius..... 3 specimens.
Archaster efflorescens..... 1 —

N° 188. — Off the coast of Dominica. — Depth, 982 fathoms.

Temperature: Surface, 80.5°; Bottom, 39.75°. — Nature of bottom: Fine brown silt.

Radiaster elegans..... 1 specimen.

N° 196. — Off the coast of Martinique. — Depth, 1,030 fathoms.

Temperature: Surface, 80°; Bottom, 39°. — Nature of bottom: Fine gray sand and silt.

Archaster mirabilis..... 1 specimen.

N° 140. — Off the coast of Virgin Gorda. — Depth, 1,007 fathoms.

Temperature: Surface, 80°; Bottom, 38.5°.

Archaster mirabilis.

N° 182. — Off the coast of Dominica. Depth, 1,131 fathoms.

Temperature: Surface, 81°; Bottom, 39.5°. — Nature of bottom: Fine brown sit and sand.

Pentagonaster affinis..... 1 specimen.

N° 111. — Lat. 19°7'N. — Long. 74°52'W. — Depth, 1,200 fathoms.

Temperature: Surface, 80°; Bottom, 39.5°. — Nature of bottom: Gray silt, formed of globerinans.

Pentagonaster dentatus..... 1 specimen.

N° 40. — Lat. 23°26'N. — Long. 84°2'W. Depth, 1,323 fathoms.

Tosia affinis..... 1 specimen.

Archaster simplex..... 1 —

N° 31. — Lat. 24°33'N. — Long. 84°23'W. — Depth, 1,930 fathoms.

Bottom temperature: 39.5°

Pentagonaster Alexandri..... 1 specimen.

Pentagonaster intermedius..... 2 —

Ctenaster spectabilis..... 1 —

Goniopecten subtilis..... 1 —

Archaster insignis..... 2 —

N° 3. — Alligator's Reef (coast of Florida).

Asterias angulosa.

LIST OF SPECIES ACCORDING TO DEPTH

Fathoms

Temperatures at the bottom and at the surface

*Less than 100 fathoms (41 dredges). — 15 species. Approximately 150 individuals.
Coefficient. — 2.7 dredges for a species*

14.	Luidia alternata.	“	“
	— clathrata.	“	“
	Astrpecten articulatus.	“	“
20.	Asterias gracilis.	“	“
56.	Solaster radians.	74.5°.	— 80°.
	Archaster mirabilis (very numerous).		
	Luidia convexiuscula.		
76.	Korethraster palmatus.	64.75°.	— 79°.
84.	Pentagonaster parvus.	61.5°.	— 78°.
	Anthenoides Peircei.		
84	Archaster echinulatus.	60°.	— 74°.
88..	Asterias contorta.	62°.	— 80°.
	Marginaster pectinatus.		
96.	Fromia Mexicana	61°.	— 79°.

*From 100 to 200 fathoms (76 dredges). — 21 species. — 144 individuals.
Coefficient. — 3.6 dredges for a species.*

101.	Asterias lineatus.	61.7 °.	— 76 °.
	Asterias gracilis.		
	Echinaster modestus		
	Asterina Wesseli.		
	Luidia convexiuscula		
	Asterias contorta.		
	Korethraster palmatus.		
	Archaster mirabilis.		
	Asterina pilosa.		
	Cribrella exradiata.		
	Pentagonaster parvus.		
120.	Zoroaster Ackleyi.		
123.	Archaster mirabilis.		
127.	Pedicellaster Pourtalesi.	56 °.	— 79.5°.
	Cribella Antillarum.		
	Asterina Lymani.		
	Luidia barbadensis.		
145.	Zoroaster Sigsbeeii.	52°.	— 70.5°.
	Goniodiscus pedicellaris.		
	Marginaser echinulatus.		

Pentagonaster subspinosus. 53°. — 80°.

From 200 to 300 fathoms (41 dredges). — 13 species. — 66 individuals.

Coefficient: — 3.15 dredges for a species.

200. Korethraster palmatus. 49.75°. — 70.75°.
Luidia barbadensis.
— elegans.
Zoroaster Sigsbeeii.
Luidia convexiuscula.
Cribrella Antillarum.
Pentagonaster subspinosus.
— arenatus.
Zoroaster Ackleyi.
Pedicellaster Pourtalesi.
Pentagonaster parvus.
Luidia alternata.
298. Archaster mirabilis. 49.5°. — 80°.

From 300 to 400 fathoms (44 dredges). — 9 species. — 12 individuals.

Coefficient. — 3.9 dredges for a species.

309. Asterias vasicularis. 46.5°. — 80°.
Echinaster modestus.
Archaster coronatus.
— mirabilis.
Zoroaster Sigsbeeii.
Pentagonaster dentatus.
Cribrella sexradiata.
356. Pteraster caribbæus.
Goniopecten demonstrans.

From 400 to 500 fathoms. — 5 species. — 9 individuals.

Coefficient. — 4.6 dredges for a species.

316. Pentagonaster ternalis. 42.5°. 80°
— dentatus.
Pteraster caribbæus.
Archaster pulcher.
450. Goniopecten demonstrans. At 451 44.5°. 84°
fathoms.

From 500 to 600 fathoms (13 dredges). — Coefficient. — 13.

At 576 fathoms. — 1 species. — 1 individual.

Pentagonaster grenadensis. 39.75°. 79.5°.

From 600 to 700 fathoms (7 dredges). — 4 species. — 4 individuals.

- 611. — Archaster mirabilis.
- 635. — Asterias contorta.
 - gracilis.
 - Blakiaster conicus.

From 700 to 800 fathoms (9 dredges). — 3 species. — 3 individuals.

- At 734 fathoms 40° 81°
 - Pentagonaster ternalis.
 - arematus,
 - Cribella Antillarum.

From 800 to 900 fathoms (15 dredges). — 3 species. — 3 individuals.

- 860. — Asterias contorta. 39° 73°
 - Pentagonaster arenatus.
- 878. — Archaster mirabilis. 39.75° 80°

From 900 to 1,000 fathoms (8 dredges). 2 species. — 2 individuals.

- 955. — Archaster efflorescens.
- 982. — Radiaster elegans. 39.75° 80.5°

From 1,000 to 1,100 fathoms (5 dredges). — 2 species. — 5 individuals.

- 1,030. — Archaster mirabilis. 39° 80°
- 1,097. — — — 38.5° 80°

From 1,100 to 1,200 fathoms (3 dredges). — 2 species. — 2 individuals.

- 1,131. — Pentagonaster affinis. 39.5° 81°
- 1,200. — — dentatus.

From 1,300 to 1,400 fathoms (4 dredges). — 1 species. — 1 individual.

- 1,323. — Archaster simplex. 40° 77°

From 1,900 to 2,000 fathoms (4 dredges). — 4 species. — 7 individuals.

- 1,920. — Pentagonaster intermedius. 39.5°
 - Ctenaster spectabilis.
 - Goniopecten subtilis.
 - Archaster mirabilis.
-

DETAILED DESCRIPTION OF THE SPECIES OF ASTEROIDS COLLECTED
DURING THE EXPEDITIONS OF THE UNITED STATES SHIP *THE BLAKE*.

CLASS OF ASTEROIDS

Free-living echinoderms during their entire life, except for rare species that are fixed momentarily during their development (*Leptychaster*, *Caulaster* ?), with the mouth turned to the bottom, with arms whose buccal surface has a groove covered with a soft integument and in which or two or four rows of membranous tubes (*tube feet*) that generally end in a sucker; with an integument supported by a skeleton whose basic pieces are four rows of contiguous ossicles (*ambulacral* and *adambulacral plates*), ossicles of the two internal rows (*ambulacral plates*) arranged in a chevron to form the basis of the ambulacral groove; the other pieces of the skeleton basically variable; first adambulacral pieces united by an interbrahial piece (*odontopore*); a dorsal madreporite plate; often with pedicellariae.

ORDER I

STELLERIDÆ FORCIPULATÆ.

Asteroids with pedicellariae supported by a soft peduncle, formed from a basal piece and two jaws than can come together as pincers. — Tube feet frequently arranged in 4 rows; mouth frame formed by ambulacral pieces. — Skeleton ordinarily reticulate, rarely formed of pieces forming a continuous covering, — soft integument covered at least in part with spines; rarely granulose.

Family I.

BRISINGIDÆ.

Asteroids with two rows of tube feet; with ambulacral and adambulacral ossicles of the same form, elongated in the direction of the axis of the arms, having the appearance of an hourglass. The first of these pieces constitute together a projecting ring, limiting a disk clearly distinct from the arms and supporting ordinarily the dorsal integument that has a skeletal system of only some irregular, perforated plates that support the spines. — No mouth frame strictly speaking. Odontophores formed of three distinct pieces, projecting onto the disk. Skeleton of the arms formed of pieces arranged in arcs leaning on the adambulacral plates, naked at the end of the arms and sometimes the entire length. Crossed pedicellariae arranged on the transverse folds of the integument that form as many transverse demi-rings as there are adambulacral pieces. — Reproductive organs limited to the base of the arms and opening towards the inferior third of their length. — Arms ordinarily numerous.

Genus HYMENODISCUS, nov. gen.

Ring surrounding the disk slightly projecting, formed of nearly perpendicular ambulacral and adambulacral pieces. Odontophores with elongated basal pieces, not projecting onto the disk. —

Transparent dorsal integument. — No dorsal skeleton of the arms whose solid parts are reduced to ambulacral and adambulacral ossicles.

HYMENODISCUS AGASIZII. Sp. nov.

(Plates I and II)

This description is based on two specimens, probably young, but both having the same degree of development and already having greatly passed the size where young *Brisinga* have all their generic characters. They are evidently very near *Brisinga* strictly speaking, but are distinguished by a much greater simplicity in all parts of the skeleton and because the disk and the arms are much less clearly separated, as in the case in the very young *Brisinga*. The disk is, indeed, scarcely more elevated than the arms, while in adult *Brisinga* and in those whose dimensions are not greater than our *Hymenodiscus*, it is much more elevated than in the arms to which it is attached, and forms around it a kind of circular cake.

Moreover, the arms, although very fragile, do not detach as in *Brisinga*. In the latter, they are broken at the edge of the disk that remains completely isolated. In *Hymenodiscus*, because of their continuity with the disk, the arms break more or less distant and part of their length remains attached.

One of the two individuals (Pl. I, *fig.* 2 and 3) is nearly reduced to its disk that is very well conserved. The other, to the contrary, has nearly entirely conserved its arms. But its disk is gravely damaged. Happily, these two individuals together form a very complete ensemble that we have used to design figure 1 of Plate I.

The dimensions of the disk, measured from one interbrachial angle to the other is 12 mm. Its skeleton forms a kind of ring with an interior diameter of 8 mm. The arms, 12 in number in the two specimens, are 3 mm wide at their base and reach approximately 80 mm in length. This gives the entire animal a diameter greater than one hundred. They are thin, elongated, and decrease regularly from the base to the end that is slightly obtuse. On each side they have a row of long (approximately 2 mm) thin spines and spaced at the base of the arms by approximately 2 mm.

The portion of the disk that comprises the interior of the skeletal ring is simply formed on the dorsal side by a semi-transparent membrane, through which can be seen the viscera and that is strewn with white dots. These dots are nothing other than largely perforated calcareous plates of irregular form that support short spines. (Pl. II, *fig.* 18 and 19.).

The skeleton of the arms is remarkably simple. It is formed, for most of its length, of four rows of ossicles, two symmetrical medial ones and two equally symmetrical lateral ones. (Pl. II, *fig.* 21 and 22.) The ensemble of these pieces forms a groove whose concavity is turned from the ventral side and whose bottom is occupied by the median ossicles. Each of these ossicles is approximately 2 mm long and 0.7 wide. The median ossicles have attached at the inferior border, near their distal end, a kind of calcareous shield, clearly elliptical in form, pointed at the two ends of its long axis (Pl. II, *fig.* 23). By its two points, each shield touches the two shields between which it is situated, so as to limit, concurrently with them and with the very body of the ossicles, an elliptical membranous space in which are located the vesicles corresponding to each tube foot. On its inferior face, each shield is applied to two consecutive lateral ossicles whose suture is located precisely below the median part. Each pair of median ossicles, with the shields connected to them, form thus a kind of chevron containing between its branches the pairs of lateral ossicles that alternate with it. Each of the lateral ossicles has, in the middle of its external edge, a small tubercle on which is articulated one of the spines that border the arms.

The *median ossicles* correspond to the *ambulacral pieces* of the other asteroids. The *lateral ossicles* correspond to their *adambulacral pieces* and we designate them under these names in the rest of this description. In *Hymenodiscus*, at the age we have examined them, i.e., before development of the gonads, *the skeleton of the arms is thus absolutely reduced to the pieces that constitute the ambulacral groove of other asteroids*. The dorsal skeleton is totally missing.

These are the same ambulacral pieces that, with the addition of some accessory pieces, form the skeletal ring of the disk, often designated by the name of peribuccal frame. Seen by the dorsal surface (Pl I, *fig. 3*), this frame is composed of 48 pieces forming together a circle with all taking a nearly equal part. Twenty-four of these pieces are ambulacral pieces a little more shortened than normal pieces but otherwise little modified. The other 24 pieces are adambulacral pieces that come to be intercalated by pairs between the preceding. Outside these adambulacral pieces and corresponding exactly to their suture line, one sees in each interbrachial angle an unpaired rectangular piece. This is exactly homologous to the pieces, constant in other asteroids, that Viguier named the *odontophore*. Following this piece, always on the exterior side, are two oblong calcareous scales, often unequal, that are arranged in a kind of V whose summit is applied to the odontophore and whose branches come to cover the ambulacral and adambulacral pieces at the base of the arms. On each arm and each side, two small scales, the last very reduced, follow these accessory scales and alternate with the ambulacral pieces. According to Ossian Sars, who described them in *Brisinga* whose buccal fame, although more modified, is constructed in the same fashion, these scales are the rudimentary dorsal marginal plates.

On the ventral side (Pl. I, *fig. 2*), the skeleton of the buccal frame is likewise simply formed by uniting with the arms. These are fused the length of the last adambulacral plate and also by the end of the next to the last. These pieces are, moreover, barely modified and the last continues even to have a spine in the middle like the others. Its buccal border alone is modified to have two divergent spines, each with one or two large crossed pedicellariae (Pl. II, *fig. 12 to 17*). As a result, each buccal angle has 4 cylindrical, obtuse, more or less divergent spines. One can consider these last adambulacral pieces as constituting the mouth frame, because they advance more towards the mouth than the ambulacral pieces. One observes this fact also in the true *Brisinga*. As a result, in these animals, contrary to that observed in properly called ASTERIADÆ, the mouth tends to reproduce the adambulacral type. But it is necessary to add also that it is obviously a kind of mouth of transition, because none of these pieces is modified so greatly that it constitutes the *mouth frame* in asteroids with either the ambulacral type or the adambulacral type of mouth.

The pedicellariae are all crossed pedicellariae. They appear nevertheless in two distinct forms and have a remarkable arrangement. One (Pl. II, *fig. 12 to 17*) are relatively large. They are isolated in groups of two, or on the dorsal membrane of the disk or on the buccal spines. The others, smaller, are much more numerous. They occur in large numbers on the membranous covering of the marginal spines, notably on the swelling at its free end. They are still more numerous on the dorsal surface of the arms where their accumulation forms a kind of wide transverse, parallel bands that seem to be part of each of the lateral spines and are as regularly spaced. Their form is a little different than that of the large pedicellariae. The latter is composed of a basal piece shaped in the form of a steam boat propeller (Pl. II, *fig. 15*), having, consequently, two concavities and two opposed convexities. In each of the convex parts is enclosed one of the jaws of a pedicellaria. These jaws are elongated and thin, ending in a kind of denticulated bowl of a spoon. They have in the middle of their length, a denticulated plate, sunken above, that goes to oppose the similar plate of the other jaw.

In the small pedicellariae, whose form is a little more compact, this plate is replaced by a simple semi-circular projection and covered with spines, the jaws of the pincer (Pl. II, fig. 4, 6 and 11). This latter ends in a spoon bowl whose border is notched with some teeth variously arranged and sometimes forming a double row. The basal piece is also a double curve and has on each surface a kind of wing that supports the corresponding jaw of the pedicellaria. The muscles that move the jaws of the pedicellaria insert, as usual, on the basal piece and on the stalk or the jaws of the pincer between which it is located. The muscles that support the pedicellariae of the marginal spines cross their cutaneous covering and form together, around the spines, a kind of fibrous case that accompanies it for its entire length.

The only viscera it is possible to observe are the interradial caeca, reduced to a kind of irregular sac (Pl. I, fig. 3, c, i) and the very simple radial caeca that extend only to the end of the 6th ambulacral piece on an arm with approximately 85.

There is no trace of the gonads in our individuals. The genital cavity is nearly nothing, both in the disk where the buccal membrane and dorsal membrane are nearly in contact as well as in the arms or the dorsal membrane, lacking any skeleton, is applied against the membrane that envelops the skeleton of the ambulacral groove.

One of our individuals comes from Dominica where it was collected at 391 fathoms. The other comes from Santa Cruz at 450 fathoms.

FAMILY II.

PEDICELLASTERIDÆ.

Asteroids with two rows or tube feet, at least in the last third of their arms, mouth frame formed by adambulacral pieces, with only five or six arms.

Genus PEDICELLASTER Lovén.

Two rows of tube feet only. Dorsal skeleton formed of thin ossicles arranged in a network.

PEDICELLASTER POURTALESI Ed. P.

(Pl. III, fig.4.)

N° 263. — Depth, 159 fathoms. — Grenada (2 specimens).

N° 238. — — 127 — Camman (11 small specimens, of which many broken).

N° 147. — — 250 — Saint Kitt.

N° 241. — — 154 — Grenada.

Five arms, thin, elongated, nearly cylindrical, obtuse at the end.

$R = 21 \text{ mm}; r = 4 \text{ mm}; R > 5r.$

The diameter of the arms, near the base, is approximately 3 mm.

The tube feet are arranged in two rows only and end in a well formed sucker.

The ambulacral groove fills nearly all the ventral surface of the arms.

The adambulacral plates are very large and each has two or three spines, conical, thin, very long, placed in a transverse row. The dorsal surface is constituted of a network of ossicles that form only 3 regular rows, one in the dorsal median line and two lateral. These three rows are connected by irregularly arranged ossicles. All the ossicles have moreover, a small spine. In the intervals of the spines are crossed pedicellariae, isolated and perfectly characteristic.

The anus, very visible, is subcentral. The madreporite is small, difficult to distinguish, marked by large radiating grooves, located at the border of the disk in the interval of two arms.

The arms at their base are extremely fragile.

The mouth frame is formed by adambulacral pieces. Each has two spines directed towards the mouth.

Remark. — The physiognomy of the animal greatly recalls that of an *Echinaster*. However, in these animals, the ambulacral groove is ordinarily closed while it is widely open in *Pedicellaster*.

Genus ZOROASTER Wyville Thomson

(Pl. III, fig. 2.)

N° 47, 47. — Depth, 321 fathoms. — Lat. 28°42'N. — Long. 88°40W. (1 specimen)

N° 147, 148, 146. — Saint Kits. 208 fathoms (6 specimens.)

Five arms. Tube feet quadriserial at the base of the arms, biserial in the last third, with a very small sucker, much narrower than the tube foot it is contracted. Tube feet are very appressed against each other. Ambulacral grooves narrow, with indented borders at the front of each tube foot. Each of these feet are placed in a kind of semi-circular box whose projecting borders separate it from its neighbor. Each projecting part is armed with a compressed spine, curved, very like the spines that occupy the same position in *Astropecten*: on the back of this spines is in general a straight pedicellaria. On the border of the groove, the pedicellariae seem to alternate with the tube feet. All the ventral surface is uniformly covered with small dense spines, lying on the surface of the body and directed towards the exterior of the arms. Among them are some larger isolated spines, very regularly spaced, corresponding nearly to the spines of the ambulacral groove. In each interbrachial angle, 3 or 4 sharp spines project below the buccal orifice.

The dorsal surface of the arms and disk lack spines. The upper part of the arms is formed of five regular rows of slightly swollen, very dense calcareous plates, leaving between them longitudinal, slightly sunken grooves filled by the lateral apophyses of the plates that surround the openings by which project, in the living animals, papulae.

The disk is formed of a central plate around which are arranged: 1° a circle of 5 interbrachial plates; 2° a second circle of 5 plates corresponding to the arms and separated from each other by the first that project between them; 3° a circle of ten plates located 2 by 2 in the interval of the arms, smaller than the preceding; 4° a circle of fifteen plates arranged 3 by 3 at the base of the arms, and of which the median, larger, separates from each other the five pairs of plates of the preceding circle to which are contiguous the other 2 plates. The disk is thus formed of 36 plates, all convex, very clearly separated from each other and circumscribing isolated pores from which project papulae. Some small straight pedicellariae are distributed on these plates.

The convex, rounded madreporite is located between the first circle of 5 plates and the circle of 10 interbrachial plates.

There is a very visible anus between the central plate and the plates of the first circle, opposite one of the interbrachial angles contiguous with that of the madreporite.

Arms narrow, thin, elongated.

$$R = 49 \text{ mm}; r = 7 \text{ mm}; R = 7r; d = 6 \text{ mm}.$$

Nota. — No crossed pedicellariae.

ZOROASTER ACKLEYI, sp. nov.

(Pl. III, fig. 1.)

N° 157. — 120 fathoms. — Montserrat (1 specimen).

N° 134. — 248 — — Santa Cruz (10 specimens).

The diameter of the specimen from Montserrat is greater than 23 cm. The individuals from Santa Cruz are smaller.

This species is clearly distinct from *Zoroaster Sigsbeeii* and *Zoroaster fulgens*. Its aspect greatly recalls more the aspect of an *Ophidiaster* or even of a *Chaetaster*, especially when one examines the inferior surface of the arms.

The arms are much more elongated and the disk proportionally smaller than in *Zoroaster Sigsbeeii*.

$$R = 100 \text{ mm}; r = 9 \text{ mm}; R = 12.2 r; d = 9 \text{ mm}; \text{the base.}$$

The arms decrease gradually in thickness from the base to the tip as in *Zoroaster Sigsbeeii*. They keep clearly the same diameter up to the first third of their length, or even swell slightly in this region, then diminish little by little without becoming as tapered as in *Zoroaster Sigsbeeii*. Their skeleton is also much less compact. It is formed of a very larger number of smaller ossicles. There are up to 17 longitudinal rows of these ossicles while there are only 9 in the other species. As a result, the arms are much easier to deform, and are curved in various directions in individuals preserved in alcohol instead of the striking rigidity of forms in *Zoroaster Sigsbeeii* and *fulgens*. The ossicles of the disk are not as swollen as in the first of these species in a way to make a strong extension above the arms and to separate the disk in a clearer fashion. The plates of the arms and the disk are uniformly covered with articulated, very small spines. Straight pedicellariae are found between them.

The spines on the ventral surface are more elongated, more pointed. Each plate has at its center some that are larger and stronger than those on the borders. The ensemble of these spines form, on the ventral surface, an ensemble similar to that of *Luidia*. The resemblance is increased because each of the adambulacral plates, instead of having a single straight marginal spine, as in *Asterias*, has a row of spines whose direction is perpendicular to that of the ambulacral groove that advances to this groove and are compressed and saber-shaped, exactly as in *Luidia*. Among these spines are, in very great number, straight pedicellariae.

The tube feet are in four rows at the base of the arms. But they finish by being only two rows at the end. They are remarkable, as in *Zoroaster Sigsbeeii*, by the smallness of their terminal sucker. This is another character that is like *Astropectinidæ* and notably *Luidia*.

The madreporite is small and widely grooved. The mouth is small. The buccal angles are nearly contiguous and armed with very strong spines.

FAMILY III

ASTERIADÆ.

Sea stars with tube feet in 4 rows, with mouth frame formed by the ambulacral pieces, with ordinarily with few arms.

Genus ASTERIAS Linné.

Dorsal skeleton formed of ossicles arranged in a network whose nodes ordinarily have spines surrounded by several circles of crossed pedicellariae. Straight pedicellariae are in the mail of the network, notably on the disk and among the ambulacral spines.

ASTERIAS CONTORTA Ed. P.

N° 299.	—	Depth, 136 fathoms.	—	Barbados (detached arms only).
N° 224.	—	113	—	— Saint Vincent (1 arm and 1 small complete individual).
N° 156.	—	188	—	— Montserrat.
N° 25.	—	92	—	— Grenada.
N° 166.	—	150	—	— Guadeloupe (1 broken specimen).
N° 273.	—	103	—	— Barbados (arms).
N° 9.	—	11	—	— In sight of Sand Key.
N° 231.	—	95	—	— Saint Vincent (arms).
N° 232.	—	88	—	— Saint Vincent (1 incomplete individual).
N° 31	—	163	—	— Cariacou.

Close species in aspect to *Asterias glacialis* from the coasts of France. Like it, it has five arms of average length, with both having a dorsal median row of very long and pointed spines, two lateral rows, one to the right, the other to the left, of spines seeming to limit the dorsal surface of the arms. On the ventral surface, a slight distance from the spines that border the ambulacral groove, a double row of less regular and a little smaller spines as in *Asterias glacialis*. All the spines are surrounded by a fleshy rim bearing a considerable number of crossed pedicellariae, while isolated large straight pedicellariae are distributed among them. But the spines that border the ambulacral groove are in two rows, instead of being one only as in *Asterias glacialis*. Moreover, between the ambulacral spines and the double row of ventral spines, *Asterias contorta* has a longitudinal series of *large isolated papulae*, while *A. glacialis* has there a series of *bunches of papulae* as on the dorsal surface.

The two species are thus very clearly distinct.

Remark. — The arms of *Asterias contorta* detach from the disk and deform with an extreme facility. We have seen only two or three complete specimens. All the arms are represented by isolated arms.

ASTERIAS FASCICULARIS, nov. sp.

(Pl. III, fig. 3.)

N° 170. — Depth, 309 fathoms. — Guadeloupe.

Five very elongated arms, slightly swollen at the base.

$R = 57 \text{ mm}; r = 9 \text{ mm}; R > 6 r.$

Ambulacral groove very large, bordered by a double row of very elongated, obtuse contiguous spines. Spines of the second row exactly superposed on those of the first and continuing very often onto the ventral surface of the arms while the internal spines fold over the ambulacral groove. Spines, similar to those that fold over the mouth, are at each of the buccal angles.

A short distance from the ambulacral groove are successively two rows of isolated spines, one slightly larger than the spines of the second row. Between two consecutive spines of the second row is in general intercalated a very large crossed pedicellaria. These two rows of spines can be considered as belonging to the ventral surface. The dorsal frame of the arms is formed by approximately 7 rows of alternate ossicles, with membranous spaces between them with a diameter less than theirs and in which are generally two papulae. On the borders of each of the membranous spaces are two or three isolated crossed pedicellariae. The ossicles in the median line of the arms in general have three or four short, mushroom-shaped spines arranged in a transverse arc. The other ossicles have one or two spines like those on the median part and sometimes also near the end. So one finds spines not only between the eight rows of membranous areas, but also on the transverse trabeculae that separate the areas of the same row. These short, obtuse spines, all alike, form thus a large number of irregular rows.

The spines of the disk, which is small and to which the arms attach by narrowing, are like those of the arms. But between them are a small number of large straight pedicellariae with curved jaws and touching only at the end. These pedicellariae have a very characteristic oval form. The basal piece is smaller than the arms of the pincer.

The madreporite is small, round, marked with wide radiating grooves. It is located in the angle of two arms.

ASTERIAS LINEARIS, nov. sp.

(Pl. III, fig. 5.)

N° 45. — Depth, 104 fathoms.

Lat. 25°33'N. — Long. 84°21'W.

Five narrow, angular arms. A single row of straight adambulacral spines, appressed, as wide at the end as at the base. Ventral surface very narrow, armed with obtuse spines forming 3 irregular rows at the base of the arms. Spines of the external row forming the lateral carina. Dorsal surface of the arms formed by three rows of plates, each with a long spine. These spines form three rows with a median and two lateral occupying the border of the arms. Each spine is surrounded at its base by several circles of crossed pedicellariae.

Between the lateral and ventral rows of spines, the papulae are large and isolated. They are small and arranged in groups between the lateral and medial rows of spines.

The disk has some sparse straight elongated pedicellariae

$$R = 50 \text{ mm}; r = 5 \text{ mm}; R = 10 r; d = 8 \text{ mm}.$$

ASTERIAS ANGULOSUS, sp. nov.

Five elongated arms, relatively thin and pointed.

In a dried specimen:

$$R = 43 \text{ mm}; r = 6 \text{ mm}; R = 7 r.$$

Width of the arms at the base (not counting the spines), 7 mm. Ambulacral groove wide, ventral surface very narrow. Lateral face nearly vertical. Median dorsal ridge very marked. The resulting arrangement for the arms is a very clear pentagonal section.

Each adambulacral plate with two thin, elongated spines, nearly cylindrical. The ensemble forms a perfectly regular double row. In each row, the spines, because of their thinness, do not appear appressed.⁸ These spines generally have an elongated straight pedicellaria. Those corresponding to the internal spines are inserted into the ambulacral groove. The ventral plates are longer than wide. Each has two long pointed spines, inserted in a very oblique line in relation to the axis of the arms. These spines form a double regular row, separated from the row of adambulacral spines by a very narrow band in which, with some isolated spines shorter than their neighbors, is a row of straight pedicellariae of the same form as those of the ambulacral groove. There is in general one of these pedicellariae at the base of each two spines. The external spine is surrounded on the exterior side by a demi-crown of crossed pedicellariae. One finds also sometimes in the area, one or two straight pedicellariae. The nearly vertical lateral plates are very enlarged from the base to the summit. They are imbricated by their enlarged part from the base to summit of the arms. This enlarged part always has an isolated long, thin, pointed spine surrounded at its base by a crown of crossed pedicellariae. The free space between the narrow bases of these plates is filled with a papular area with only a few (1 to 3) papulae. The dorsal skeleton is formed of nearly parallel bands of two or three flat and imbricated calcareous plates, each lateral plate uniting with a corresponding plate of the dorsal ridge. As a result, the plates of the dorsal ridge, the costiform bands that leave it, the lateral plates and even the ventral plates have the same number. These costiform bands are separated by empty spaces of the same width so that they, transversally elongated and where there appear to be only a very few papulae (probably one at each end). The costiform bands are spineless except some in the middle region of the arms that have in the middle a small pointed spine surrounded at its base by a circle of crossed pedicellariae. In this case, the middle region of the band enlarges to contact the adjacent bands and to cut the papular area in two. All the plates forming the medial dorsal ridge have a long pointed spine surrounded at its base by crossed pedicellariae. Each arm has, in total, three rows of spines: one dorsal median and two laterals plus, sometimes, the rudiment of an intercalated row. At the base of these arms, the costiform bands enlarge to form around the disk a calcareous circle connected by five rays corresponding to the middle of the arms to the plates surrounding the anus. The

⁸ In the dried specimen that is our type, the spines of the internal row are inclined toward the ambulacral groove. The spines of the internal row are to the contrary inclined toward the ventral surface of the arms.

madreporite, small and slightly grooved, begins this bony circle. On the disk are a small number of spines interspersed with straight pedicellariae.

I have seen a nice dried specimen of this species and one other preserved in alcohol, but deformed, both sent by the Museum of Comparative Zoology of Cambridge (Massachusetts) thanks to the kindness of Alex. Agassiz.

Locality: Alligator Rocks (coast of Florida) at 110 fathoms depth and the Strait of Florida (85 fathoms depth).

ASTERIAS GRACILIS, sp. nov.

Six arms, very elongated, thin, pointed, unequal, three of them on one side being larger than the three others (in the four specimens I have examined).

In the specimen in alcohol

$$R = 15 \text{ mm}; r = 3 \text{ mm}; R = 5 r,$$

R of the largest arm being measured. The relation R/r is a little smaller in the dried individual.

Ambulacral spines arranged in two rows, equal between them. In front of this double row is a double row of small straight pedicellariae, emerging from the bottom of the ambulacral groove. Outside the adambulacral spines, on the lateral surfaces, is a double row of flat spines, with parallel borders, slightly enlarged at the tip, abruptly truncated, finely striated, divergent, longer than the adambulacral spines that immediately follow. These spines are surrounded on the outside with a demi-circle of crossed pedicellariae. A very large number of these pedicellariae are in the space that separates these spines from the first dorsal spines. These are much shorter, nearly cylindrical, finely striated and slightly spinous at the top. They are numerous and arranged without order on the ossicles that limit the papular areas. But these are arranged to the contrary very regularly. They constitute six alternating longitudinal rows, in each of which the areas are separated by transverse ossicles covered with pedicellariae and spines whose enlarged heads constitute the solid bands of separation between the rows of papular areas. These have a diameter greater than the width of the ossicles that separate them. Between the spines produced by the solid parts of the arm are a very large number of crossed pedicellariae that are not clearly arranged in a circle around their base. On the base of the arms and on the disk where the papular areas no longer have a determined order and where the spines are more numerous, these crossed pedicellariae are added to the relatively large straight pedicellariae, 1.5 times longer than wide and whose two jaws have between them at their insertion on the basal piece, a very obvious space.

In none of these specimens that I have carefully examined have I been able to distinguish the madreporite: three specimens from Sandkey (Florida), from 120 and 129 fathoms depth, the other from the Tennessee Rocks from 174 fathoms, sent from the Museum of Comparative Zoology of Cambridge (Massachusetts).

N° 292. — Depth, 50 fathoms. — Barbados (1 specimen. — 3 arms regenerating).

N° 272. — — 87 — — Barbados (19 specimens. — arms regenerating).

N° 216. — — 154 — — Sainte Lucie (1 specimen. — 3 arms regenerating, one larger than all the others.)

N° 224. — — 113 — — Saint Vincent (1 specimen. — (1 specimen with 3 arms regenerating).

N° 38. — — 95 — — Lat. 23°52'N. — Long. 88°5'W.
N° 171. — — 183 — — Guadeloupe.
N° 25. — — 92 — — Grenada.
N° 233. — — 174 — — Saint Vincent.
N° 293. — — 85 to 125 — — Barbados (2 specimens).
N° 157. — — 120 — — Martinique.
N° 15. — — 101 — — Lat. 25°33'N. — 84°21'W. (5 specimens).

Order II

STELLERIDÆ ECHINULATÆ.

Pedicellariae simply constituted of modified spines. Tube feet nearly always in two rows. — Mouth frame formed from parts of the adambulacral pieces.

FAMILY I.

ECHINASTERIDÆ.

Dorsal skeleton formed of pieces constituting a mesh whose nodes ordinarily have a spine or covered with small spines their entire length. No marginal plates.

Genus ECHINASTER Müller and Troschel.

ECHINASTER MODESTUS Ed. P.

(Pl. III, fig. 7.)

N° 170. — Depth, 120 fathoms. — Montserrat.
N° 269. — — 123 — — Saint Vincent.
N° 45. — — 101 — — Lat. 25°33'N. — Long. 84°24'W. (2 specimens).

Five arms. — R = 36 mm; r = 6 mm; R = 6 r.

The arms are proportionally larger and shorter in small specimens. Each adambulacral plate has in the ambulacral groove a spine large, short, cylindrical, obtuse, reinforced behind by a spine just as large, but a little shorter and sometimes some smaller spines, placed transversally on the plate, one behind the other. Then comes a very regular row of spines that stop generally towards the middle of the arms. Then, from one border to the other of the arms, nine very regular rows with small spines between which are sometimes distributed other spines irregularly. Ossicles of the skeleton forming an irregular network, with wide mail, on the nodes of which are placed the spines. In the mails of the network are 3 or four papulae. The integument is thick. The madreporite is small, projecting, round, with very fine radiating grooves. The anus is very visible near the center of the disk and is surrounded by small spines

Remark: In older individuals, the rows of spines are less regular than in the young. Compare with *Echinaster spinulosus*.

Genus CRIBRELLA Agassiz.

Ossicles of the skeleton arranged in a network and covered with small uniform spines, ordinarily very dense. — No pedicellariae.

CRIBRELLA ANTILLARUM Ed. P.

(Pl. III, fig. 6.)

- N° 238. — Depth, 127 fathoms. — Camman.
N° 200. — — 429 — — Martinique.
N° 274. — — 200 — — Barbados (2 specimens).
N° 218. — — 164 — — Sainte Lucie (1 incomplete specimen),
N° 162. — — 734 — — Guadeloupe.

The specimen from Guadeloupe is twice as large as the other specimens of the same species. But its arms have been fixed in alcohol in too contorted a position to be able to determine the exact proportions. The average specimens from other localities have the proportion and following characters:

Five arms, elongated, pointed, flexible in all directions in the living state and contorted in all ways in the animal dried or preserved in alcohol.

Adambulacral plates small, but very distinct, rectangular and elongated perpendicularly to the ambulacral groove, covered with very pointed small spines, but little projecting and dense to form a kind of granulation. These spines become abruptly large near the ambulacral groove and form two or three irregular rows of dense spines, each plate have 2 or 3 spines. Two or three of these spines occur on the free edge of the plate and form the adambulacral armature. The ventral surface is formed of rows of small rectangular plates that become less and less regular away from the ambulacral groove. The plates of the first row correspond exactly to the adambulacral plates and the plates of the following rows also nearly correspond to those of the adjacent rows, and as a consequence to those of the adambulacral row. There are five rows at the base of the arms, but they decrease rapidly to three. All the plates that compose it are covered with a dense granulation formed of spines a little smaller and less pointed than those of the adambulacral plates. The mouth frame pieces do not project. They are small and each in the buccal angle is bordered with 3 or 4 cylindrical spines rounded at the tip, a little larger than the adjacent ones. Their surface also has some small spines of ordinary form.

The dorsal surface is a dense network of finely granule ossicles, similar to that on the dorsal surface of other cribrellids. The mails of this network have a diameter a little small than that of ossicles. Each has a papular pore. The anus is subcentral, surrounded by spines a little larger than adjacent ones. The madreporite is large, located half the distance between the center of the disk and the corresponding interbrachial angle. It is covered with granules like those of the dorsal ossicles and only distinct, consequently, by the slightly special arrangement of these granules and by the projection that it makes on the disk.

CRIBRELLA SEXRADIATA Ed. P.

(Pl. IV, fig. 6.)

N° 47. — Depth, 101 fathoms. — Lat. 25°3'N. — Long. 33°21'W. (3 specimens).
N° 298. — — 150 — — Barbados.

This species is close to the preceding by the characters of its ventral surface, but very clearly differing by their proportions of its shorter and more obtuse arms, and especially by their number, 6, absolutely exceptional in cribrellids. It has the faculty of reproduction by division, into two halves that occurs in several *Asterias* with numerous arms, various *Linckia* and some *Asterina*. Only one of the three specimens I have observed has all its arms. In the others, three arms are nearly the same size and the others, considerably shorter, are evidently new and destined to replace three arms that had been lost. The repetition of this same phenomenon in the same conditions in two specimens out of three indicates well that it is not accidental. Here the description of the most complete individual that is also the largest.

Six arms, relatively short and obtuse:

$$R = 13 \text{ mm}; r = 6 \text{ mm}; R = 3 \text{ mm}.$$

Adambulacral plates rectangular, elongated perpendicularly to the ambulacral groove, covered with dense granules, obtuse, that abruptly increase in size at the free edge of the plate to form two rows of small obtuse spines. At the most external of these rows, each plate has 3 spines, and 2 only at the most internal that is completely at the edge of the ambulacral groove. The ventral surface has regular rows of rectangular plates. There are three rows at the base of the arms, two after the middle of the length, the intermediary rows having gradually disappeared. These plates correspond to the adambulacral plates. They are covered with dense, regular granules.

The dorsal surface is composed of the network of ossicles usual in cribrellids. The ossicles of this network are covered with granules finer than those on the ventral surface. The mails of the network are smaller than the ossicles themselves and have only one papula.

As in most species with reproduction by divisions, there are two madreporites on the dorsal surface. These very small, rounded plates are covered with granules and are located to the right and left of the same arm and near the end of the corresponding interbrachial angles.

Remark. — These two species are clearly cribrellids according to the arrangement of the dorsal network and general aspect. It is notable that they are very close to *Linckia*. They are distinguished from all other cribrellids by the presence of 2 or 3 spines on the border of their ambulacral plates while that other cribrellids have only one. They also lack papular pores on their ventral surface.

FAMILY II.

SOLASTERIDÆ.

Dorsal skeleton formed of pieces arranged in a network or imbricated. The nodes of the network of imbricated pieces are elevated tubercles having bunches of spines ordinarily thin and

silky. At least one row of marginal plates is larger than the other skeletal pieces. Pieces of the ventral skeleton are arranged generally in parallel bands going from the adambulacral plates to the marginal plates.

Genus KORETHRASTER Wyville Thomson.

Small asteroid with five arms. Skeletal ossicles relatively large, star-shaped, their entire border sometimes contiguous the length of each of the interbrachial rays that are then marked by a groove. Tufts of spines on these ossicles.

KORETHRASTER PALMATUS.

(Pl. VIII, fig. 5 and 6.)

Five short arms, convex above, slightly flat below.

R = 14 mm; r = 47 mm; R = 3 r.

Interbrachial angles not rounded.

Tube feet in two rows, ending in a sucker of ordinary form. Adambulacral plates small, each with a spine in the ambulacral groove. Ventral surface formed of 3 longitudinal rows of small rectangular plates, elongated in the transverse direction of the arms, rows imbricated so that the plates of the more internal row cover the side of the plates of the contiguous row. Each of these plate has on its free border, parallel to the ambulacral groove, a pair of thin, flat spines that seem fused and forming a mobile lamella that generally falls back toward the free border of the arms. A fourth row of spines has similar brushes of spines that form a wide border fringe. The dorsal surface is formed of quadrangular ossicles, indented on their four sides and touching by the truncated ends to form between them a small circular space with a papula. Each of the ossicles has in its center a projecting tubercle that ends in a rounded head and a wide brush of ten to twelve thin spines that may be more than one mm in length, arranged in a circle on the head of the tubercle and united by a continuous membrane, forming a kind of monopetal corolla of which they are the ribs. These spines of the corolla can open or close as the animal wants.

Between the arms, as well as on the back and the ventral side, grooves leave either from the mouth or the center of the disk and go to the interbrachial angles so that each arms is clearly separated. The small, rounded madreporite, marked with short and very wide fine irregular lines, is very near the anus, as in *Pteraster*, is astride one of these grooves.

Remark. — This *Korethraster*, with the wide brushes of spines on its ossicles and the empty space located between the back and their end is evidently a transition to *Pteraster*.

KORETHRASTER HISPIDUS, nov. sp.

N° 292. — Depth, 56 fathoms — Barbados.

N° 000. — — 80 — — Havana (Sigsbee).

Small species with five short, obtuse arms, flat below, very strongly convex above.

$R = 10 \text{ mm}; r = 4 \text{ mm}; R = 2.5 r.$

Each adambulacral plate has on the very border of the groove, 3 very short, divergent spines. More outside, on the ventral surface, a transverse row of three equally divergent spines, arranged so that a naked band separates from the border of the arms that is sharp and fringed with groups of obtuse spines on the dorsal plates. Each dorsal ossicle has a group of a dozen very short, obtuse or even with a slight enlargement spines at the top, divergent, longer on the border of the arms. They are irregularly arranged on the surface of the ossicles, but in a manner that covers all the surface. Isolated papulae between the ossicles are in eleven slightly regular rows from one border to the other of the arms.

The madreporite is round, convex, very small, half-hidden between the spines of the dorsal surface. It is located half-way between the center of the disk and the interbrachial angle.

Genus RADIASTER, nov. gen.

Large asteroid with five wide arms that merge gradually with the disk, with small marginal plates. The ventral plates are arranged in transverse series and all have tufts of short, robust spines. — Mouth frame pieces very projecting, long and narrow.

RADIASTER ELEGANS, nov. sp.

(Pl. IX, fig. 1.)

Nº 180. — Dominica, — 982 fathoms (only one specimen).

Large asteroid with five arms.

$R = 92; r = 26; R = 3.5 r.$

Disk very flat. Arms approximately 22 mm in diameter at the base, connected by a very broad interbrachial arc. Border clearly limited by a row of marginal plates hidden by the integument, but each with at its external and internal border a group of spines much larger than the analogous spines found on the marginal plates of SOLASTER. These marginal groups thus form on the entire contour of the animal a very regular double row. These groups of spines are a little compressed, so that those of the same plate are closer to each other than they are to the adjacent plates. Each arm has 39 to 46 marginal plates. The groups of spines of the dorsal plates, also covered by the integument, are formed of thin, elongated, mobile spines that separate from each other or form a bundle. The madreporite is small and near the border of the disk.

Each adambulacral plate has a bundle of cylindrical spines that are longer and nearer the border of the ambulacral groove. Generally there are three spines on the very border of the plate. Each adambulacral plate corresponds to a row of ventral plates that are directed very regularly in a nearly transverse direction, from the ambulacral groove to the external border of the arms. Although the plates are hidden by the integument, one clearly distinguishes them thanks to the bunches of spines found on each. These bunches of spines, very isolated from each other, form on the ventral surface, as many very regular rows as there are adambulacral plates. There are nearly 70, so that there is no correspondence between the number of marginal plates and those of

adambulacral plates. The spines that form these ventral bunches are a little shorter than those that form the dorsal bunches. The mouth frame pieces are very projecting, covered with spines. They are 8 mm long and their width, taken together, is 3 mm. These pieces nearly make contact and hide the buccal membrane.

There are no pedicellariae.

The tube feet are biserial and end in a well-developed sucker.

Genus CTENASTER, nov. gen.

Six arms. Body entirely covered by a bare skin. Slightly spinous. A row of small marginal plates, each with a divergent line of spines in the middle, perpendicular to the direction of the arms. — Mouth frame pieces little apparent, long and obtuse.

CTENASTER SPECTABILIS, sp. nov.

(Pl. V, fig. 1 and 2.)

Six thin arms, but very short, attached by the very rounded interbrachial arcs to a wide and thick disk. Each tube foot with a very distinct flat sucker, wider than their diameter. — All of the skeletal plates, dorsal and ventral, covered by a skin that hides numerous sharp spines.

Mouth located in the center of a large membranous disk with elongated mouth frame pieces. These have, as the other adambulacral plates, a comb of five divergent spines with obtuse points. The other adambulacral plates have on the ventral surface a row, perpendicular to the ambulacral groove, of 4 or 5 divergent spines of which the external is thinner than the others and a little longer. Each plate is separated from the adjacent ones by a groove of the skin that extends in a slightly sinuous fashion, sometimes even bifurcating, to the edge of the disk or the arms. On each of the bands bordering these grooves are generally some small thick, very spaced spines. The dorso-ventral border is formed by plates under the skin. Each has a row of 5 or 6 very large spines perpendicular to the plane of the disk. There is no relation between the number of these marginal plates and the number of adambulacral plates.

Dorsal surface covered with intertwined papillae of small divergent spines. A smooth band is opposite each interbrachial space. The madreporite is oval, half-way its radius, contiguous with a smooth interbrachial space a little larger than the others.

$$R = 132 \text{ mm}; r = 48, R = 2.7 r.$$

N° 31 — Depth, 1,920 fathoms. — Lat. 23°33'N. — Long. 84°23'W.

I have not seen the anal pore with certainty. The affinities of this remarkable genus with *Ctenodiscus* are evident, but the ventral skin is not covered with scales and the marginal plates are not apparent. The number of arms is 6 instead of 5.

FAMILY III.

PTERASTERIDÆ.

Each dorsal ossicle with a spine crowned with long divergent spines supporting a membrane that forms above the back a kind of tent protecting the young during their development.

GENUS PTERASTER Müller and Troschel.

Skin of the dorsal tent does not have a regular reticulation. Each adambulacral plate has a comb of spines united by a membrane and can stand erect above the ventral membrane to which their web is raised.

PTERASTER CARIBBÆUS.

- N° 151. — Depth, 356 fathoms. — Nevis (2 specimens of which one is very deteriorated).
N° 000. — — 158 — — Sand-Key (one specimen).
N° 130. — — 151 — — Frederikstadt (2 small specimens in bad condition).
N° 222. — — 122 — — Ste. Lucid (1 small deteriorated specimen).

The largest specimens are those of Nevis. In the one in nearly good condition, except a torn dorsal membrane, one has:

$$R = 30 \text{ mm}; R = 15 \text{ mm}; R = 2 r^9.$$

The tube feet are clearly in 2 rows in the large specimens. They are closer together in small individuals. A superficial examination can make one believe they are arranged in 4 rows. But we recognize with a little attention that the arrangement is always the same. These tube feet, ending in a large sucker, are biserial. The ambulacral plates are enlarged at their two ends.

The adambulacral plates that support them are irregularly round, wide, but imbricated in a way that their edge along appears on the ventral surface, where it appears as an arc inclined from the inside to the outside and from the top to the base of the arms. It has 7 divergent spines. The first 6 increase regularly from the inside to the outside. The 7th is much larger and exceeds the width of the arms. All these spines are united by a membrane stretched like the wing of a bat. In addition, another membrane connects the ensemble of large spines onto each plate of the 7th row. These membranes uniting the other spines attach to them the length of the large spine, but remain free the rest of their length.

The mouth frame comes from adambulacral pieces. They are united in making on the ventral surface a slightly projecting cone. Each of them has 6 spines that increase in size in approaching the end of the buccal angle. The one in the angle is wide, flat, and lance-like. In the specimen from Sand Key, this spine is remarkable, as well as the adjacent one of the symmetrical plate, because its structure, instead of being porous like those of other solid parts of echinoderms, is to the contrary compact, crystalline like, so that each spine ends like a perfectly transparent spearhead.¹⁰

Immediately outside the adambulacral plates and resting on them are the ossicles that form the rest of the skeleton that are very remarkable. They are, indeed, kinds of stars with 4 oblique branches, slightly enlarged at their free end and of which two are long and two are short. At the

⁹ r is measured from the center of the mouth to the angle of the ventral membrane.

¹⁰ Although I did not observe this character in either smaller *Pteraster*, nor in larger *Pteraster* dredged at Sand Key, I do not believe that one should consider it as specific, in the presence of the identity of all the others. It is still a point to examine.

crisscrossing point of these branches is a calcareous stalk, likewise oblique to the plane of the star, longer than the longer branches and ending in a round head.

From this head diverge long, thin spines, 6 or 7 for each ossicle, forming a kind of broom of which all parts are united by a fine membrane. At their free ends these small brooms touch and all are united by a continuous membrane, distant from the dorsal surface formed by the ossicles. It is this membrane that gives the animal its nearly pentagonal form. Actually the arms, bounded by the ossicles, are clearly distinct from each other up to near the mouth, as can be verified with deteriorated subjects.

The madreporite can be seen only in individuals from which the membrane has been removed. It is naturally at the level of the ossicles that have the broom of spines enveloped in the dorsal membrane. It is rounded, large, convex, very near the anus. Its surface is marked with sinuous grooves, frequently anastomosing in a way to isolate some, irregular and projecting islets.

Remark. — We had previously been sent this species by Alexander Agassiz with the asteroids from the museum of Cambridge. It was represented in this museum by two specimens: one from Casco Bay (Maine); the other from Sand Key from a depth of 128 fathoms. I have not been able to examine a typical specimen of other species known as *Pteraster* from the Atlantic. But the present species seems to me to be distinguished from *P. miliaris* by its shorter arms and greater number of dorsal spines, while it differs from *P. pulvillus* by fewer spines, because there are more than ten in this species. With the uncertainty, I have believed it necessary to give a very complete description.

FAMILY IV.

ASTERINIDÆ.

Small asteroids with arms connected by large interbranchial arcs. Dorsal skeleton formed of imbricated pieces covered with spines.

Genus ASTERINA Nardo.

Skeletal pieces imbricated, spines on their free border. No marginal plates. Border of the arms generally abrupt. Arms short and wide at their base.

ASTERINA LYMANI.

N° 290. — Depth, 140 fathoms. — Barbados.

N° 198. — — 120 — — Barbados.

Each adambulacral plate with 4 appressed spines. Ventral surface formed of small plates very distinct from each other and each covered with tufts of long, thin, silky spines. On the border of the disk, these tufts, isolated from each other, form a wide fringe. The dorsal surface also is formed of small plates with small tufts of long, thin spines. Each arm has on both sides of the dorsal median line three longitudinal rows of isolated papulae.

The madreporite is hidden by the tufts of spines.

ASTERINA PILOSA sp. nov.

(Pl. III, fig. 8.)

N° 177. — Depth, 118 fathoms. — Dominica.

Species with six arms, clearly separated from each other by rounded interbrachial angles. End of arms obtuse.

$R = 10 \text{ mm}; r = 6 \text{ mm}; R < 2 r.$

Each adambulacral plate with 4 thin, nearly equal spines. Ventral plates very irregularly arranged in rows obviously perpendicular to the free edge of the arms, covered with thin, elongated spines forming on the ventral surface a very dense covering. The ventral plates decrease little by little in small proportions as they approach the free end of the arms. Each plate of the border has a dense tuft of elongated, very thin and silky spines. The mouth frame pieces do not project and each has a comb of five spines, making ten spines for each buccal angle.

The plates of the dorsal surface, which is slightly convex, are smaller than those of the ventral surface, imbricated, and each with a bristling tuft of small thin, divergent spines, unequal and pointed. Between these plates, near the median line of the arms, are several regular rows of isolated papular pores. There are approximately six rows for each arm. Immediately below the point where the external rows of two adjacent arms meet is a larger opening (genital opening?) than those of the dorsal papulae.

The madreporite is small, convex, nearly entirely hidden by the dorsal spines and located in the first third of the distance between the center of the disk and the adjacent interbrachial angle.

The anus is very visible.

ASTERINA WESSELI Lütken.

N°35. — Depth, 101 fathoms. — Lat. 25°33'N. — Long. 80°21'W.

One small specimen.

ORDER III.

STELLERIDÆ VALVULATÆ.

Excavate or valvular pedicellariae. Body bordered by a double row of marginal plates larger than the adjacent ones. One dorsal row and a ventral row of marginal plates. Skeletal plates naked or simply granulose. Tube feet in two rows. Mouth frame formed by adambulacral pieces.

FAMILY I.

LINCKIADÆ

Arms thin, cylindrical or conical, connected with sharp angles. Marginal plates little distinct from the others. Excavate pedicellariae, when present.

Genus OPHIDIASTER Müller and Troschel.

Ventral marginal plates separated from the adambulacral plates by a single row of papular areas, Below, a regular row of isolated spines outside the adambulacral spines. Ordinarily excavate pedicellariae, more or less developed.

OPHIDIASTER FLORIDÆ, sp. nov.

(Pl. IV, fig. 1.)

Five short arms, conical and obtuse at the end.

$R = 33 \text{ mm}; r = 8 \text{ mm}; R = 3.7 r.$

Ventral surface slightly flat and formed, as in *Linckia*, by a small number of rows of plates between which are no papulae and that are smaller than the marginal and dorsal plates. The general granulation, formed of rounded granules, contiguous, perfectly regular and very large, prevents distinguishing the number of rows and the borders of the plates that compose it. The adambulacral spines are obviously arranged as in the other species of the genus *Ophidiaster*. I.e., outside the spines, that are located on the very border of the groove and that are all equal, one observes a row of spines, obtuse, ovoid, much larger than the preceding row. Two consecutive spines of the external row are separated by two small flat spines like those of the external row and implanted obliquely. The two rows of spines are nearly contiguous and much nearer consequently than in most of the other species of *Ophidiaster*. Towards the base of the arms, 1.5 mm outside the external row, is a row of spines exactly like those that compose this latter, but that scarcely pass the level of the interbrachial angle and have only eight spines at most. Outside this row, also at a distance of approximately 1.5 mm, one observes indications of a new row formed of similar spines, but much shorter. This multiplication of ventral spines is again an exceptional character, probably in relation with the relative large development of the ventral surface (whose width does not exceed however 4.5 mm at the beginning of the arms).

The average row of spines (that with approximately 8 spines) seems to be extended by a less regular row and a little more internal of excavate pedicellariae composed of the same type as in other *Ophidiaster*. The bowls of these pedicellariae, which scarcely reach to the base, are slightly projecting with smooth borders. It is the same small valves that fold into their interior. Several of these pedicellariae have three jaws instead of two. One recalls that similar pedicellariae have been found only in *Ophidiaster*, and not in *Linckia* and *Scytaster*. This confirms our identification from the arrangement of the ambulacral spines, which the development of the ventral surface would have placed in doubt.

The dorsal and lateral surfaces are formed of 7 perfectly regular rows of ossicles, elongated, oval and no longer trefoil shaped as in most *Ophidiaster*. These ossicles, covered with a granulation like that of the ventral surface, are very strongly projecting and very distinct from each other. Between the first row of lateral row (ventral marginal plates of GONIASTERIDÆ and the ventral plates strictly speaking) there is no papular area. On the rest of the lateral and dorsal surface, one finds 6 regular rows of papular areas placed in deep grooves separating the seven rows of ossicles. These papular areas have only two to four well-spaced pores. On the disk, the ossicles

have a very regular arrangement. Around a central ossicle are scarcely visible ossicles forming the surface of a pentagon bordered by ten ossicles, larger, convex, very distinct, contiguous, one corresponding to the median line of the arms, the others to the interbrachial angles. It is outside this pentagon, between one of the sides and one of the interbrachial angles that is found the madreporite, in form of an equilateral triangle and covered with fine radiating grooves. On the disk, the papular areas are not distinct.

Only one specimen in very good condition, preserved in alcohol, dredged at 37.5 m in the Florida Strait. Donated by Alexander Agassiz before the Blake dredges.

OPHIDIASTER AGASSIZII sp. nov.

Five arms, nearly cylindrical, narrowing only towards the end to end in an obtuse point.

$R = 70$ mm; $r = 10$ mm; $R = 7 r$; $d = 137$ mm.

Thickness of an arm, near the base: 12 mm. At 1 cm from the end, 8 mm. Adambulacral spines arranged, according to the general rule, in two rows separated from each other, the interval being filled by general granulation. The spines of the internal row are cylindrical, equal and separated from each other by a vertical row of granules that replaces the small spine seen in this place in other species and that recalls the characteristic arrangement in some species of *Linckia* such as *L. multifora* Lamarck and *L. miliaris* Lam. This is the first time, we think, that such an arrangement is reported in a true *Ophidiaster*. The spines of the second row are short, conical, and larger than the internal spines and more spaced so that three spines of this latter corresponds to only 2 spines of the first. The granulation between these two rows of spines is the same as the general granulation, or at least as the part that covers the series of skeletal plates of the animal. The number of these series is 7, of which one is in the median line of the arms. They are perfectly regular except in some very limited regions where the animal appears to have been wounded. This plates are, as usual, in a trefoil shape with the peduncle cut and the median foliole, turned towards the base of the arms, a little larger than the lateral folioles. The plates of all these series corresponds exactly and are touched in two consecutive rows by their lateral folioles, so that the skeleton can just as easily be broken down into regular transverse rows as longitudinal rows. A slight groove, passing by the base of the plates of one transverse row is seen on all the entire circumference of the arms that thus takes, as least in dried individuals, a clearly ringed aspect. The number of transverse rows of plates is approximately 43, from the tips of a kind of pentagon on the disk. On the interior of this pentagon, the few plates are arranged irregularly around the anus. The madreporite is circular, small, cribillated rather than grooved, outside this pentagon and completely marginal.

The rows of longitudinal plates are separated by 8 rows of papular areas whose most inferiors are in contact with the adambulacral plates. Each of these rows is composed of elliptical areas, distinct from each other, elongated transversally on the top of the arms and their sides, nearly circular in the area of the ambulacra. Each has 14 to 18 papulae. The granulation that covers the areas is finer than that that covers the plates and is perfectly uniform. It is in the papular areas, slightly sunken in relation to the rows, that the pedicellariae can be seen. These are the type that we have called as restricted to the *Ophidiaster excavate pedicellariae*. But here, the two alveoli are wide at their base, pointed at the top so that the ensemble gives the organ a form exactly boat-like. A transverse bar separates, as usual, the two alveoli from each other and divides the boat into two symmetrical halves. In *O. pyramidatus* Gray, the pedicellariae have a form nearly the same,

but the borders of the alveoli themselves are a little smaller near this bar. They are also less pointed so that the boat-like form is much less clear. Finally the pedicellariae near the border of the ambulacral groove are much larger than the others and their alvoli much more rounded. These differences are not found in *O. Agassizii*. In this latter species, a single papular area can have 5 or 6 pedicellariae. These easily escape observation if one were not warned, because they do not project above the general granulation, they are very small, and the cavity of their alveoli can be easily confused with the nearby papular pores.

The color appears to have been reddish in life.

Locality: Juan Fernandez Islands. — Two dried specimens collected by L. Agassiz during the Hassler expedition.

After the publication of our *Revision de Stellérides*, these two individuals were graciously donated by Alexander Agasszi to whom we dedicate the species. They thus were part of the collection of the Museum of Harvard College at Cambridge (Massachusetts), before the *Blake* expeditions. They provide us however a natural opportunity to describe it. Moreover, the dredges of the *Blake* collected at 120 fathoms of depth at Barbados, an *Ophidiaster* very close to the preceding, that we consider belonging to the same species, but that has some special characters. The spines of the first row on the ventral service are a little smaller and more pointed. Those of the second row are replaced by a perfectly regular row of excavate pedicellariae with two valves and a narrower bowl.

Genus LINCKIA Gray.

Ventral surface formed of several contiguous rows of 4 plates not separated by *transporifères*. No pedicellariae nor large spaced spines forming a border outside the ambulacral groove. Arms long and cylindrical.

LINCKIA NODOSA Ed. P.

I described this species, without knowing its origin, in my revision of the asteroids. Alexander Agassiz sent me three specimens, one of large size without indication of locality. Two others of much smaller size were dredged at 6 fathoms depth in front of Tortuga.

Genus FROMIA Gray.

Arms relatively short, flat and triangular, with rounded ossicles and a double row of very distinct marginal plates on each side.

FROMIA JAPONICA, sp. nov.

(Pl. IV, figure 2.)

Five flat arms, as well as the disk, ending in a very obtuse point.

R = 32 mm; r = 7 mm; R = 4.7 r; d = 65 mm.

Spines of the ambulacral groove arranged in two rows, the external row being very irregular. Adambulacral plates with 2, rarely 3, divergent, unequal spines very distant from each other, ending in a very obtuse point. These spines that form the internal row are immediately followed by the external row. These also have 2 per plate, but one ordinarily remains rudimentary and forms only a short point, while the other becomes larger than the internal spines and is conical and whose width does not exceed that of the latter. The adambulacral plates are followed by a row of plates a little longer than wide, obviously rectangular in form, each corresponding, in general, to 2 adambulacral plates. The width of these plates becomes less and less towards the end of the arms and the row itself becomes completely indistinct after the last fourth of the arms. In the interbrachial region, this row is followed by another formed of plates a little like the preceding, but decreasing more rapidly in length. This row stops after the first third of the arms and scarcely has 6 to 7 smaller and smaller plates towards the end of the row. Each, except the first, corresponds to one of the plates of the preceding row. There are no papulae between them. These 2 rows constitute the ventral skeleton. Then come the 2 rows of lateral plates. The inferior row has 17 plates for each arm. These plates are more elliptical than rectangular, nearly two times long as wide. Each corresponds to two plates of the preceding row. Between these plates and those of the ventral row, at the inferior border of the first, is an isolated papular pore, so that two consecutive pores are separated by 2 ventral plates and 1 lateral. There are only 6 or 7 of these pores from the base of the arms. Some isolated pores, 2 or 3 at most, are found even between the 2 rows of ventral plates. The superior row has 15 lateral plates for each arm. The dimensions are unequal, and each smaller plate often separates 2 larger plates so that the border of the arms takes a slightly beaded appearance. The entire surface of the disk and dorsal surface of the arms has flat plates of variable size, obviously circular, around which are distributed isolated, equidistant papular pores, 6 around the larger plates. On the arms, these plates can be considered as forming three principal irregular rows. Some smaller intercalated plates are found between the two external rows and the lateral plates.

The anus is subcentral, scarcely visible. The madreporite, small and circular, does not extend above the level of the disk and is located in the middle of its small radius. It has very short, non-radiating, slightly edged grooves.

All the body is uniformly covered with a fine granulation.

This species is clearly distinguished from *F. milleporella* and *F. pistoria* by its ambulacral armature, by the greater disproportion between its marginal and dorsal plates, as well as the small number of them that constitute the dorsal surface of the arms.

Locality: *Japan*.

A specimen from Japan donated by the Museum of Comparative Zoology of Cambridge (Massachusetts).

FAMILY II.

GYMNASTERIADÆ.

Skeletal plates covered by an integument. No granulation.

Genus MARGINASTER, nov. gen.

Small asteroid, pentagonal or with inconspicuous arms. Ossicles covered with a thin integument. Ossicles delicate, ordinarily slightly spinous. — Body bordered by a double row of very distinct marginal plates.

MARGINASTER PECTINATUS Ed. P.

(Pl. I, fig. 4 and 5.)

N° 32. — Depth, 95 fathoms. — Lat. 23°52'N. — Long. — 88°5'W.

Curious small asteroid, having exactly the form of a pentagon whose top is blunt.

R = 5 mm; r = 4 mm.

Sides of the body nearly rectilinear, ventral surface flat, dorsal surface convex, but united to the ventral surface in a manner to form a sharp border.

Tube feet in two rows. Ambulacral groove bordered by a row of flat spines, truncated at the top, isolated on each of the adambulacral plates. A second row of smaller, irregular spines is found behind the adambulacral spines. The adambulacral plates are small and indistinct, as well as the ventral plates, because of the thickness of the skin that uniformly covers them. On the surface of each of the ventral triangles between the border of the arms and the ambulacral grooves are 3 or 4 spines, short, divergent, enveloped by the integument and irregularly located. The free border of the disk is formed on the ventral surface by wide rectangular plates, whose large side is perpendicular to the border of the arms and that are separated from each other by very distinct grooves, often extended by other grooves that abruptly go perpendicularly to the nearest ambulacral groove. There are eight or ten of these plates on the each side of the body, and each has a comb of 5 or 6 flat spines on it border.¹¹

On the dorsal surface, the skeleton is again less apparent than those of the ventral surface. The small isolated blunt spines are very projecting and are sparse over the entire surface. The body is likewise bordered by a row of large plates corresponding to those of the ventral surface and has like them a comb of spines, shorter however than those of the ventral surface.

The madreporite is small and located half the distance between the center of the disk and the arms.

The anus is visible.

MARGINASTER ECHINULATUS Ed. P.

(Pl. I, fig. 6 and 7.)

N° 278. — Depth, 60 fathoms. — Barbados (3 specimens).

¹¹ The only specimen we have seen being slightly irregular, the number of plates is not the same on the five sides, varying from 6 to 10 on both the dorsal and ventral surfaces. However, on the sides that appear the most normally formed, the number of plates is 10.

Small asteroid already distinct from the first because the sides are indented so as to separate five short, wide arms. The interbrachial angles are not rounded:

$$R = 5 \text{ mm}; r = 3 \text{ mm}; R = 1.6 r.$$

Adambulacral plates project above the ambulacral groove and end in a demi-circle to festoon the borders. They have on their free end a demi-circle of 4 or 5 small spines and on their free surface a transverse row of 2 or 3 divergent spines. Ventral surface distinct, especially laterally, and forming rows separated by grooves that go obliquely to the ambulacral grooves to the end of the arms. Each has two divergent spines. — Eight ventral marginal plates on each side of the body, each with a comb of five divergent spines on their free border.

Dorsal skeleton hidden by the skin. Plates indicated only by small spines that are very irregularly arranged. Marginal plates indistinct, bordered by very short spines. A row of papulae on each side of the median line of the arms. Apical plates of the arms are oval and very large.

I have not seen the madreporite.

Remark — Could this be a very young *Ctenaster*?

FAMILY III.

PENTAGONASTERIDÆ

Skeletal plates naked or granulose, contiguous, polygonal, circular or star-shaped.

Genus PENTAGONASTER.

Visible parts of the skeletal pieces pentagonal or circular.

PENTAGONASTER PARVUS Ed. P.

(Pl. VII, fig. 7 and 8.)

N° 276. Depth, 94 fathoms. — Barbados (2 specimens).

N° 298. — 129 — — Barbados.

N° 296. — 84 to 125 fathoms. — Barbados.

N° 32. — 25 fathoms. — Lat. 23°62'N. — Long. 88°6'W. (pedicellariae on the plates that touch the adambulacra).

N° 253.. — 92 — — Grenada.

Body pentagonal, sides slightly concave. In the largest specimen

$$R = 24\text{mm}; r = 14 \text{ mm}; R = 3/2 r.$$

Adambulacral plates with a row of spines following by two rows of granules, five to six spines on each. Ventral surface formed of very large rounded plates, entirely granulose near the marginal plate, gradually become naked at the center towards the mouth, and finishing by being bordered by a simple row of granules.

Ten ventral marginal plates on each side of the body, bordered by a simple row of square granules except at the end of the arms where the latter are trapezoidal or triangular.

Eight dorsal marginal plates, bordered by a row of granules. Dorsal plates rounded, appressed, bordered by a row of granules with two or three very small isolated tubercles in their center. Madreporite covered with rounded granules, located nearer the center of the disk than the marginal plates, surrounded by three dorsal reniform plates.

The number of marginal plates decreases with size. It is reduced to 6 in a small specimen where $R = 8$ mm.

PENTAGONASTER GRENADENSIS Ed. P.

(Pl. XII, fig. 2.)

N°265. — Depth, 176 fathoms. — Grenada.

Nice pentagonal species, with slightly concave sides and a more obtuse top of the arms than in the preceding species.

$R = 26$ mm; $r = 17$ mm; $R = 1.4$ r.

Adambulacral spines extend to the same levels as the granules and the ventral surface with which they merge. There are five or six on each adambulacral plates. Ventral plates pentagonal, uniformly granulose and covered with very large granules. Fourteen granulose ventral marginal plates.

Fourteen dorsal marginal plates, finely granulose like the ventrals or slightly naked in the center. Dorsal plate polygonal, uniformly granulose and sometimes with a very small pedicellaria. — Madreporite located one-fourth the distance to the edge of the disk.

PENTAGONASTER TERNALIS Ed. P.

(Pl. I, fig.1.)

N° 173. — Depth, 734 fathoms. — Guadeloupe.

N° 264. — — 417 — — Grenada.

Five pointed arms, connected by an interbrachial arc with a long curve.

$R = 100$ mm; $r = 30$ mm; $R = 3.3$ r.¹²

Approximately 50 ventral marginal plates. These plates are first rectangular and elongated in the direction of the rays of the disk, then become nearly square. They come in contact with the adambulacral plates towards the second third of the arms from the mouth. These plates are roughly granulose, as well as the ventral plates that are irregularly polygonal. Adambulacral plates nearly square, covered with the same granulation as the ventral plates, with a row of 9 to 10 spines on the border of the ambulacral groove, prismatic and truncated at the end. In addition, most of the plates

¹² These dimensions are only approximate, all the arms of the individuals I examined being broken at the end.

have near one of their angles near the ambulacral groove that is nearest the mouth a pedicellaria that is remarkable because it is formed of 3 or more often four valves a little like that of the adjacent granulations, but are very clearly distinguished by the mobility and the way they are grouped. One finds similar pedicellariae, although a little smaller, on some of the ventral plates that follow the adambulacral plates.

The dorsal marginal plates have the same number as the ventral plates, contiguous to those of the opposite side the entire length of the arms, covered with a large granulation. Dorsal plates projecting, spaced, polygonal, covered with granules. The most external, slightly projecting, form a kind of crown. Most with one or two pincer pedicellariae with only two valves. Isolated papular pores at the angle of the plates at the bottom of the grooves that separate them. Polygonal madreporite with very long radiating grooves, of the size of the adjacent dorsal plates, located in the first quarter of the distance between the center of the disk and the interbrachial arc. Very distinct sub-central anus, surrounded by small spines.

The individual from Grenada is the smallest. Its dimensions are, except for the reservation that we have made:

$$R = 78 \text{ mm}; r = 22 \text{ mm}; R = 3.5 r.$$

The number of marginal plates appears to be the same as in the preceding individual.

PENTAGONASTER SUBSPINOSUS, nov. sp.

(Pl. VI, fig. 1.)

In sight of Havana. — Depth, 175 fathoms. — (Lat. 22°9'15"N. — Long. 82°21'W,)

N° 274. — Depth, 209 fathoms. — Barbados (5 specimens).

N° 241. — — 163 — — Cariacou (1 specimen).

Five arms united by an interbrachial arc with a large curve.

$$R = 85 \text{ mm}; r = 25 \text{ mm}; R = 3.4 r; d = 162 \text{ mm}.$$

The arms are thin and from the middle of their length nearly pointed and fragile near their end. There are 58 to 60 ventral marginal plates. I must make some reservations. None of the specimens I have observed are complete. These plates, at first more elongated in the direction of the rays, gradually become square, then elongated in the direction of the edge of the arms. They leave from the middle of the arms immediately in contact with the adambulacral plates.

All are covered with very large granules, regular, separated, and having especially in the interbrachial region 1 to 3 conical spines in the middle of their free border. The ventral plates are polygonal and separated from each other by fine grooves. Each is bordered by a row of small spines and with a group of very large granules in their center, especially in the center of the plate. The adambulacral plates have up to eight spines in the ambulacral groove, appressed and nearly cylindrical. Outside them are 2 to 3 more or less regular rows of spines on their surface, like those of the ventral plates. These latter, as well as the adambulacral plates and the entire ventral surface, are covered with a thin dermal layer.

The mouth frame pieces do not project.

The dorsal marginal plates do not coincide exactly with the ventral marginal plates and appear a little more numerous (4 to 6 more). Their granulation is also fine, especially on the internal border. A variable number of them have in their free border a spine like those of the ventral plates. They are contiguous with those of the opposite side the entire length of the arms. The dorsal plates are very regular polygons, covered with granules of which the first row forms around them a slightly projecting border. The grooves separating the plates have tubercles that unite them, and isolated pores, generally located in the angle of the plates and have papulae.

The madreporite is a little larger than the adjacent plates marked with fine sinuous radiating grooves. It is located in the first quarter of the distance between the center of the disk and the interbrachial arc.

The anal pore is indistinct.

As in the analogous species, the broken arms are regenerating.

N° 274. — Depth, 209 fathoms. — Barbados.

One individual has very small marginal interbrachial plates. Its spines on the ventral plates are naked. These spines seem thus to have disappeared and are not absolutely characteristic of the species.

PENTAGONASTER ARENATUS, sp. nov.

(Pl. VII, fig. 3 and 4.)

Five elongated and pointed arms, interbrachial arcs with a very large curve.

$R = 57$ mm; $r = 15$ mm; $R < 4 r$. Thickness = 100 mm.

Fifty two ventral marginal plates, at first wider than long, the gradually becoming longer than wide, uniformly granulose, completely spineless, contiguous with the adambulacral plates the greater length of the arms. A triangular area formed of numerous plates, granulose, irregularly polygonal and indistinct between the interbrachial arc and the buccal angle.

Small mouth frame pieces, indistinct from the adjacent plates. Adambulacral plates with 6 or 7 small thin, very short spines. (The ambulacral groove is very appressed and the tube feet cannot be seen.)

Fifty dorsal marginal plates like the ventrals, contiguous the entire length of the arms. The dorsal surface is formed of granulose plates that are indistinct from the each other. — Small madreporite, located in the first fourth of one of the small rays leaving the center.

N° 141. — Depth, 861 fathoms.

One other specimen from Santa Cruz has only 36 to 40 dorsal marginal plates on each side of the body.

$R = 57$ mm; $r = 14$ mm; $R = 4 r$.

At station 29 (Lat. 24°36'N. — 84°5'W, depth, 955 fathoms), two small specimen of this species were collected. The plates at the ends of the arms still have a very long spine. The adambulacral spines are thin and arranged in a fan.

N° 254. — Depth, 164 fathoms. — Grenada.

One individual with arms a little thinner and 38 marginal plates on each side of the body.

The dorsal plates are polygonal, clearly separated, especially those of the arm. The ensemble forms a kind of star on the disk.

The ventral plates are covered with a light dermal veil.

$$R = 40 \text{ mm}; r = 11 \text{ mm}; R < 4 r.$$

N° 173. — Depth, 734 fathoms. — Guadeloupe.

A specimen from Guadeloupe having 52 marginal plates on each side of the body:

$$R = 64 \text{ mm}; r = 18 \text{ mm}; R > 3.5 r.$$

N° 274. — Depth, 209 fathoms. — Barbados.

Two specimens, in one of which:

$$R = 27 \text{ mm}; r = 7 \text{ mm}; R > 3.5 r.$$

and 28 marginal plates on each side.

N° 281. — Depth, 288 fathoms. — Barbados

One specimen, again very small having 28 marginal plates.

N° 117. — Depth, 874 fathoms. — Lat. 17°47'10"N, — Long. 67° 03'20"W.

One small deformed specimen.

N° 275. — Depth, 218 fathoms. — Barbados.

An individual very near the typical *Pentagonaster arenaceus*, but distinguished by the presence of pincer pedicellariae on the ventral plates near the adambulacral plates. There are also some of them on the dorsal plates and the dorsal marginal plates. These pedicellariae are isolated and located on the end of the plates.

The dimensions of this individual are:

$$R = 40 \text{ mm}; r = 12; R 3.4 r.$$

PENTAGONASTER ALEXANDRI, sp. nov.

(Pl. VI, fig. 3, 4, 5, 6, 7 and 8.)

This nice little species is remarkable in that it recalls in some ways *Astropecten* or rather some *Archaster* and seems to be between the family ASTROPECTINIDÆ and that of GONIASTERIDÆ in a new link of transition.

There are five arms, very short and obtuse, indistinct and emerging from the ends of a regular pentagon whose sides are slightly convex, uniting the arms.

$$R = 9 \text{ mm}; r = 4.5 \text{ mm}; R = 2 r.$$

Width of the arms at the base is 3 mm.

On the ventral surface, the adambulacral plates have 3 rows of spines. The 3, more often 4, spines of the internal row on each plate are thin, elongated, divergent, and inclined towards the ambulacral groove. The 3 spines of the external row, inclined to the contrary outward, are larger shorter, and less obtuse at the end. The mouth frame pieces are separated by a very visible groove. The ambulacral grooves and the two marginal interbrachial plates limit, on the ventral surface a triangular area in which, in the specimen I examined, there are no more than six or seven ventral plates each with a group of 3 to 7 very large granules that are spaced, projecting, and with small spines. There are 12 ventral marginal plates on each side of the body (6 for each arm). These ventral plates rapidly decrease from each interbrachial arc to the end of the arms. The first two on each side of this arc are the only ones separated from the adambulacral plates. The others are in contact with them. All these plates have spaced granules that become larger and stronger as they approach the free border of the plate and then simulate spines.

There are 10 dorsal marginal plates on each side of the body (5 for each arm) and an unpaired one, triangular and very large, at the end of the arms. These plates are square and diminish from the interbrachial arc to the end of the arms. They have large, spaced granules arranged like those of the corresponding plates of the ventral border. Except for the two plates located at each interbrachial arc and a small part of those that border with those of the pentagonal area of the disk, the dorsal marginal plates on each side of the arms are exactly contiguous with those of the opposite side, so that the paxillar area of the disk does not go between them. This latter is made of spines that are relatively large and obtuse, but very long in a way to constitute true paxillae. Five of these plates, larger than the others, form a pentagon at the center of the disk with smaller paxillae. The madreporite is small and has only a few grooves. It is located immediately outside this pentagon, equal distance from the center of the disk and the internal border of the marginal plates.

A single example preserved in alcohol was collected at Barbados during the Hassler expedition at 100 fathoms depth.

Donated by Alexander Agassiz.

Could be young.

To the individual just described can be added seven specimens from the dredges of the *Blake* from the following localities:

N° 36. — Depth, 84 fathoms. — Lat. 23°20'N. — Long. 89°16'W (2 individuals).

N° 11. — Depth, 242 fathoms. — Lat. 22°9'30"N. — Long. 82°21'30"W. (Sigsbee, 2 individuals).

N° 00. — Depth, 175 fathoms. — In sight of Havana (2 individuals).

N° 32. — Depth, 95 fathoms. — Lat. 23°52'N. — Long. 88°05'W. (1 individual).

These specimens (Pl. VI, fig. 6, 7 and 8) appear at first to be *Pentagonaster Alexandri* E.P., collected by the *Hassler*, because the paxillar area on the dorsal surface is bordered by four marginal plates, while the corresponding area along the arms of the type has only two marginal plates. The other marginal plates are contiguous. However, in the smallest specimen of the second series, the border of the paxillar area again corresponds only to two marginal plates and two halves. And in the type, one sees the points of the paxillar pentagon goes between the 2nd pair of marginal plates from the top of the interbrachial arc so that there is obvious transition between the extreme arrangements.

Moreover, the total number of dorsal marginal plates increases regularly from the smallest to the largest specimens.

10 in the Hassler specimen.

12 in the specimen from dredge n° 11 of the new series.

14, whose two extremes are very small, in one of the specimens collected by Captain Sigsbee, but have a normal size in the specimen from dredge n° 32.

16, whose two extremes are very small, in the other specimen n° 32 of Captain Sigsbee, but have a normal size in specimen from dredge n° 36.

18, including two very small ones, in the large specimen of dredge n° 36 and in the large specimen of dredge n° 11.

As the number of plates increases, the relative length of the arms becomes larger.

In the large specimen of dredge n° 11, one has: $R = 16$ mm; $r = 7$ mm; $R = 2.3 r$ instead of $R = 2 r$, a proportion seen in the small specimens. It is again an example that shows that one can scarcely consider as a specific character the number of marginal plates without comparing specimens of the same size.

The number and size of the paxillar plates of the disk also increases with age. In small specimens and on the borders of the disk, each paxilla is formed of a ventral spine and a crown of marginal spines. In the largest, this crown remains large but the central area is much wider and is filled with a variable number of spines. One always sees on the disk a central plates and five interbrachial plates larger than the others. The madreporite is always a little below the edge of the paxillar plates. — The number of ventral marginal plates can exceed 18.

On the adambulacral plates, the number of internal spines can be 6. Those of the external row rarely exceeds 3. The lateral spines are often nearly rudimentary.

We believe it again necessary to report to this species, in spite of the difference in origin a remarkable specimen with a slightly greater elongation of the arms, found in the following conditions:

N° 31. — Depth, 1,930 fathoms. — Lat. 24°33'N. — 74°52'W.

PENTAGONASTER DENTATUS Ed. P.

(Pl. III, fig 8).

Pentagonal form, end of pentagon slightly extended so that the sides appear concave.

$$R = 14 \text{ mm}; r = 8 \text{ mm}; R = 1.78 r.$$

Very large mouth frame pieces (3 mm), are separated from each other by a very apparent oval space, covered, as usual, by the skin. Maximum width of the ensemble of the two pieces 1.5 mm. Each adambulacral plates with five very long spines, very distinct from the ventral granulation, followed by a row of very large granules that disappear in general in the center of the plates, to which they form an irregular border. There are ten ventral marginal plates on each side of the body; the last two of each triangular sides; the others rectangular, elongated in the direction of the border of the animal, bordered with a row of granules finer than those of the ventral surface. It is the same for the dorsal marginal plates that are the same number as the ventral marginal plates of the same form. The dorsal surface is entirely granulose but with finer granules than those of the ventral surface. Only some plates of the median region of the arms are naked.

The madreporite is a little larger than the adjacent plates, marked with very large grooves and located approximately half the distance from the center.

In the largest individual (dredge n° 260) $R = 39 \text{ mm}; r = 22 \text{ mm}$. The sides of the pentagon are regularly concave. There are up to 16 marginal plates for each side of the body. The plates of the middle part of the borders are square. All other characters are conserved.

PENTAGONASTER AFFINIS Ed. P.

(Pl. VIII, fig. 4.)

N° (?). — Depth, 1,323 fathoms. — Lat. 23°26'N. — Long. 83°2'W.

N° 182. — — 1,131 — — Dominique.

Different from *P. dentatus*, to which it is otherwise extremely close, by its more granulose ventral surface and the large granules of the dorsal surface, forming a projecting crown around them. Each plate is clearly separated from the adjacent ones. There are 14 irregular marginal plates on each side of the body. All the other characters are the same.

PENTAGONASTER INTERMEDIUS

(Pl. 5, fig. 5.)

N° 31. — Depth, 1,930 fathoms. — Lat. 24°33'N. — Long. 84°23'W. (2 specimens).

Five very distinct arms, obtuse at the end, connected by the nearly rectilinear border of the pentagonal disk.

$$R = 27 \text{ mm}; r = 11 \text{ mm}; R = 2.4 r.$$

Each adambulacral plate has six or seven flat, very elongated spines. Immediately behind them is a large pedicellaria with projecting valves, taller than wide, slightly wider or truncated at

the end, flattened in the direction of the length of the arms, and followed by several irregular rows of very large granules, projecting and clearly separated from each other.

Ventral marginal plates equally granulated, rectangular, elongated in the direction of the arm length, 22 for each side of the body. Large mouth frame pieces, very slightly projecting, granulose and separated by a very distinct slot. Their length is 3 mm; their greatest width is 1 mm.

There are twenty four dorsal marginal plates on each side of the body, naked and surrounded by a circle of granules, with the upper part granulose with the lower part granulose.

Plates of the disk are uniformly granulose, but having a tendency to be naked towards the center, so that most have simply a more or less complex border of granules. All these plates are obviously uniformly granulose in some specimens.

Madreporite is a little larger than the plates surrounding it, slightly nearer the center of the disk than the most adjacent marginal plates.

Genus GONIODISCUS Müller and Troschel.

Skeletal pieces star-shaped and granulose.

GONIODISCUS PEDICELLARIS, sp. nov.

N° 295. Depth, 180 fathoms. — Latit. Barbados.

N° 224. — 115 — — Saint Vincent (2 specimens).

N° 219. — 151 — — Saint Lucie (2 specimens).

Five arms united by a very large curved interbrachial arc.

$$R = 59 \text{ mm}; r = 18 \text{ mm}; R = 3 r.$$

Fifty eight ventral marginal plates from one end to the other of two consecutive plates, wider than long in the interbrachial arc, very rapidly becoming nearly square. They are covered with very spaced small spines and very frequently have an irregularly placed valvular pedicellaria. The calcareous plates that form the ventral disk are surrounded by a crown of small spines like those of the marginal plates. At the center of the plates nearest the adambulacral plates is a valvular pedicellaria taller than wide, in the form of spoon bowl. This pedicellaria is replaced by a spine in the middle region of each of the sectors of the ventral surface. On the ventral surface, the adambulacal and marginal plates are contiguous after the 14th marginal plate, counting from the interbrachial arc.

Each adambulacral plate has, in the ambulacral groove, five spines nearly the same size. A little behind, three or four spines much larger and often irregularly located. Finally, on its border towards the end of the arm is a conical pedicellaria nearly the size of the large arms.

The marginal plates of the dorsal surface have the same number as those of the ventral surface and are covered, like them, with small spines, larger at the external border of the plates. The dorsal plates project slightly, very separated from each other and with radiating calcareous trabeculae between them. Each is surrounded by a crown of spines and has at its center one to three spines, sometimes replaced by a pedicellaria like those of the ventral surface. The interbrachial plates do not form distinct bands.

The madreporite is near the first third of the distance from the center of the disk to the interbrachial angle.

Remarks. — The two individuals from Saint Vincent are smaller and have only 46 marginal plates. Also, on both the dorsal and ventral surface, the pedicellariae are replaced everywhere by small spines. In all their characters, these individuals are very near *Goniodiscus rugosus*¹³ of the *British Museum*. They differ from them especially because the interbrachial dorsal plates do not form distinct rows and because the dorsal plates are, to the contrary to that seen in *G. rugosus*, clearly distinct from each other despite the granulation. The major ray of these individuals is no more than 74 mm instead of 104.

The individual from St. Lucie is smaller: major ray 32 mm and only 30 marginal plates, but the characters of granulation and the form of the dorsal and ventral plates, as well as the arrangement of the adambulacral armature, are the same. I believe thus that it is only a matter of local varieties and different age of the same species.

Genus ANTHENOIDES, gen. nov.

Pentagonal body. — Ventral skeleton formed of polygonal pieces. — Dorsal skeleton reticulated, covered with a granulose skin.

Anthenoides approaches *Anthenea* by its dermal covering of the dorsal surface and by the valvular pedicellariae on the ventral surface. It is separated however by the thinner dorsal skin, the relatively small size of the pedicellariae and especially by the fact that these organs, instead of being on all the ventral plates that gives *Anthenea* a very characteristic aspect, are found only on the plates nearest the ambulacral groove. The dermal covering of the ventral surface is scarcely apparent. The general forms of these animals are less heavy than those of *Anthenea* and recall those of *Pentagonaster* with elongated arms.

ANTHENOIDES PEIRCEI Ed. P.

(Pl. VIII, fig. 1.)

N° 296. — Depth, 84 fathoms. — Barbados.

Five pointed arms connected by a broad interbrachial arc. Fifty four ventral marginal plates, elongated in the interbrachial arc in the direction of the ray of the disk, then nearly square, strongly granulose with granulation stronger on their external border whose apical angle often has a granule larger than the others, forming a kind of short and mushroom-shaped spine. These plates are in contact with the adambulacral plates a little beyond half-way the length of the ambulacral groove from the mouth.

Ventral plates granulose, slightly swollen. Those that touch the adambulacral plate and nearest the mouth, in the following row, generally have a slightly projecting valvular pedicellaria without a particular orientation. — Adambulacral plates have a comb of 7 spines well separated from each other, slightly divergent and larger towards the middle of the plate. Behind these spines is a second row of three spines, larger and shorter, three per plate. Behind these, the first valvular pedicellariae are separated from each other by grooves between the plates.

¹³ Edmond Perrier, *Revision des Stellérides du Muséum*, 1875, page 233, n° 145.

Fifty dorsal marginal plates on each side, nearly square, covered, as all the surface of the back, with a very thick skin, finely granulose, allowing to be seen the ossicles of the skeleton that are polygonal as in *Pentagonaster*, and bordered with small papulae separated from each other.

Dorsal surface slightly convex and deformable by pressure.

Anus visible.

Madreporite rounded, very distinct, marked with fine radiating grooves, located in the first third of the distance between the center of the disk and the interbrachial arc.

Two other individuals of this species were collected at Sainte Lucie (dredge n° 219; depth, 151 fathoms) and at Guadeloupe (dredge n° 177; depth, 150 fathoms). They are much larger than the individual from Barbados. The dimensions of the first are $R = 156$ mm; $r = 53$ mm; those of the second, $R = 131$ mm; $r = 33$ mm. They also differ from the individual that we just described by some peculiarities that could, at first, take them for individuals of a different species, but that are simply, in our opinion, the effect of age. The spines of the ambulacral groove, those that border this interior groove, are larger, more robust and appear even more numerous. The granules around the pedicellariae of the ventral surface are larger than the adjacent ones of the same plate, taking also proportionally greater dimensions. It is the same for the granules of the external border of the marginal plate that form for the animal a border of spines analogous to that of *Porania*. The spines are sometimes pointed on several rows. The strongest are located at the internal apical angle of the plates. The dorsal surface appears, in its turn, more swollen. There is in summary only differences in the degree of development of parts that are indicated already in the smallest individual. We conclude thus to the combining into a single species these beautiful asteroids.

Order IV.

STELLERIDÆ PAXILLOSÆ.

Dorsal skeleton formed of paxillae, ventral skeleton generally spiny. — Large marginal plates constituting one ventral row.

Mouth frame pieces voluminous, elongated, projecting, forming an elongated oval very clearly distinct from the rest of the ventral plates.

FAMILY I.

ARCHASTERIDÆ.

Asteroids with an anus. — Marginal plates not contiguous with adambulacral plates their entire length.

Genus GONIOPECTEN, nov. gen.

Mouth frame formed of large pieces projecting on the inferior surface of the disk and the ensemble making an elongated oval. Suckers of the tube feet often rudimentary or absent. Skeletal ossicles granulose without spines or with immobile spines.

GONIOPECTEN DEMONSTRANS, sp. nov.

(Pl. IV, fig. 5.)

N° 130. — Depth, 351 fathoms. — Santa Cruz (1 specimen).

N° 135. — — — — Frederikstadt (1 specimen).

N° 151. — — — — Nevis (2 specimens).

One of the two specimens from dredge n° 151 has a span of 220 mm, the other 240 mm. That of Santa Cruz that I will describe more thoroughly is 210 mm and the two rays have the following relationship: $R = 4.3 r$. The width of the arms at the base is 23 mm.

This species, very remarkable by its size and elegance of its form, is at the same time one of the most important of the genus *Goniopecten* because of the clearly intermediate characters that it shows between *Pentagonaster* and *Astropecten*.

The two surfaces of the body are nearly flat. The animal is 10 mm at its thickest.

The width of the five arms gradually decrease from the base to the tip and are connected by a fairly strong curved interbrachial arc.

There are approximately 92 ventral marginal plates, which makes 46 for each side of the body. These plates are rectangular and the greatest length is perpendicular to the axis of the arms. The grooves that separate them continue up to edge of the ambulacral groove and separate them at the same time from the adambulacral plates, so that the number of these plates is precisely the same as that of the ventral marginal plates. However, they are not exactly in line with them. The consecutive grooves that separate them form at the end of the marginal plates an angle whose variable opening is sometimes directed towards the end of the arms, sometimes towards their base. Two consecutive grooves can even be not exactly parallel, and the band they limit sometimes widens from the marginal plate to the adambulacral plate. In the region of the disk, this band is formed by a double row of alternating polygonal plates, generally elongated in the direction of the width of the arms. These double rows can be seen easily on the arms. They are soon formed of more than two plates that seem even mingled in the first third of the arms. At the least, the membranous skin that covers the entire skeleton and even the spines prevents distinguishing the suture lines that separate adjacent plates.

Between the marginal plates and the adambulacral plates, one notes some short, thick indistinct spines embedded in the skin. Smaller regular spines occur on the border of each series of plates, in the transverse grooves that go from the ambulacral groove to the edge of the arms, a fine regular indentation like that of *Astropecten* between their ventral plates. Sometimes the skin is marked with polygonal impressions that make it appear scaly.

Each ambulacral plate projects into the ambulacral groove a strong keel that is introduced between two consecutive tube feet so that each of them seems to be enclosed between two consecutive keels. On the border of each plate is a comb of spines like those of *Pentagonaster*. The anus is subcentral.

Remark. — The relations of this species with the true *Astropecten* are more evident. While in the PENTAGONASTERIDÆ, usually the ventral plates form, between the marginal plates and the adambulacral plates, a more or less regular mosaic but without any relation with the plates that limit the ventral surface of the body in the ASTROPECTINIDÆ. The ventral surface is always divided into parallel bands, apparently formed of a single plate and corresponding to the adambulacral plate. The ventral bands with polygonal plates of *Goniopecten demonstrans* are evidently something exactly intermediary between that observed in the two families. We add that the dorsal paxillar surface, the small spines bordering the marginal plates, the projection of the

mouth frame pieces, the keel of the adambulacral plates replaced by a saber-shaped spine in *Astropecten*, the smallness of the sucker of the tube feet, characters common with all the *Goniopecten* add again to the resemblance of *Goniopecten demonstrans* with the *Astropecten* properly called.

GONIOPECTEN INTERMEDIUS, nov. sp.

(Pl. VII, fig. 1 and 2, and pl. IV, fig. 4.)

N° 29. — Depth, 955 fathoms. — Lat. 24°36'N. — Long. 84°4'W (3 specimens).

N° 2. — Depth, 833 fathoms. — Lat. N° 24°24'N. — Long. 84°. — One specimen.

Five slightly elongated arms united by rounded interbrachial arcs.

R = 34 mm; r = 12 mm; R = approximately 3 r. — Body flat.

Ventral marginal plates number from 44 to 54. Wider than long, granulose, each with an isolated, obtuse spine in the middle of their free border, contiguous on the arms with the adambulacral plates. The space between the buccal angle and the border of the marginal plate with numerous irregular plates that are polygonal and granulose.

Mouth frame pieces are large, projecting on the disk, very distinct from each other. — Each adambulacral plate with approximately seven spines. Tube feet end in a very small, nearly punctate sucker.

Dorsal marginal plates number 44, granulose, wider than long, with spines at least in the interbrachial arc. These spines are themselves like those of the ventral plates but a little smaller. — Dorsal plates of one of the borders of the arms separated from those of the other border by a paxillar area less wide than the plates themselves, covered with paxillae very analogous to those of *Astropecten*. — Anus subcentral. — Madreporite located in the middle of one of the small rays, half hidden by paxillae larger than those of the rest of the dorsal surface.

In the larger specimen the span is 110 mm. In the small specimen it is only 62 mm. In the other larger specimen it is to the contrary 145 mm.

I believe it is necessary to consider as young *Goniopecten intermedius* the small asteroids collected at station 2908 (Martinique), depth 213 fathoms; eight at station 290 (Barbados, depth 790 fathoms; one at station 273 (Barbados, depth, 103 fathoms; and station 157 (Montserrat) at 120 fathoms. Their span varies from 8 to 25 mm.

The number of marginal plates of the ventral side varies likewise from 18 to 26. The terminal plates of the arms are not larger than the others. The ventral marginal plates decrease rapidly from the interbrachial arc to the end of the arms. Unlike what one observes in adults, the marginal plates do not have spines on the dorsal or the ventral side. The granulation of the plates is like that of the adults. In some individuals only the granules, more elongated, are like small spines. It is impossible to distinguish the madreporite on the dorsal surface. This plate is, moreover, scarcely visible in adults. The dorsal plates are, as in the latter and as in *Astropecten*, smaller than they are closer to the center of the disk.

The adambulacral plates have 6 spines.

GONIOPECTEN SUBTILIS, sp. nov.

(Pl. V, fig.3 and 4.)

N° 3. — Depth, 1,930 fathoms. — Lat. 24°33'N. — Long. 84°23'W.

Pentagonal disk ends in 5 thin, nearly linear arms.

$R = 60 \text{ mm}; r = 12 \text{ mm}; R = 5 r.$

Seventy ventral marginal plates, first wider than long, but gradually becoming longer than wide. Granulose with some short, elongated granule, nearly spiniform. Contiguous nearly the entire length of the arms with the adambulacral plates. Each has a comb of 5 or 6 flat spines, obtuse, divergent, of which the median ones are longer than the others so that the ensemble forms a semicircle. — Each group of spines are very clearly isolated from the adjacent ones to make a festoon on the border of the ambulacral groove. The rest of the plate is covered with divergent spines. — The ventral plates are granulose.

Granulose mouth frame pieces, very distinct from the other slightly prominent plates. Tube feet with a small sucker.

Seventy dorsal marginal plates, granulose, first wider than long, then nearly square. Those of the two borders of an arm separated the entire length of the arm by a single row of granulose plates, longer than wide. The entire dorsal surface formed of granulose hexagonal plates, very distinct from each other, hiding the madreporite. — Anus very apparent.

Genus ARCHASTER Müller and Troschel

Arms united by large interbrachial arcs; body flat.

ARCHASTER PULCHER, nov. sp.

N° 227. — Saint Vincent. — Depth, 573 fathoms (one specimen).

Five arms: $R = 12 \text{ mm}; r = 4 \text{ mm}; R = 3 r.$

Arms joined by blunt angles, 26 ventral marginal plates, covered with slightly spaced granules in the form of small spines and with a larger spine, slightly projecting, on their upper-external angle. Triangular area between the ambulacral grooves and the marginal plates is very distinct. The plates have small spines whose number does not exceed six. Spines like those of the adambulacral plates that have 4 or 5 nearly equal spines in the ambulacral groove, slightly divergent and forming a regular row.

Mouth frame pieces very projecting, each ending towards the mount in a large spine. Sucker of the tube feet very small.

Twenty five dorsal marginal plates on each side, covered with small, spaced spines. Very large terminal plate with 2 spines, as is ordinary in young *Pentagonaster*. Small dorsal plates, especially towards the center of the disk, with only 6 round spines in the form of granules. — Madreporite nearly touches the marginal plates, distinct only by its larger size than that of adjacent plates, and covered with spines like those of the latter.

Anus not apparent.

ARCHASTER EFFLORESCENS, nov. sp.

N°29. — Depth, 965 fathoms. — Lat. 24°36'N. — Long. 84°05'W.

Five slighted elongated arms, rounded interbrachial angles.

R = 17 mm; r = 5.5 mm; R = 3 r; E = 31 mm.

Twenty ventral marginal plates, separated from each other by a very large groove filled with the spines that fringe the plates and that are of the same nature, but only a little longer than those that cover the surface of these latter.

Each plate has one or two very short spines.

Very small mouth frame pieces separated from the marginal plates by a triangular area formed of four rows of small plates, each with six to 10 small spines radiating around one or several small central spines.

Dorsal marginal plates, not very apparent from above, number twenty, granulose with a short spine at their center that, in the last plates are inclined towards the top of the arms. — Dorsal paxillae, very small, very numerous, have only six or eight small obtuse spines. Madreporite covered with spines like those of the paxillae, located very near the marginal plate.

Anus sub-central.

ARCHASTER INSIGNIS, nov. sp.

(Pl. IX, fig. 5.)

N° 31. — Depth, 1,930 fathoms. — Long. 84°23'W. — Lat. 24°33'N. (2 specimens).

A triangular area formed by several rows of plates between the ventral marginal plates and the mouth frame pieces project onto the ventral surface and enclose between them a very clear oval surface. — On the triangular area one sees, sparse among the fine spines, a dozen very large pedicellariae with two, three or even four jaws. — Each mouth frame piece with eight thin spines at the buccal angle. — Adambulacral plates with eight thin spines, contiguous, of which the median is longer. — Thirty one ventral marginal plates, each with a long pointed spine and a covering of fine spines.

Small tube feet.

Thirty small dorsal marginal plates. Each with a spine. — Dorsal plates of the disk are invisible. The entire back covered small bunches of three or four small spines that hide the madreporite.

E = 90 mm; R = 45 mm; r = 12 mm; R = 3.5 r.

ARCHASTER MIRABILIS, nov. sp.

(Pl. VIII, fig. 7 and 8; pl. LIXL, fig. 4, and pl. X, fig. 2 and 3.)

N° 148. — Depth, 208 fathoms. — St. Kitts (2 specimens).

Five thin, elongated pointed arms, united with a sharp angle.

$$R = 87 \text{ mm}; r = 12 \text{ mm}; R > 7 r.$$

More the forty-eight marginal plates on each side (40 and more for each arm) in large specimens. Ventral marginal plates contiguous with the arms from the third, counting from the interbrachial angle, nearly square, bristly with small spines among which are two or three spines that are much more elongated, very pointed, and in the middle of the border of the plate, another very elongated, pointed spine that can reach, towards the middle of the arm, 8 mm in length. Adambulacral plates slightly protruding into the ambulacral groove in a way to separate the tube feet. Each has on the internal border a comb of ten thin, cylindrical spines, enlarging rapidly at the edge of the plate in its middle, and divergent. On the plate, surrounded by the base of its spines, is a large conical spine like those of the marginal plates and at the side of which are three small spines that seem sometime to form a belt around it.

Between the mouth and the interbrachial arc, a small number of ventral plates fill the interval between the buccal pieces and the marginal plates. On these plates, spines a little larger and more mobile than the others, are arranged, in two opposite arcs, towards the concavity in which they can fold. The spines of one of the arcs can meet those of the opposite arc to grasp objects between them. The ensemble constitutes a kind of pedicellaria of a new type that one can call *pectinate pedicellariae*.

Each of the arcs of pedicellariae has five to six spines. There is a pectinate pedicellaria on each of the ventral plates between the mouth, the ambulacral grooves and the marginal plates. But there are also smaller ones on the ventral marginal plates that sometimes have two. The mouth frame pieces are 4 mm long and their ensemble is 2.5 mm wide. The two spines they have in the buccal angle are notably larger than the adjacent ones. The tube feet end in a very small but quite distinct sucker.

The dorsal marginal plates are very small, nearly square and granulose. Each has only one long conical spine like that of the ventral marginal plates. A circle of similar spines on the disk surrounds the anus. There are 6 to 10 of various sizes. The paxillae are small, spaced and granulose. The madreporite, much larger than they are, is very near the interbrachial angle and has very wide radiating grooves. In many specimens, one sees an orifice at the base of the arms, very near the median line (genital orifice?).

Remarks. — This species is extremely common and at the same time very variable. Here the name of the localities where it has been collected, but it rarely reaches there the size of the individual that we will describe.

N° 2. — Depth, 805 fathoms at 4 miles from Morrolight.

A very large specimen, but with no trace of pectinate pedicellariae that are replaced by spines.

N° 231. — Depth, 95 fathoms (6 specimens).

In the largest of six specimens of this station:

$R = 50 \text{ mm}; r = 10 \text{ mm}; R = 5 r.$

The relation of the large and small diameter of the arms is thus very small. The arms are also wider at their base. The marginal plates number 28, instead of 40, on each arm of the ventral side. In addition, the adambulacral plates have, on their free surface, no longer one but 3 or 4 fasciculate spines. The spines of the marginal plates are also shorter than those of the type. There are no longer spines around the anus. But most of the dorsal paxillae have a small fragile spine at the center and of which one finds the trace on some of the dorsal paxillae of the type.

The curious pectinate pedicellariae of the ventral surface are very developed but irregularly placed. One of the triangular areas of the ventral surface has none. Another has two of them on one of its sides and none on the other. The 3rd has one on each. The fourth has one on each side. The fifth has two on each side. This variability indicates these pedicellariae are completely lacking in some specimens.

This individual could certainly be considered a distinct species if it did not have numerous characters that unite it to the type.

N° 443. — Depth, 150 fathoms. — Lat. 17°38'N. — Long. 63°43'W.

One specimen with proportions nearly analogous to the preceding but lacking pedicellariae.

N° 175. — Depth, 111 fathoms. — Dominica.

One similar specimen with very visible genital openings. The adambulacral plates have only 6 to 8 spines.

N° 225. — Depth, 186 fathoms. — Barbados

One specimen with proportions analogous to those of station 231 but with more developed marginal spines and with very elongated dorsal spines near the anus.

N° 238. — Depth, 127 fathoms. — Camman.

Numerous specimens with variable characters and of small size.

N° 272. — Depth, 76 fathoms. — Barbados.

One specimen of small size with only one pedicellaria in the middle of each ventral area.

N° 157, — Depth, 120 fathoms. — Montserrat.

Six specimens of average size or small.

N° 244. — Depth, 163 fathoms. — Cariacou.

Three specimens of which one, although small, is very near the type.

N° 200. — Depth, 73 fathoms. — Barbados.

Many small specimens.

N° 273. — Depth, 103 fathoms — Barbados.

Many small specimens.

N° 129. — Depth, 314 fathoms. — Frederikstadt, Santa Cruz.

One very nice specimen.

$$R = 36 \text{ mm}; r = 6 \text{ mm}; R = 6 r.$$

Slender form. Spines long and thin. No spines around the anus, nor pectiate pedicellariae on the ventral surface. At the base of each arm is a large membranous papilla (opening of genital tube?), surrounded by a circle of very small papillae. This peculiarity is more or less evident in many specimens.

N° 208. — Depth, 213 fathoms. — Martinique.

Four specimens.

N° 156. — Depth, 88 fathom. — Montserrat.

Four specimens which are a dark color.

N° 291. Depth, 200 fathoms. — Barbados.

One specimen near the type, but with smaller anal spines.

N° 157. — Depth, 120 fathoms. — Montserrat

Seven specimens of small and average size.

N° 231. — Depth, 95 fathoms. — Saint Vincent.

One small specimen.

N° 122. — Depth, 115 fathoms. — Santa Cruz.

Three small specimens.

N° 292. — Depth, 56 fathoms. — Barbados.

Numerous specimens of small and average size.

N° ?. — Depth, ? fathoms.

One small half broken specimens without indication.

N° 140. — Depth, 60 to 180 fathoms. — Saint Kitts.

Four very small specimens.

N° 154. — Depth, 298 fathoms. — Montserrat.

One small specimen.

N° 259. — Depth, 259 fathoms. — Milligan Key.

One specimen.

N° 134. — Depth, 248 fathoms. — Santa Cruz (14 individuals).

N° 167. — — 120 fathoms. — Montserrat (5 individuals).

N° 36. — — 84 fathoms. — Lat. 23°20'N. — Long. 89°16'W (3 individuals).

N° 5. — — 229 to 152 — Lat. 24°15'N. — Long. 84°13'W (4 individuals).

N° 157. — — 88 fathoms. — Plymouth (5 individuals).

N° 155. — — 88 — — Montserrat (4 individuals).

N° 291. — — 200 — — Barbados (2 individuals).

N° 202. — — 210 — — Martinique (1 individual).

N° 290. — — 73 — — Barbados (12 individuals).

N° 32. — — 95 — — Lat. 23°52'N. Long. 88°05'W (13 individuals).

N° 273. — — 103 — — Barbados (3 individuals).

N° 892. — — 56 — — Barbados (1 individual).

N° 164. — — 150 — — Guadeloupe (12 individuals).

N° 175. — — 611 — — Dominique (1 individual).

N° 277. — — 106 — — Barbados (7 individuals).

N° 196. — — 1030 — — Martinique (1 individual).

N° 296. — — 84 — — Barbados (2 individuals).

125

N° 282. — — 154 — — Barbados (1 individual).

N° 166. — — 150 — — Guadeloupe (1 individual).

N° 158. — — 148 — — Montserrat (4 individuals and some debris).

N° 269. — — 224 — — Saint Vincent (1 individual).

N° 148. — — 208 — — Saint Kitts (1 individual).

N° 295. — — 84 — — Barbados (2 individuals).

ARCHASTER CORONATUS, nov. sp.

N° 2. — Depth, 805 fathoms. — 4 miles from Morrolight.

N° 19. — Depth, 310 fathoms. — Lat. 23°3'N. — Long. 83°10'5/

Very young specimen.

Five thin, elongated arms, — interbrachial angles slightly rounded, — 43 marginal plates. — Ventral marginal plates contiguous with the adambulacral plates except near the disk where a single row of six plates, decreasing in size very quickly from the disk, separates the marginal plates from the mouth frame pieces and the three first adambulacral plates. — Adambulacral plates have a demi-circle of 9 spines decreasing in size gradually from the middle to the ends. Behind a spine, straight, single, long, thin and pointed. — Each mouth frame piece with ten spines decreases in size from the buccal angle, separated on the ventral surface by a very large gap and having small spines both on their surface and on their border of contact that thus appears crenulated. Ventral and marginal pieces covered with small spines. The latter have also in their middle a pointed spine, much longer than the others, sometimes surrounded by several spines half as large as it and like it strongly echinulate.

Dorsal marginal plates longer than wide, with rounded angles, each with a median spine. — Spine of the 4th plate after the interbrachial angle much wider than the others. The spines of the 3rd and 4th plates to the contrary very reduced. None on the first.

Dorsal papillae very small, covered with fine spines likewise between them. — Around the anus is a group of fifteen long, thin, pointed spines.

Madroporite small but projecting, rounded with large grooves, near the marginal plates without touching, however.

R = 65 mm; R = 8 r; d = 9 mm; E = 105 mm.

ARCHASTER ECHINULATUS Ed. P.

(Pl. I, fig. 4.)

N° 32. — Depth, 95 fathoms. — Lat. 23°57'N. — Long. 88°05'W. (5 specimens).

Two ventral plates separate the marginal from the mouth frame pieces. — Spines of these plates are grouped to make a pectinate crown. — A small fragile spine is on most of the dorsal plates of the disk. — Small sucker at the end of the tube feet.

N° 45. — Depth, 101 fathoms. — Lat. 25°33'N. — Long. 84°21'W. (5 specimens).

N° 5. — Depth, 152 to 229 fathoms. — Lat. 24°15'N. — Long. 82°13'W. (5 specimens).

N° 36. — Depth, 84 fathoms. — Lat. 23°20'N. — Long. 89°16'W. (2 specimens).

Number of dorsal marginal plates varies with size from 19 to 15. — All specimens have more or less numerous spines on the dorsal marginal plates, most of the granulations of these plates being transformed into small spines. — In the largest specimen, very long spines surround the anus.

ARCHASTER SIMPLEX, nov. sp.

(Pl. I, fig. 8.)

N° 40. — Depth, 1,323 fathoms. — Lat. 23°26'N. — Long. 84°02'W (1 specimen).

No ventral plates between the ventral marginal plates and the mouth frame. — An unpaired marginal plate in the angle of the arms supports the mouth frame pieces that are rounded at the end. — Fourteen marginal plates longer than wide, slightly convex on the external border to make the border of arms appear slightly festooned. These plates directly support the ambulacral plates that are smaller, projecting into the ambulacral groove. Some small spines and one much larger, fine and pointed, located on the border of each ventral marginal plates. — Adambulacral plates have 4 or five divergent spines on their border with another very large at their center. Tube feet end in a very distinct sucker.

Fourteen dorsal marginal plates, longer than wide, nearly oval in form, and an unpaired triangular, each with a long pointed spine at the interbrachial angle.

Spine of the unpaired plates with one longer, at least twice that of the others. Another spine near the anus. — Plates of the disk very small, very little apparent. — Back has numerous small spaced spines, without apparent calcareous plates. Madreporite small, round, with an irregular wavy surface, nearly in contact with the unpaired plate.

$E = 35 \text{ mm}$; $R = 18 \text{ mm}$; $r = 3 \text{ mm}$; $R = 3 r$; $d = 4 \text{ mm}$.

Genus BLAKIASTER, nov. gen.

Rounded or slightly convex arms, connected by sharp angles, with marginal plates inclined from the base to the top of the arms. A triangular area of distinct plates between the top of the angle of the ambulacral groove and the brachial angle.

BLAKIASTER CONICUS, nov. sp.

(Pl. IX, fig. 2.)

N° 25. — Depth, 92 fathoms. — Grenada (1 specimen).

N° ?. — Depth, 175 fathoms. — Havana (1 specimen)/

Five arms connected with an acute angle, thick, slightly obtuse at the top, slighted rounded below, flat above.

$R = 27 \text{ mm}$; $r = 10 \text{ mm}$; $R < 3 r$; $d = 46 \text{ mm}$.

The characteristic physiognomy of this species is connected to the thickness and arrangement of the marginal plates, as well as the covering of the spines of the ventral plates.

The ventral marginal plates number 15 for each arm, oblique from the outside to the inside and from the top to the base of the arms. They are separated from the adambulacral plates only by a small, square plate, except in the interbrachial angle where a triangle formed of a dozen plates, of which one is at the center of the triangle, separates them from these plates. The adambulacral plates are likewise oblique in relation to the ambulacral groove. They have in this groove 4 or 5 elongated and divergent spines. But all their surface is covered, like that of the other ventral plates, including the marginal, with a dense covering of thin, very elongated spines, in the middle of which

one distinguishes, on the border of the marginal plate, one stronger, more elongated and pointed spine. The mouth frame pieces are scarcely larger than the adjacent adambulacral plates, but projecting and very distinct.

The tube feet are conical and end in a point.

The dorsal marginal plates are nearly vertical in the interbrachial angle, so that one scarcely sees them when one looks at the animal from above. But they become more and more apparent as one approaches the end. They are covered with large granulations. The dorsal surface is formed of rounded plates with granules more elongated to make a kind of paxilla approximately 1 mm in diameter. The madreporite is small, scarcely larger than the paxillae that surround it, and the grooves crossing its entire length, as in *Astropecten*, instead of being rays as in most of the other types.

The anus is not distinct.

Remark. — *Blakiaster* is very near *Astropecten* and is distinguished especially by the triangular area that separates the marginal plates from the adambulacral plates in the area of the mouth. The spines of the ventral surface are also less dense and less long than those of most *Astropecten*, the dorsal paxillae less clear and the armature of the ambulacral groove lacks the saber-shaped spine so frequent in *Astropecten*.

FAMILY II.

ASTROPECTINIDÆ.

No anus. — Marginal plates contiguous their entire length with the adambulacral plates.

Genus LUIDIA

Single distinct row of ventral marginal plates.

LUIDIA BARBADENSIS sp. nov.

(Pl. I, fig. 7.)

N° 26. — Depth, 40 fathoms. — Long. 83°36'W. — Lat. 24°37.5'N.

N° 204. — — 200 — — Barbados.

N° 274. — — 209 — — Barbados.

N° 300. — — 82 — — Barbados.

Six very long and extremely fragile arms, always very distorted in individuals preserved in alcohol.

$R = 125 \text{ mm}; r = 10 \text{ mm}; R = 12.5 r.$

At their greatest width, the arms are approximately 11 mm in diameter. They are flat above and keep a slightly brick red color in alcohol.

The adambulacral plates have, in the ambulacral groove, a very compressed, slightly recurved spine. Then, immediately outside, two other equally compressed spines, but nearly straight and arranged a little obliquely, one behind the other. Behind them, two or three small, thinner spines complete the armature of the plate that also has a pedicellaria with three jaws.

Buccal pieces very projecting with a comb of 5 or 6 spines directed towards the mouth.

The ventral plates are barbed with small spines and have a median row of larger, conical spines, of which the last two are considerably larger and form the usual border of spines of the arms. On each arm, the three lateral rows of paxillae of each side are formed of paxillae larger than those of the middle region; then are two very regular rows of smaller paxillae, the median paxillae are still smaller and irregularly arranged.

The madreporite is hidden by the spines.

Remark. — In the specimen from locality n° 26, that is much smaller than the others, the dorsal paxillae are nearly equal and the arms proportionally much shorter.

This species differs from *L. convexiuscula* because, in this one, the arms, regularly convex in the dorsal region, appear formed of a more resistant tissue, because the median paxillae seem to merge more gradually with the lateral paxillae and also because the color of *L. convexiuscula* preserved in alcohol is pure white while, in the color of deformed specimens of *L. barbadensis* I am observing is reddish.

LUIDIA CONVEXIUSCULA sp. nov.

(Pl. VI, fig. 40.)

N° 45.	—	Depth, 101 fathoms.	—	Lat. 25°33'.	—	Long. 84°21'W.
N° 292.	—	56	—	—	—	Barbados (1 broken specimen).
N° 155.	—	89	—	—	—	Montserrat (1 small specimen).
N° 200.	—	76	—	—	—	Barbados.
N° 296.	—	84	—	—	—	Barbados.
N° 149.	—	208	—	—	—	Saint Kitts.
N° 254.	—	164	—	—	—	Grenada.

Six arms. — Small pedicellariae with three valves in the area of the angles of the arms. — Adambulacral plates have, in the ambulacral grooves, a long, compressed and recurved spine. Behind it a bunch of smaller spines. — Ventral plates short, covered with small spines and a single long marginal spine.

Back of the arms slightly convex, with nearly equal paxillae, a little smaller however in the middle of the arms and on the disk, with small divergent, nearly equal spines of which the median one is a little larger than the others and does not end in a point. — Approximately 15 rows of paxillae.

Madreporite invisible without preparation.

D = 54 mm; R = 28 mm; r = 5 mm; R = 5.5 r.

LUIDIA ELEGANS Ed. P.

N° 291. Depth, 200 fathoms. — Barbados.

Two specimens of which one is only fragments of the arms. The other nearly entire and in which:

$$R = 115 \text{ mm}; r = 12 \text{ mm}; R = 9.5 r.$$

This specimen is much larger than the type that I described in *Archives de Zoologie expérimentale*, vol. V, p. 25. The arms are also proportionally longer and the color that was completely blanché in the type is brick red, pale in individuals preserved in alcohol that I have examined. These characters are the same and the pedicellariae are notably distinguished from close *Luidia* because they have only two valves.

LUIDIA ALTERNATA Say

N° 39. — Depth, 14 fathoms. — 60 miles to the north of Jolbos Island (2 broken specimens).
N° 155. — — 88 — Montserrat (1 small specimen).

LUIDIA CLATHRATA Say

N° 39. — Depth, 14 fathoms. — 60 miles to the north of Jolbo Island (2 specimens).

Genus ASTROPECTEN Linck

Two rows of marginal plates.

ASTROPECTEN ARTICULATUS Say

N° 39. — Depth, 11 fathoms. — 60 miles to the north of Jolbo Island (1 specimen).
N° 38. — — 20 — — Yucatan Bank. — (Lat. 23°10N. — Long. 88°35'W).

ASTROPECTEN ALLIGATOR sp. nov.

Five arms, flat, ending in a point. Interbrachial angles not rounded:

$$R = 40 \text{ mm}; r = 9 \text{ mm}; R = 4.5 r.$$

Width of the arms at the base = 9 mm.

The adambulacral plates are bordered with spines, of which three, divergent are in the borders of the ambulacral groove. One or two, small, are on the lateral border of the plates and 3 on the external border. Sometimes a spine rises from the central part of the plate. The spines of the ambulacral border are also the only ones with a constant number. — The ventral plates have some pointed scales that become thinner and denser on the borders and between the plates. A small number of obtuse and flattened spines are found among the scales. They become longer towards the external border of the plate, forming a marginal row of small spines, usually 3, above which are two longer, flattened and pointed spines.

The ventral plates clearly border the dorsal marginal plates. There are 30 on each arm, slightly elevated, nearly square, except in the area of the interbrachial arc where they are a little wider than long. The granules that cover them are very large, projecting and not contiguous. The first three or four interbrachial plates have, in the middle of their internal border, a vertical, very short conical spine. The spine that supports the triangular area at the end of the angle is a little larger than the others. This spine gradually becomes longer near the external border of the plate without however reaching it. At the base of the arms, the paxillar area is nearly 4 times the width of the marginal plates. The paxillae are small and formed of some central granules surrounded with a crown of six to eight small spines, slightly swollen at the top. They are, near the border of the arms, arranged in very clear transverse rows. At the base of the arms are fifteen paxillae from one border to the other. — The madreporite, not very apparent, has grooves, not very numerous and not radiating. It is separated from the marginal plates only by one or two paxillae, while there are twenty between them and the center, slightly elevated above the disk.

Alligator Reefs (Florida) at 147 fathoms.

IMPORTANT REMARKS

In the preceding descriptions, we often call *span* the distance between the ends of two arms separated by another, or, which amounts to the same, of two non-consecutive arms, and we call this length *E* in the abbreviated notations that we have used. In these same notations, *R* is the distance from the center of the disk to the end of an arm; *r*, the distance from the center of the disk to the angle or the interbrachial arc; we call *d*, the width of the arms where they meet when this is an acute angle.

GENERAL SUMMARY

The expeditions of the *Travailleur* and the *Talisman*, on the one hand, and the expedition of the *Blake*, on the other, have made very completely known the deep fauna of asteroids in the two opposite regions of the Atlantic, so that it possible to point out some contrasts that can be corrected, but that is useful to call attention and lead to new research. In the European-African region, the *Talisman* found six very distinct forms of *Brisinga*: 1° *B. coronata* Sars; 2° *B. Edwardsi* E. Perrier; 3° *B. squamosal* sp. nov., which more complete research will permit perhaps identification with the preceding, and whose arms, covered with dense plates, lack spiny circles; 4° *B. robusta* sp. nov., with robust and very spiny arms; 5° *B. elegans* sp. nov., small, with wide disk, with twenty relatively short and thin arms; 6° *B. hexacnemos* sp. nov., with six arms. To these forms, it is necessary to add a remarkable asteroid, *Coronaster brisingoides* sp. nov., with numerous arms and two rows of tube feet, like those of *Brisinga*, but whose skeleton is very clearly a skeleton of *Asterias*. Likewise, in the Mediterranean, the brisingids are represented only by a small and reduced form. The Caribbean Sea has, instead of the rich fauna that we just enumerated the types, has only the curious and so interesting *Hymenodiscus*.

The asteroids near *Ctenodiscus* with a more or less apparent peduncle, such as *Caulaster pedunculatus*, *Machairaster pictus* sp. nov., have keeled arms, with spines on the keel, and other forms allied with *Porcellanaster*, absent up to now in the Caribbean Sea, where the *Blake* has found only one species of *Pteraster* instead of the very numerous *Pteraster* and *Hymenaster* that the *Talisman* collected. In turn, the expedition of the *Talisman* has given us neither *Ctenaster*, *Radiaster* nor *Anthenoides*, so that the only generic forms common to the deep regions of the

Caribbean Sea and the African coast are *Pentagonaster*, *Dorigona* and *Archaster*, which appear to have on both side very similar aspects.

These contrasts and these similarities obviously are not definitive and call for more complete investigation. It would be premature to make a general conclusion. But it shows that, in spite of the stamp of uniformity shown by the deep fauna of all the seas, there is still, as in the littoral faunas, at least some stations whose animal population is not strictly the same. There is certainly, in this uniformity, a diversity whose extent would be of greatest interest to determine

EXPLANATION OF THE PLATES

PLATE I.

Fig. 1. — *Hymenodiscus Agassizii*, sp. nov., magnified approximately 2 times.

Fig. 2. — Disk of *Hymenodiscus*, T. P., magnified approximately 4 times and seen from below. *d*, teeth; *p*, spines supported by the teeth; *t*, tube feet.

Fig. 3. — Disk of the same seen from above. — *a*, normal ambulacral pieces; *b*, the first ambulacral pieces modified to form the crown that surrounds the disk; — *c*, appendix of the stomach probably corresponding to the interradiial caeca of *Asterias*; — *d*, circular lip surrounding the mouth; — *e*, adambulacral pieces; — *f*, membranous spaces between the ambulacral and adambulacral pieces; — *i*, origin of the radial caeca.

Fig. 4. — *Marginaster pectinatus*, sp. nov., magnified 2 times and seen from below.

Fig. 5. — The same seen from below.

Fig. 6. — *Marginaster echinulatus*, sp. nov., seen from above.

Fig. 7. — The same seen from below.

Fig. 8. — *Archaster simplex*, sp. nov., seen from below, magnified approximately 6 times.

PLATE II.

Hymenodiscus Agassizii E. P.

(Details.)

Fig. 1. — A marginal spine covered with its skin covered with crossed pedicellariae. *a*, spine; — *b*, skin that covers it; — *c*, pedicellariae.

Fig. 2. — Swollen part of the skin mass of the same spine more enlarged. *a*, skin; — *b*, peduncle of a crossed pedicellaria; — *c*, calcareous skeleton of this pedicellaria; — *d*, bipolar cells located at the base of the peduncle of the pedicellaria.

(Verick. — Ocular 1, objective 3.)

Fig. 3. — A portion of the same skin mass seen more magnified to show the fibrous mass that surrounds the spine and that sends bundles of fibers into the peduncle of each pedicellaria.

a, calcareous spine; — *b*, its skin envelope; *c*, bundles (muscular?) that go into the peduncle of each pedicellaria.

Fig. 4. — One of the crossed pedicellaria on the marginal spines.

a, skin of the pedicellaria; *b*, jaw or calcareous branch; — *p*, peduncle.

Fig. 5. — Another crossed pedicellaria opened to show the mode of insertion of the fibrous bundles of the peduncle, *p*, on the jaws, *m*.

Fig. 6. — Another pedicellaria opened and arranged to show the relations of the two jaws of the organ with the basal piece and the mode of insertion of the adductor muscles on the jaws.

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Fig. 7. — Basal piece of a crossed pedicellaria seen from one of surfaces in contact with the jaws.

Fig. 8. — The same piece seen from its upper border.

Fig. 9. — Another pedicellaria showing the nuclei of its skin.

Fig. 10. — Upper end of the jaw of one of the small crossed pedicellaria of the transverse folds of the dorsal skin, seen from its interior surface.

Fig. 11. — An entire jaw of one of these pedicellaria seen in profile.

Fig. 12. — One of the buccal spines with a large crossed pedicellaria. *a*, calcareous spines; — *b*, skin that covers it; — *c*, skeleton of the crossed pedicellaria with this spine; — *d*, basal piece; — *e*, adductor muscles; — *f*, abductor muscles; — *g*, peduncle of the pedicellaria.

Fig. 13. — One of the calcareous jaws of a buccal pedicellaria, more enlarged.

Fig. 14. — A buccal pedicellaria, decalcified. *a*, skin with numerous nucleated cells; — *b*, adductor muscles; — *c*, abductor muscles.

Fig. 15. — Basal piece of a buccal pedicellaria seen from its lower border.

Fig. 16. — The same seen from its upper border.

Fig. 17. — The same seen from one of its lateral surfaces.

Fig. 18. — One of the meshed plates that are contiguous in the dorsal skin and supporting the spines. *a*, calcareous trabeculae; — *b*, swollen and more solid part on which the spines are articulated (Verick. — Ocular 1, objective 2); this piece is seen from its interior surface.

Fig. 19. — Another meshed plate of the skin seen from its external surface. *a* and *b*, as above; — *c*, adambulacral pieces.

Fig. 20. — Some ossicles of the ambulacral grooves seen in profile from the external side, magnified approximately 4 times. *a*, ambulacral pieces; — *b*, adambulacral pieces.

Fig. 21. — Skeleton of the base of the arm seen from above. *a*, normal ambulacral piece; — *b*, shorter ambulacral pieces from the base of the arms; — *c*, pieces joining together the first ambulacral pieces. — *e*, lateral pieces representing the rudimentary marginal ossicles representing the lateral appendages of the following pieces that are the odontophoes.

Fig. 22. — Another part of the same groove, seen in profile from the internal side.

Fig. 23. — An isolated ambulacral piece seen from below by its internal surface.

PLATE III.

Fig. 1. — *Zoroaster Ackleyi*, sp. nov.

Fig. 2. — *Zoroaster Sigsbeeii*, sp. nov.

Fig. 3. — *Asterias fascicularis*, sp. nov.

Fig. 4. — *Pedicellaster Pourtalesi*, sp. nov.

Fig. 5. — *Asterias linearis*, sp. nov.

Fig. 6. — *Cribrella Antillarum*, sp. nov.

Fig. 7. — *Echinaster modestus*, sp. nov.

Fig. 8. — *Asterina pilosa*, sp. nov.

PLATE IV.

Fig. 1. — *Ophidiaster Floridæ*, sp. nov.

Fig. 2. — *Fromia japonica*, sp. nov.

Fig. 3. — *Goniodiscus pedicellaris*, sp. nov.

Fig. 4. — Young *Goniopecten intermedius*.

Fig. 5. — *Goniopecten demonstrans*, sp. nov.

Fig. 6. — *Cribrella sexradiata*, sp. nov.

PLATE V.

Fig. 1. — Disk and one of the arms of *Ctenaster spectabilis*, sp. nov., seen from above.

Fig. 2. — The same parts seen from below.

Fig. 3. — *Goniopecten subnullis*, sp. nov.

Fig. 4. — The same seen from below.

Fig. 5. — *Pentagonaster intermedius*, sp. nov., seen from above.

Fig. 6. — The same seen from below.

PLATE VI.

Fig. 1. — *Pentagonaster subspinosus*, sp. nov., seen from above.

Fig. 2. — The disk and one arm of the same seen from below.

Fig. 3. — An enlarged arm of *Pentagonaster Alexandri* dredged by the Hassler, seen from below.

- Fig. 4. — *Pentagonaster Alexandri*, dredged by the "Hassler", natural size.
 Fig. 5. — An arm of the same size, enlarged and seen from below.
 Fig. 6. — An enlarged arm of *Pentagonaster Alexandri* dredged by the *Blake*.
 Fig. 7. — *Pentagonaster Alexandri* (from Blacke), natural size.
 Fig. 8. — An enlarged arm of the same seen from below.
 Fig. 9. — *Solaster radians*, sp. nov., natural size.
 Fig. 10. — An arm of the same, enlarged seen from above.
 Fig. 11. — An arm of the same, enlarged seen from below.

PLATE VII.

- Fig. 1. — *Goniopecten intermedius*, sp. nov., seen from above.
 Fig. 2. — An arm of the same seen from below.
 Fig. 3. — *Pentagonaster arenatus*, sp. nov. seen from above.
 Fig. 4. — The same seen from below.
 Fig. 5. — *Pentagonaster intermedius*, sp. nov., variety, seen from above.
 Fig. 6. — The same seen from below.
 Fig. 7. — *Pentagonaster parvus*, sp. nov., seen from below.
 Fig. 8. — The same seen from below.

PLATE VIII.

- Fig. 1. — *Athenoides Peircei*, sp. nov.
 Fig. 2. — *Pentagonaster grenadensis*, sp. nov.
 Fig. 3. — *Pentagonaster grenadensis*, sp. nov.
 Fig. 4. — *Pentagonaster affinis*, sp. nov.
 Fig. 5. — *Korethraster palmatus*, seen from above.
 Fig. 6. — *Korethraster palmatus*, seen from below.
 Fig. 7. — *Archaster mirabilis*, variety, seen from above.
 Fig. 9. — *Archaster mirabilis*, variety, seen from below.

PLATE IX.

- Fig. 1. — *Radiaster elegans*, sp. nov.
 Fig. 2. — *Blakiaster conicus*, sp. nov.
 Fig. 3. — *Archaster pulcher*, sp. nov.
 Fig. 4. — *Archaster mirabilis* (spinose variety), seen from above.
 Fig. 5. — *Archaster insignis*, sp. nov., seen from below.

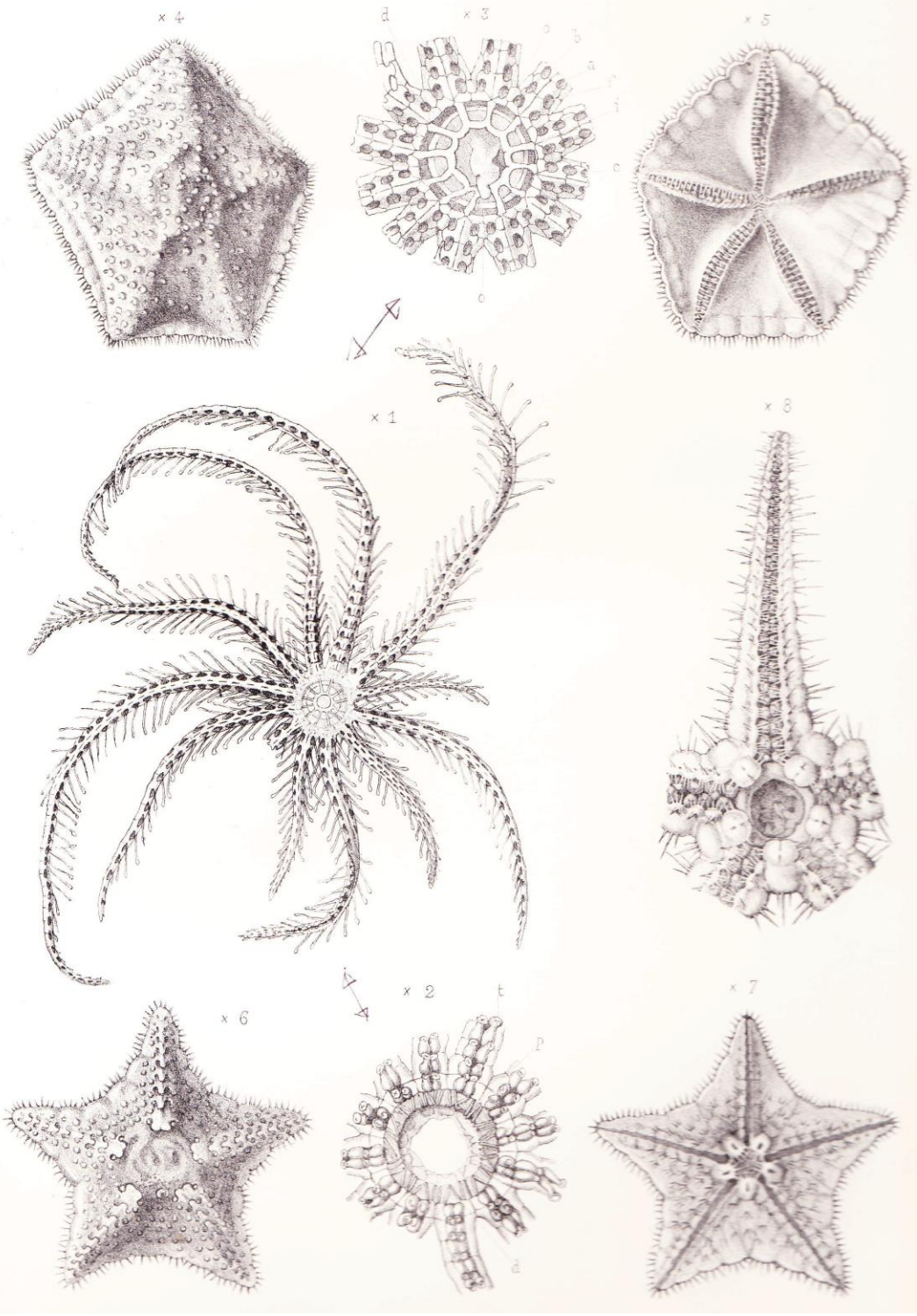
PLATE X.

- Fig. 1. — *Pentagonaster ternalis*, sp. nov.
 Fig. 2. — *Archaster mirabilis*, variety.
 Fig. 3. — *Archaster mirabilis*, variety.
 Fig. 4. — *Archaster echinulatus*, seen from below.
 Fig. 5. — *Archaster mirabilis*, variety.

Fig. 6. — *Luidia convexiuscula*, seen from below.

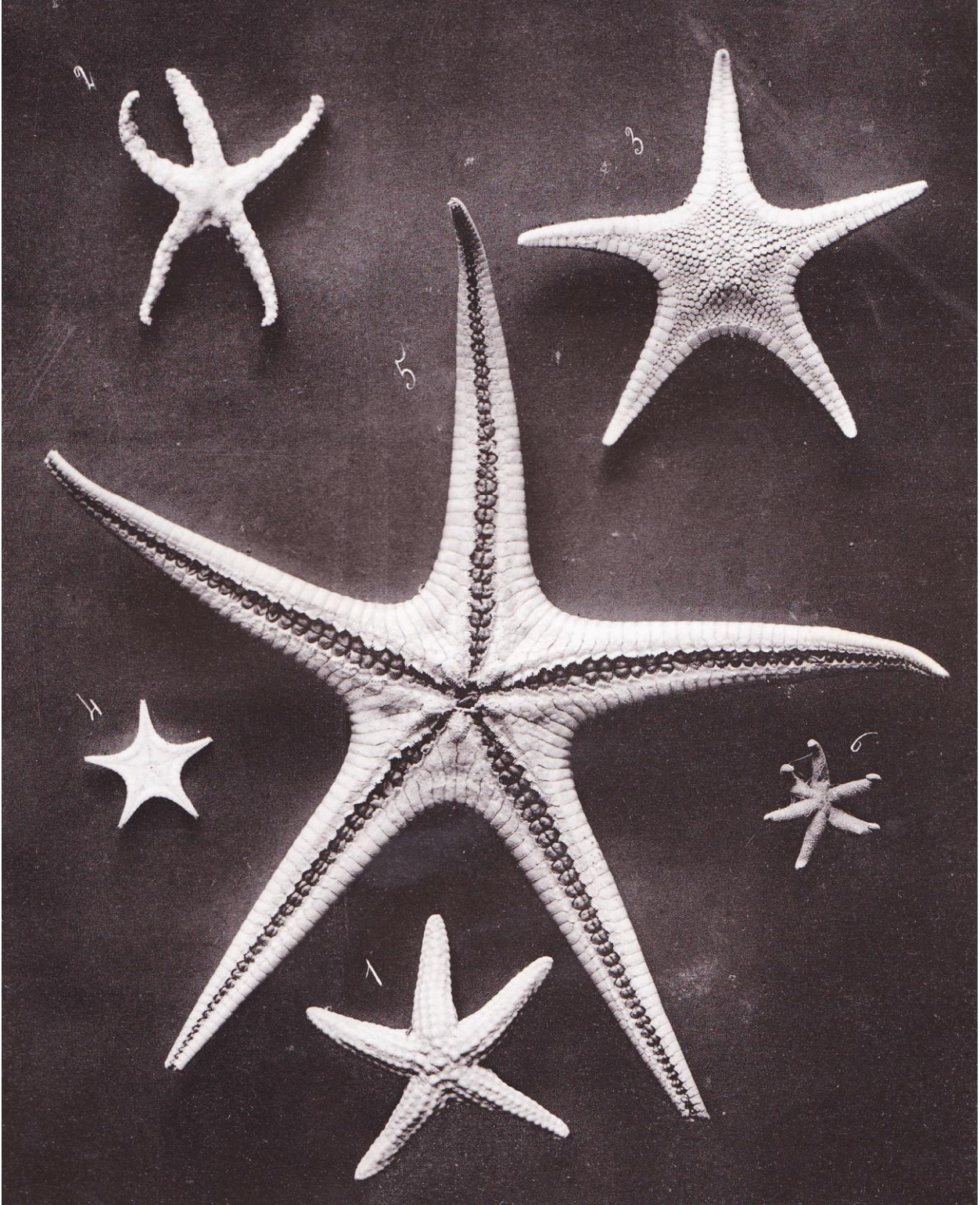
Fig. 7. — *Luidia barbadensis*, sp. nov., seen from below.

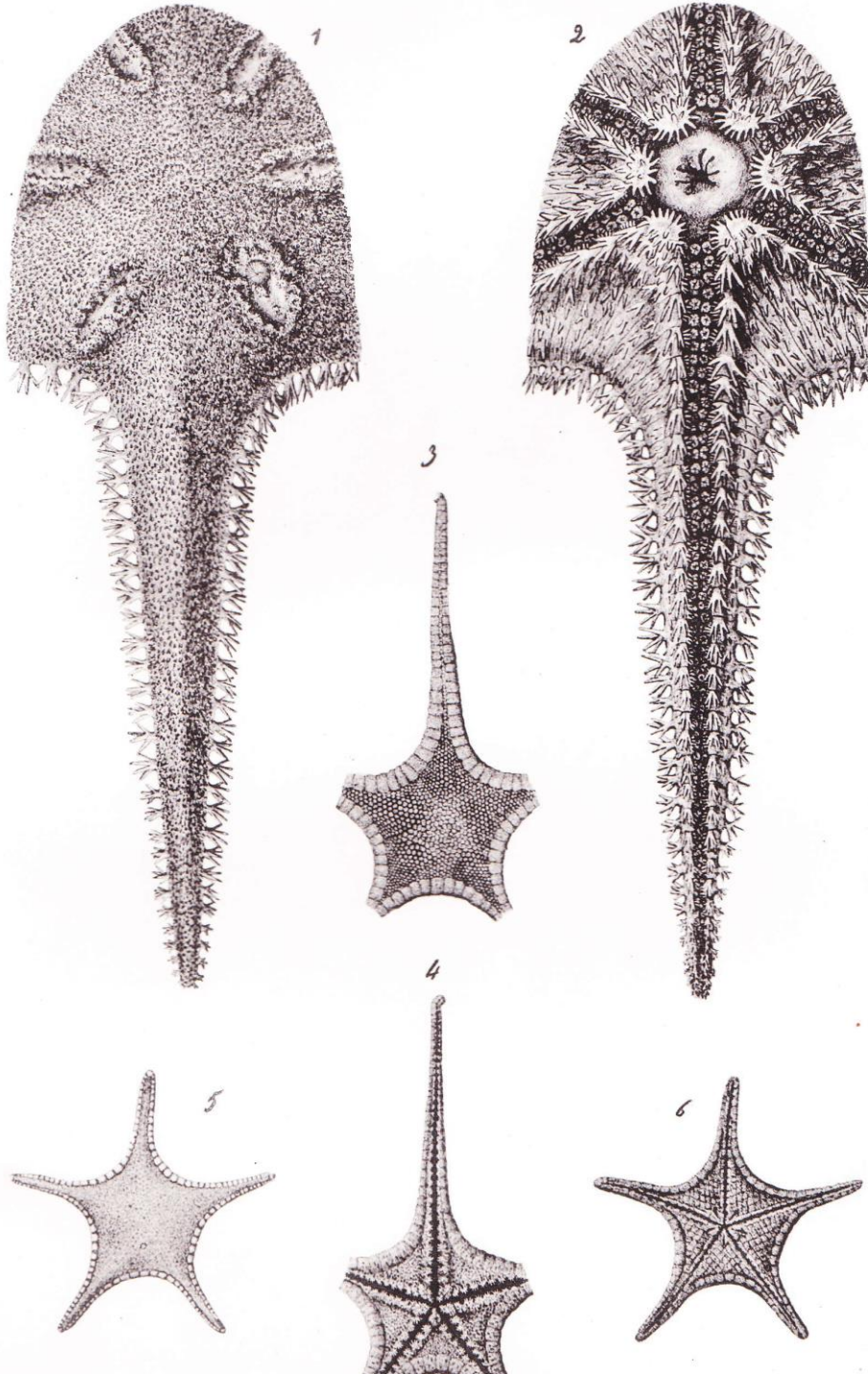
Plate 1

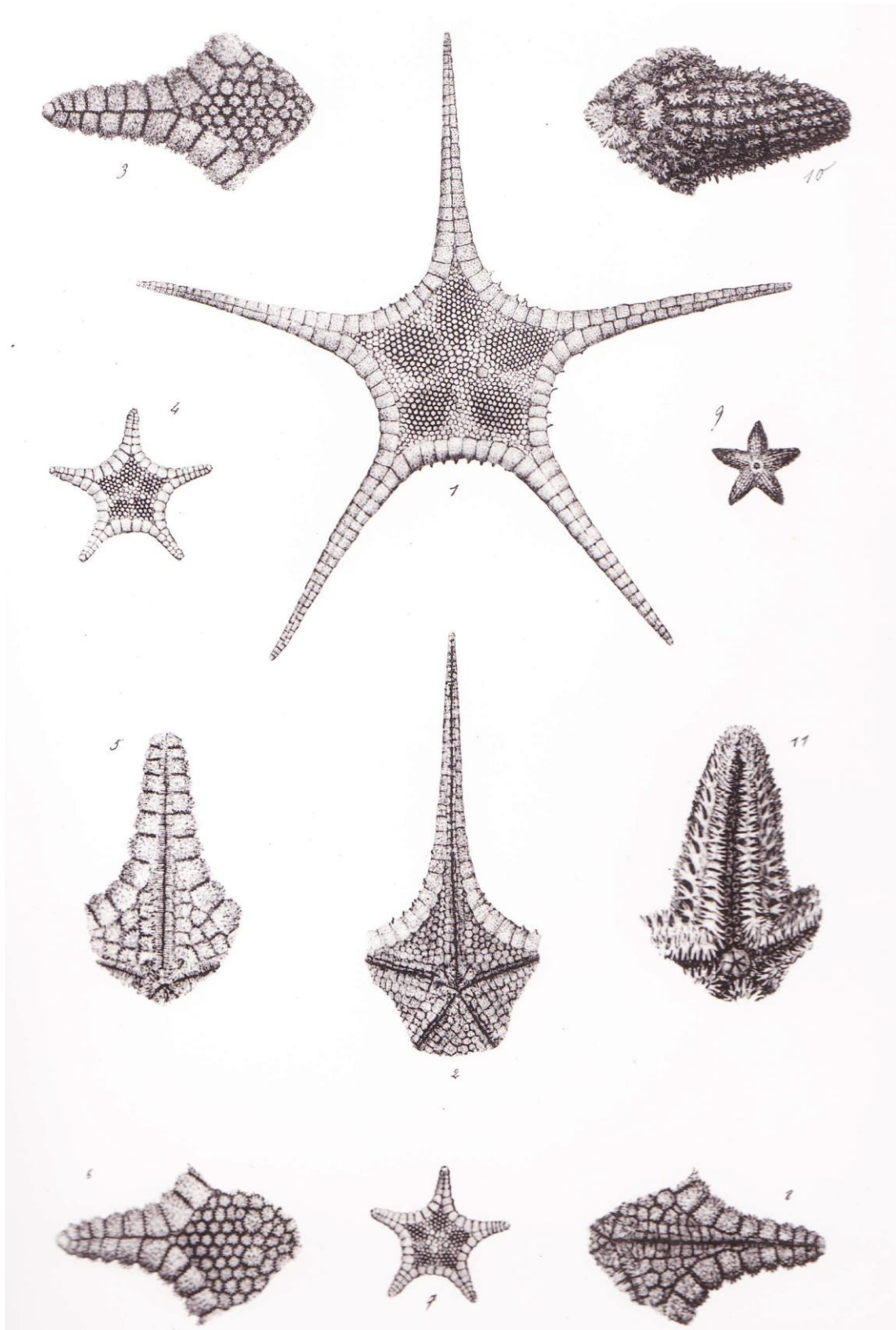


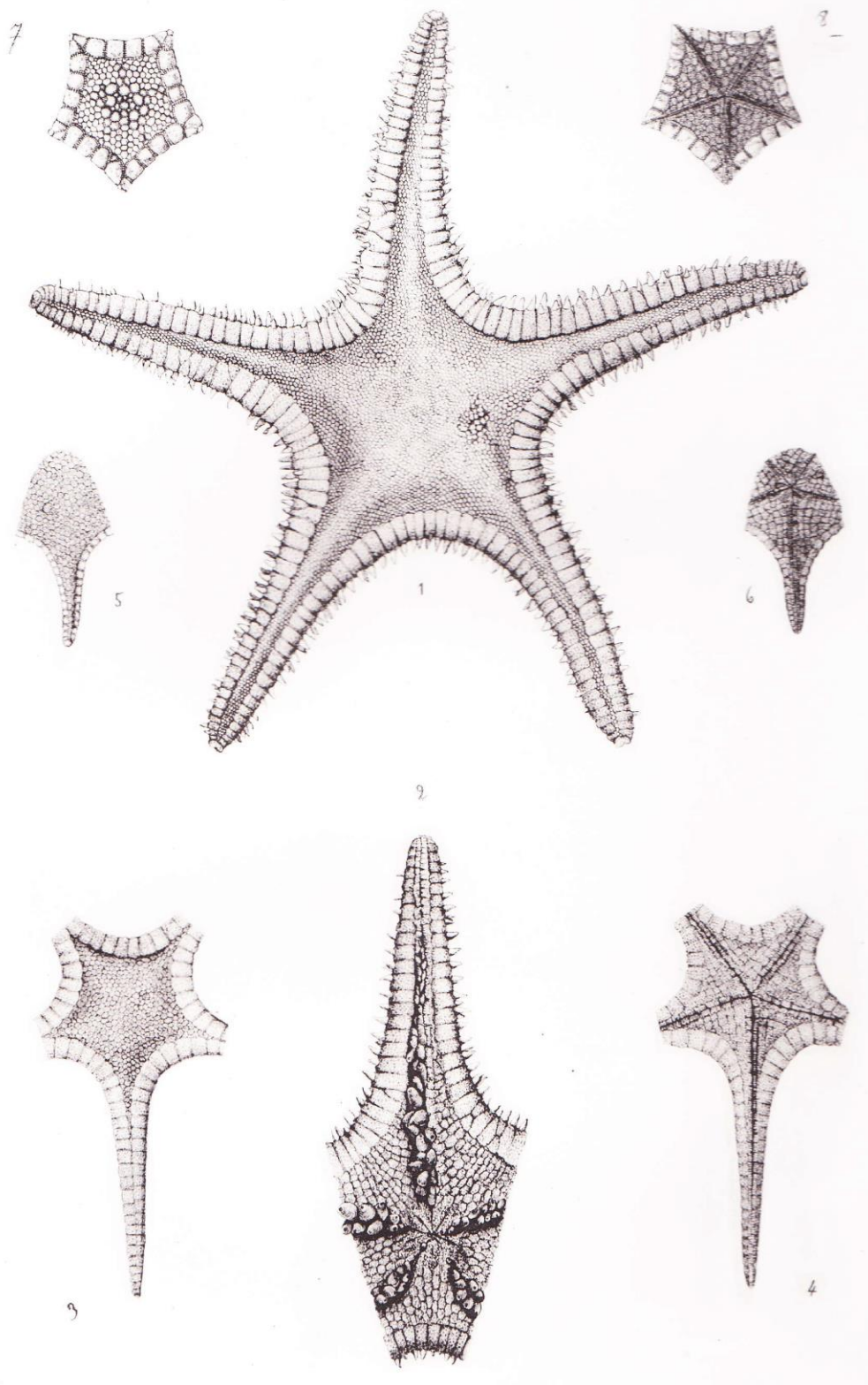












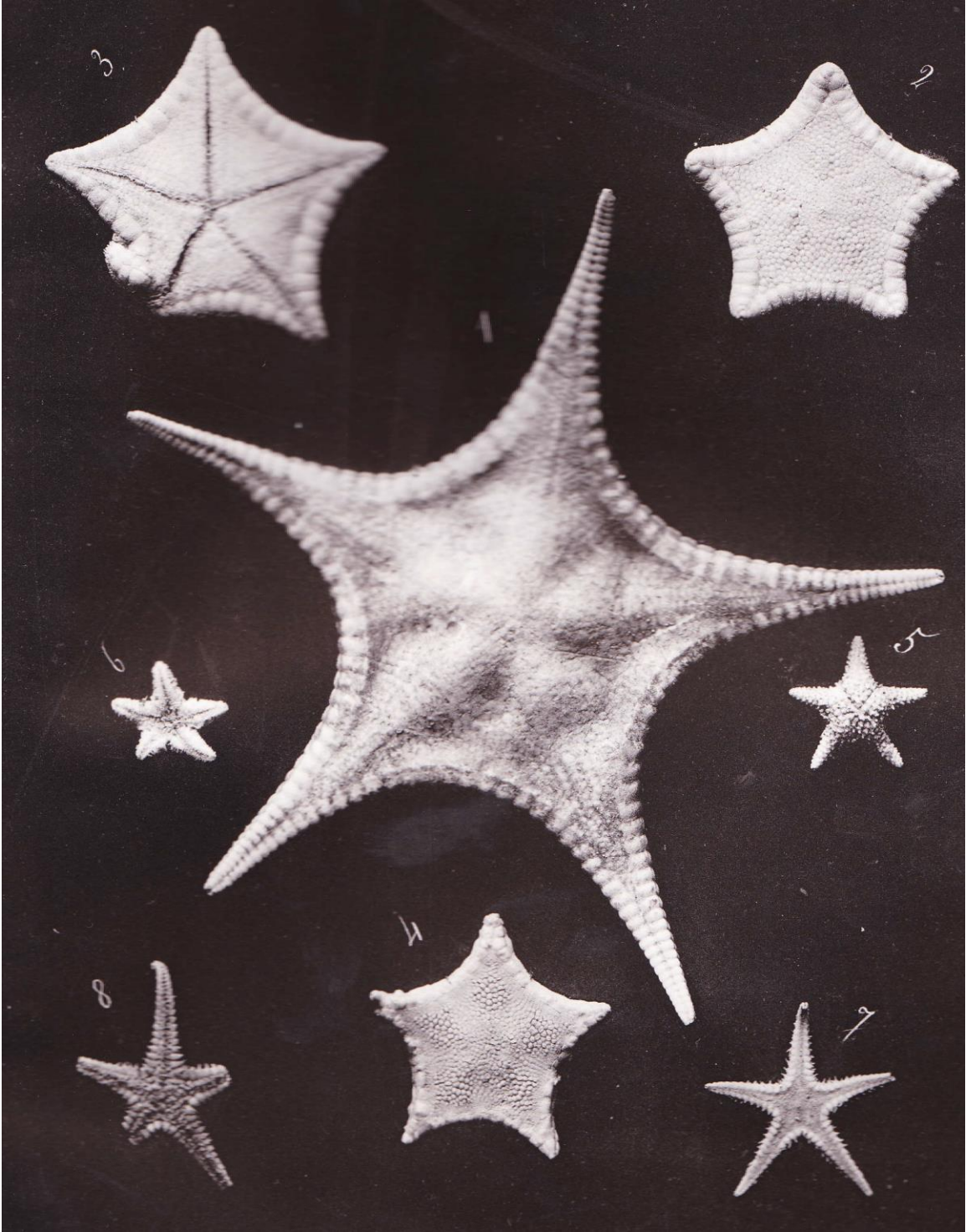


Plate 9

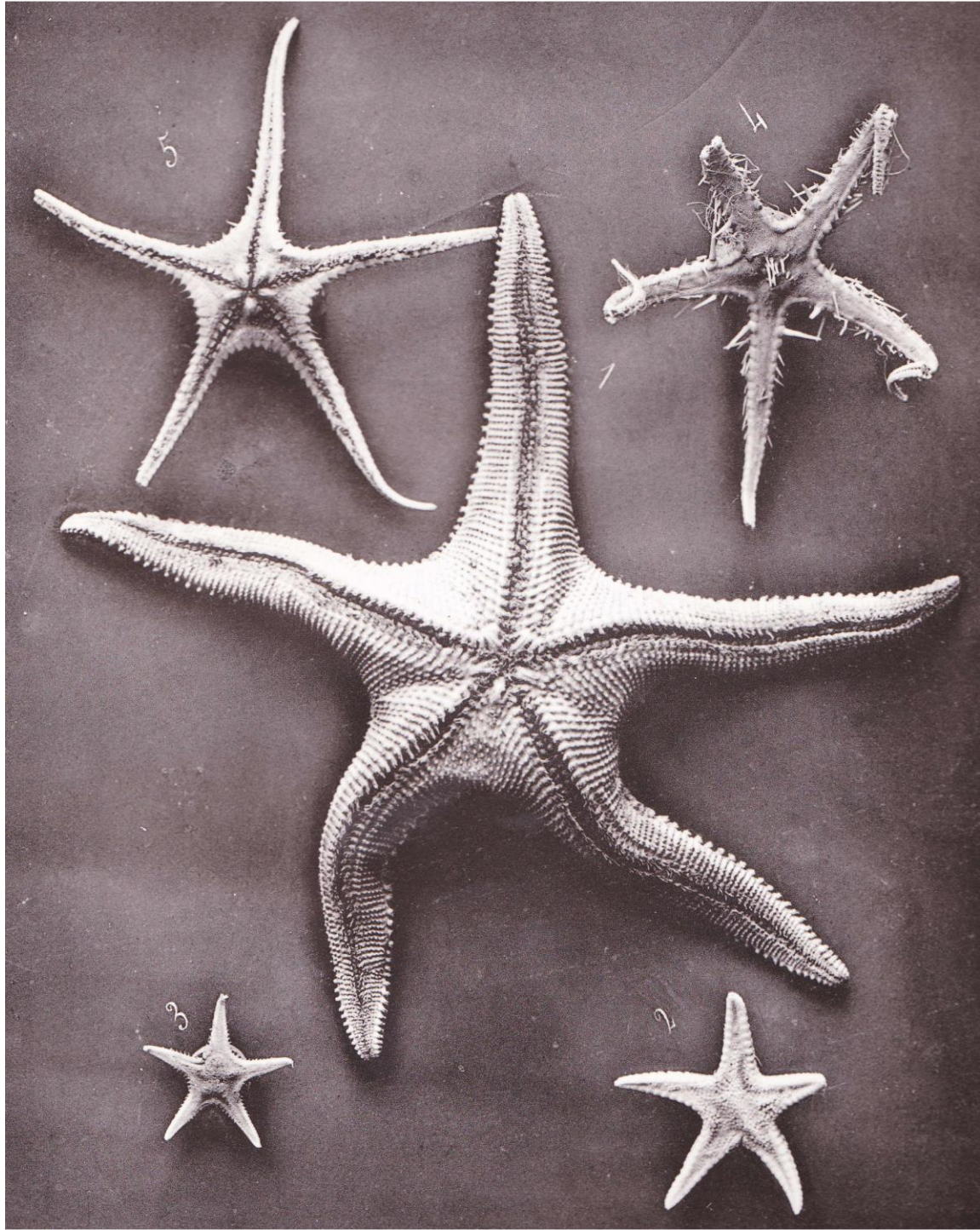


Plate 10

