RÉSULTATS

DES

CAMPAGNES SCIENTIFIQUES

ACCOMPLIES SUR SON YACHT

PAR

ALBERT Ier

PRINCE SOUVERAIN DE MONACO

PUBLIÉS SOUS SA DIRECTION

AVEC LE CONCOURS DE

M. JULES RICHARD

Docteur ès-sciences, chargé des Travaux zoologiques à bord

FASCICULE XI

Contribution à l'étude des Stellérides de l'Atlantique Nord

(Golfe de Gascogne, Açores, Terre-Neuve)

Par EDMOND PERRIER

AVEC QUATRE PLANCHES

IMPRIMERIE DE MONACO

1896

RESULTS

OF THE

SCIENTIFIC CRUISES

ON HIS YACHT

BY

ALBERT I^ST

SOVEREIGN PRINCE OF MONACO

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JULES RICHARD

Doctor of Science, in charge of zoological Works on board

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NUMBER 11

Contribution to the study of the asteroids of the North Atlantic
(Bay of Biscay, The Azores, Newfoundland)

By EDMOND PERRIER

WITH FOUR PLATES

IMPRIMERIE DE MONACO

Perrier, E. 1896. *Contribution to the study of the asteroids of the North Atlantic* (Bay of Biscay, The Azores, Newfoundland). Translated by John M. Lawrence

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.

Albert I (13 November 1848 – 26 June 1922) was Prince of Monaco and Duke of Valentinois. He was responsible for numerous oceanographic cruises of exploration and collection. In recognition of his achievements, the British Academy of Science made him a member in 1909 and the US National Academy of Science awarded him its Alexander Agassiz Medal in 1918.

Translator's note

The HIRONDELLE is THE SWALLOW.

Much of the taxonomy in the memoir is outmoded but the observations remain valid.

I have not altered Perrier's taxonomic names I have tanslated the common name stellérides, which Perrier used for the Class Stellérida, as asteroids. Perrier also used the term sea stars instead of stellérides.

I thank Michell Jangoux for assistant with some of the moe obscure of Perrier's terms.

I have not altered occasional apparent misuse of "ambulacral" for "adambulacral".

CONTRIBUTION

TO THE STUDY

OF THE ASTEROIDS

OF THE NORTH ATLANTIC

(Bay of Biscay, The Azores, Newfoundland)

BY

EDMOND PERRIER

FOREWORD

The number species of sea stars collected during the voyages of the HIRONDELLE is greater than thirty-five, separated among twenty-seven genera. Six of the species are new: one, *Pedicellaster parvulus*, belongs to a genus long known but still poorly defined. A second, *Stolaster neglecta*, made part of a section separated as a sub-genus of *Asterias* by Percy Sladen, but that I have believed should be elevated to the rank of genus by modifying the characteristic a little. The four others should be types of new genera. They are; *Progonaster*[1], *Grimaldii*, *Calycaster monœcus, Sclerasterias Guernei* and *Hexaster obscurus.* Six species are known only recently and make part of the series of species that live in the great depths. These are: *Brisinga coronata* Sars, *Neomorphaster Talismani* Perrier, *Pentagonaster crassus* Perrier, *P. Gosselini* Perrier, *Pontaster venustus* Sladen and *P. limbatus* Sladen. These six forms constitute, consequently, again excellent collections. The new genera belong respectively to as many different families or sub-families, those of *Zoroasterinæ*, *Stichasterinæ*, *Asteridæ*, *Pterasteridæ*.

The *Prognaster* are large sea stars with long, thin arms. They are notable: 1º by the constitution of the skeleton of the dorsal disk that has, as in the crinoids, a dorso-central, five small sub-basals, five large basals, after which come the first radials or carinals; 2º by the skeleton of their arms, whose carinal and dorso-marginals predominate in a remarkable manner over the other plates, to the number of eleven, that make each dorsal arc. Their plates do not have scales as in *Pholidaster* Sladen, but spines as in *Zoroaster*.

[1] Because of the inversion in the order of publication of my research, the diagnosis of the genus *Prognaster* was published in my Stellérides du TRAVAILLEUR et du TALISMAN, 1894, p. 85. I have previously described summarily *Prognaster longicauda* under the name *Zoroaster longicauda.*

The *Calycaster* are of very small size. Their ray is 5 to 18 mm. They are perhaps young of some form belonging to *Neomorphaster* Sladen. They are distinguished by the extreme simplicity of their skeleton, reduced: 1º for the disk, to a dorso-central and five basals, the five radials begin the carinal series; 2º for the arms, to carinals or dosal medians and to the double series of marginal The ambulacral skeleton has the normal structure. The tube feet are biserial. The crossed pedicellariae indicate that these small asteroids belong to the order *Forcipulata.*

The *Sclerasterias* are also of small size, but the development of all their parts seems to indicate they are adult. They are near *Stolasterias* by the arrangement in longitudinal rows of the pieces of their skeleton that, exclusive of the ambulacral skeleton, has three series of principal plates (carinals or marginal) and at least, between the dorsal marginals and the carinals, a row of dorso-laterals or intermediary dorsals.

Hexaster obscurus is part of the family *Pterasteridæ*. It is close to *Marsipaster* and *Calyptraster* of Sladen that were dredged by the CHALLENGER, the first between Valparaiso and Juan Fernandez, the second off the coast of Brazil. It comes from Newfoundland like *Pedicellaster parvuus* at a depth of 155m. This genus is remarkable, among all *Pterasteridæ*, by its six arms and by its convex, relativey resistant dorsal surface. It is disntinguished from *Marsipaster* by the shortness of its actino-lateral spines and by its independent supplementary buccal spines. The number of these spines (one instead of three per dental plate) separates it from *Calyptraster* and indicates a different form of teeth.

It was interesting, to rediscover at Newfoundland, a form of asteroid whose equivalents have been encountered only in southern seas.

The other new forms that we just indicated come from deep regions: *Progonaster Grimaldii* has been dredged to the north of the Azores at 2,870 m depth; *Calycaster monœcus* east of Flores (Azores) at 1,557 m; *Sclerasterias Guerrnei*, in the Bay of Biscay at 240 to 300 m.

By the simplicity in some theoretical way of the skeleton, *Prognaster* and *Calycaster* gives evidence of greatest interest for homologizing the skeletons of sea stars with those of other echinoderms and crinoids in particular. The skeleton of the disk is, in fact, is constituted exactly like the calyx of a crinoid. We have proposed (**7**[2], p. 8) to call *calicinales* the fundamental pieces that characterize this primitive skeleton. These pieces number $2n + 1$, if $n = 5$ and $2n + 1 = 11$ consequently.

The carinal pieces are the equivalent of the radials and brachials of the crinoids with five arms. As for the marginal and ambulacral skeletal pieces, so constant in asteroids, they are represented in crinoids only by the rudimentary formations that are often missing.

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[2] Characters in **bold** between parentheses, refer to numbers of the bibliographic index placed at the end of the work.

CLASSIFICATION

In 1884 (**2**. P. 154) in my *Mémoire sur les Etoiles de mer recueillies dans la Mer des Antilles et le Golfe du Mexique* during the expeditions of dredging directed by Alexander Agassiz, I proposed dividing the class of Asteroidea into four orders, based on the form of the pedicellariae and on the constitution of the skeletal integument. These four orders were the following:

Order I. — STELLERIDÆ FORCIPULATÆ: Pedunculate pedicellariae, formed of three pieces, a basal separated from the pieces of the basic skeleton, the other two forming a pincers. — tube feet often quadriserial. Ambulacral mouth frame. Families *Brisingidæ, Pedicellasteridæ, Heliasteridæ, Asteriadæ.*

Order II. — STELLERIDÆ ECHINULATÆ: Dorsal skeleton reticulated with mobile spines capable, in some cases, of prehension and constituting pincer pedicellariae, directly attached to the basic skeletal pieces like on the basal pieces. — tube feet biserial, adambulacral mouth frame. Families *Echinasteridæ, Pterasteridæ, Asterinidæ.*

Order III. — STELLERIDÆ VALVULATÆ: Pedicellariae with two valves implanted in an alveolus of basic skeletal pieces and capable of closing upon each other. Body bordered by a double row of marginal plates larger than the adjacent ones. Skeletal plates naked or simply granulose. — tube feet biserial, adambuacral mouth frame. Families *Linckiidæ, Gymnasteriadæ, Antheneidæ, Pentagonasteridæ*.

Order IV. — STELLERIDÆ PAXILLOSÆ: Dorsal skeleton formed of paxillae, ventral skeleton generally spinous. Large marginal plates constituting at least one ventral row. Teeth voluminous, elongated, projecting, forming an elongated oval clearly distinct from those of the plates. Families: *Archasteridæ, Astropectinidæ.*

In 1885, in my *Note préliminaire sur les Echinodermes dragué par le* TRAVAILLEUR *et le TALISMAN* (**3**), I modified the extent of some families, reserving until later giving the reason. In 1879, Dr. Camille Viguier, in his *Anatomie comparée du squelette des Stellérides* (**10**, p. 93) had divided the asteroids into two sub-classes, *ambulacral asteroids* and *adambulacral asteroids*, characterized by the buccal pieces whose most projecting ones were the first ambulacral pieces in the first sub-class, the first adambulcral pieces in the second. The sub-class ambulacral asteroids comprises the families of *Asteridæ, Heliasteridæ*, and *Brisingidæ,* of which another characteristic is the presence of straight or crossed pedunculate pedicdellariae. In this sub-class, the family *Brisingidæ* is uniquely characterized by the biserial arrangement of the tube feet. This division was established without considering *Pedicellaster* and *Brisinga* that Viguier had not been able to study. It is clear today that *Pedicellaster* is much nearer *Asteriadæ* than *Labidiaster* and especially *Brisinga*, themselves very close genera.

Pedicellaster is a true *Asterias* with two rows of tube feet. *Labidiaster* and *Brisinga* are separated from *Asteriadæ* by the number and form of their arms, the arrangement of the genital organs. The very clear contrast between the large, flat but raised disk and the arms and also by the tendency of skeletal pieces to be arranged in distinct rings, limited to the genital region of the arms, a character that, truthfully, is expected in *Labidiaster* I thus separated in 1884 (**2**, p. 194)

Pedicellaster from *Brisinga* to make the type of a special family, based on the number of arms, equal to or slightly above five. *Zoroaster* comes naturally to be placed in this family.

The discovery by the dredges of the TALISMAN of *Coronaster*, which is a *Pedicellaster* with nine or eleven arms; that of *Freyella sexradiata*, which is a brisingid with six arms, indicates that the number of arms has no distinctive value for the two families of *Brisingidæ* and *Pedicellasteridæ*. The skeleton with wide, square meshes of *Coronasater* recalls moreover that of *Labidiaster*. It was evident that by the discovery of these forms the distance between the two families is decreased. I thus returned in 1885 (**3**) to the point of view of Viguier. However, in placing *Coronaster* and *Pedicellaster* into the family *Brisingida*, I left *Zoroaster* outside, which, because of the particular construction of the skeleton, I united with *Stichaster* in a new family of *Stichasteridæ*.

In *Stichasteridæ*, the skeletal pieces are arranged in longitudinal series more or less becoming very large on the dorsal surface of the arms as on the disk so that there remains only a very small space between them. As a result, the walls of the arms take a thickness, a solidarity and an aspect so that they resemble a little the arms of *Linckiidæ*. In the same work, I have brought to three the number of families of the order of *Stelleridæ paxillosæ* and given the rank of family to the *Porcellanasteridæ*, which Percy Sladen had made a simple sub-family of *Archasteridæ*.

Some other modifications have been added to these dispositions in my Mémoire sur les Etoiles de mer du cap Horn (**6**). But this memoir was in press when appeared the work of Percy Sladen on the sea stars of the CHALLENGER. I have compared in an appendix printed after it the results of my research with those obtained by Percy Sladen. I shall not return there and pass immediately to the examination of the cuts proposed by the English scholar.

Percy Sladen declares that he rejects for various reasons all the classifications that preceded his. He divides the present asteroids that he calls *Euasteroidea* in the following way:

Class ASTEROIDEA

Sub-Class EUASTEROIDEA Sladen 1866

Order I. *PHANEROZONIA* Sladen 1866

Large marginal plates, well developed in the adult. Contiguous dorsals and the marginals and, in general, usually having their axes in the same plane. Papulae limited to the abactinal area (*Stenopneusia*). Ambulacral plates well developed, the development of the ambjulacral skeleton being slower or only as rapid as that of other parts of the body wall (*Eurystrosteria*). Adambulcral mouth frame. Valvular pedicellariae, foraminate or excavate.

Families: *Archasteridæ* (Viguier) Sladen 1886; *Porcellanlasteridæ* Sladen 1883; *Astropectinidæ* Gray 1840; *Pentagonasteridæ* Perrier 1884; *Antheneidæ* Perrier 1884; *Pentacerotidæ* (Gray) *emend.* Perrier 1884; *Gymnasteridæ* Perrier 1884; *Asterinidæ* (Gray) *emend*. Perrier 1884.

Order II. CRYPTOZONIA Sladen 1886

Indistinct marginal plates or more or less rudimentary in the adult. Supero-marginal plates often separated from the infero-marginals by intermediary plates and often having their axes in different planes. Papulae not confined to the abactinal area, but can also be found between the

marginal plates and on the actinal area (*Adetopneusia*). Ambulacral plates more or less appressed and narrow, the development of the ambulacral skeleton being frequently very accelerated in relation to the rest of the body wall in general (*Leptostrosteria*). Ambulacral of adambulacral mouth frame. Pedunculate or sessile pedicellariae (except in *Linckiidæ*).

Families: *Linckiidæ* Perrier *emend; Zoroasteridæ* Sladen 1888; *Stichasteridæ* Perrier 1885; *Solasteridæ* Perrier 1884; *Pterasteridæ* Perrier 1875; *Echinasteridæ* Verrill 1871; *Heliasteridæ* Viguier 1878; *Pedicellasteridæ* Perrier 1884; *Asteriidæ* Gray 1840 *emend.; Brisingidæ* Sars 1875.

This classification appears at first very different from that which Viguier and I have proposed. It relegates to the background the pedicellariae, the skeleton integument and the constitution of the mouth. It brings to the front the relative size of the marginal plates, the relative growth of the ambulacral skeleton and of the skeleton of the rest of the body and, this is the most novel fact, it gives great importance to the mode of distribution of the papullae on the body surface. Percy Sladen acknowledges that these three characters generally agree.

Basically, Percy Sladen is much nearer than it seems to his predecessors. I have already, in 1884 (**2**) introduced the marginal plates into the characteristics of orders III and IV of the class of Asteroidea (*Stelleridæ valvulatæ, S. paxillosæ*), so that the order of *Phanerozonia* of Percy Sladen is only the sum of my orders II and IV, as his order of *Cryptozonia* is only the sum of my orders I and II (*S. forcipulatæ, S. spinulosæ*). The differences are that Sladen classes *Asterinidæ* among the *Phanerozonia* and *Linckiidæ* among the *Cryptozonia.* But these modifications are scarcely happy, because the *Asterinidæ*, instead of having the basic character of *Phanerozonia,* which is to have very apparent large marginal plates, in general has only small ones. *Linckiidæ*. classed among the *Cryptozonia*, to the contrary, often has very apparent marginal plates and moreover, to maintain it among the *Cryptozonia*, P. Sladen is obliged to introduce, in that which concerns us an exception in the characters of this order. One cannot dispute that the general structure of their skeleton that is frequently paxillar, by the development of the buccal pieces, by the tendency of the integumentary skeleton with its development of spines, by the constitution of the pedicelleriae with the aid of these spines without important modification of plates that support them, the families *Archasteridæ, Porcellasteridæ, Astropectinidæ* do not form a homogeneous whole very different from that constituted by *Pentagonasteridæ, Antheneidæ, Pentacerotidæ, Gymnasteridæ,* so that the two orders that I have proposed are maintained. To the latter of these orders are attached naturally *Linckiidæ*, at the same time by the structure of the mouth, the constitution of the integumentary skeleton and their pedicellariae. The *Asterinidæ* appear to have more connections with *S. paxillosæ* than with *S. valvulatæ*. But these sea stars have also clear characters that does not permit placing them in any of these two orders. Moreover, they give a first example of the lack of concordance between the characters that Percy Sladen considers nearly equivalent, such as the exclusive distribution of the papulae and the large development of the marginal plates. In these conditions, being given the constitution of their dermal skeleton, there is in summary no reason to separate *Echinasteridæ,* to which are connected some forms of *Solasteridæ*, to bring *Archasteridæ* closer to them. We conserve consequently, as more natural than that of Sladen, the reunion of these families in the same order of *Spinuilosæ*. Since then, the division of the asteroids into four orders, such that we proposed in 1884, remains intact.

In the two orders of Sladen, the delimitation of families does not differ essentially from that I myself have adopted, as one can be assured by looking at his list. Their arrangement is little different in the order *Phanerozonia*. The three first families of this order correspond to my order of *S. paxillosæ*; the following four to my order *S. valvulatæ.* In the order *Cryptozonia,* there are greater differences, and in this regard, I believe my scholarly colleague is mistaken. Sladen, while

recognizing the mode of construction of the pedicellariae has taxonomic value, because he introduces them in the characteristics of his orders, does not give sufficient weight, in some cases, of the extent of this value. If the pedicellariae were no more than a form of spines or granules of the body wall, scarcely modified as is the case for the pedicellariae of *Archaster, Luidia, Asterina* and *Acanthaster,* I would understand at the very least that could not put great weight in the different modifications to appreciate the affinities of families, but when it is a matter of these organs as different as the straight and crossed pedicellariae of *Asteridæ* on one hand and the excavate pedicellariae of *Ophidiaster* on the other, when these complicated organs are found down to the least detail of their structure in certain types of sea stars, when especially these organs lack any known function, it seems their persistence is only a phenomenon of heredity, it is impossible not to see in them the equivalents of parchment that indicates an undeniable kinship. We do not believe, consequently, that one can disturb the homogeneity of the order *Forcipulatæ,* either by some dissociation or by the intercalation of disparate elements between the families that compose it. This is what our friend Percy Sladen does in placing *Linckiidæ* beside *Zoroasteridæ* and *Stichasteridæ* and in separating these two latter families from the other *Forcipulatidæ* from those that almost entirely compose our order *Spinulosæ*.

For us, the association of the families of *Brisingidæ, Pedicellasteridæ, Heliasteridæ, Asteridæ, Zoroasteridæ* and *Stichasteridæ* is one of the most natural and most unchallengeable that one can form in Zoology, it implies in an absolute manner the dissociation of the order *Cryptozonia* (= *Adetopneusia* = *Leptostrosteria*) of Sladen and the families that compose it. Once the order *Forcoipulatæ* is defined, one, that of *Linckiidæ,* should be transferred to the order *Valvulatæ*. The other families constitute, united to the *Asterinidæ,* the order *Spinulosæ*. Nothing prevents, certainly, of taking secondary weight in the arrangement of families of characters, however lacking are equivalents between them, which Percy Slladen has wanted to make primary, contrary to the opinion of all his predecessors to whom they were known, but to whom they did not have this degree of importance.

An attentive study of the numerical relationships shown by the diverse parts of the skeleton of asteroids shows moreover, between the last families associated by Sladen in the order *Cryptozonia,* differences of structure that we have not sufficiently considered and that, better known, could lead ultimately to modify the delimitation of presently recognized families and their place in the series. The skeleton of asteroids shows, indeed, constant parts whose reciprocal relationships have not been as rigorously examined as one could desire. They are:

1º the *ambulacral skeleton*, that include the ambulacral pieces, the adambulacral pieces, always of equal number and whose first ones make up the mouth frame.

2º the *marginal skeleton*, formed of a double row of marginal plates and the plates that can be found between them.

3º the *carinal skeleton*, formed of pieces in the median line of the arms and that we call *carinal pieces*.

4º the *ventro-lateral skeleton*, formed of pieces between the adambulacral skeleton and the lateral skeleton.

5º the *dorso-lateral skeleton*, formed of pieces between the marginal skeleton and the carinal skeleton.

6º the *calicinal skeleton* or disk skeleton, whose essential pieces are the dorso-central, the five basals, the five radials and the madreporite.

In general, the ventro-lateral skeleton is made up of the transverse arcs of plates that extend from the adambulacrals to the ventral marginals. The number of arcs never exceeds that of the

adambulacral plates. It can be equal to them. More often it is less and the transverse arcs increase every two, three or even more.

Each of these rows can in turn touch one distinct marginal or even two, three rows corresponding to one marginal.

The ventral marginal, the dorsal marginal and the carinals are usually the same number. The dorso-laterals that extend between the dorsal marginal and the carinals can also form regular transverse arcs whose number is equal or greater to those of the latter plates. But most often, these arcs are connected by longitudinal or oblique plates that connect successive arcs of plates, or displace them more or less so that the entire dorsal skeleton shows all transitions between a calcareous network with regular mesh, square or triangular, and a network completely irregular with a more or less dense mesh.

Likewise, the fundamental plates of the calicinal skeleton can remain clearly very distinct or no longer be recognizable, even with the greatest attention, among the other plates of the disk. At a young age and in a very small number of adult forms, they form nearly by themselves the calcinal skeleton, as in crinoids. Most often, secondary plates become intercalated among them and separate them more or less from each other. They often have a regular arrangement when the fundamental plates keep their predominance. They come together, to the contrary, in an absolutely irregular manner when they grow as quickly, or even more quickly, than the fundamental plates.

It is thus easy to find in the skeleton of sea stars some precise landmarks that make it possible to fix the form of descriptions of these animals and to clarify the right important variations to characterize more or less extended groups. I am only reminding myself of this point of view, which has been developed in my description of sea stars collected by the TRAVAILLEUR and the TALISMAN, but that are necessary to clarify here some consequences, in order to bring out clearly the relative value of classifications and to justify that we have adopted to classify the species collected by the HIRONDELLE.

In spite of the irregularities in the constitution of a dorsal network complex, in the greatest number of *S. forcipulatæ*, the ventro-lateral arcs, the marginal plates, the dorso-lateral arcs, the carinal plates have the same number so that, in the simplest form, the interambulacral skeleton is composed of successive arcs with their ends resting on the adambulacral plates (*Brisinga*). The first inferior plates of these arcs rest in general on the suture of two adambulacrals, and between two sutures supporting these arcs are most often two or three that do not support any. These arcs are naturally more or less separated, so that the adambulacrals are more or less long. The difference between the skeleton of *Brisinga* and those of other *S. forcipulat*æ, as we see, is completely secondary.

Stichaster aurantiacus and *Neomorphaster Talismani*, do not differ in this regard from typical *S. forcipulatæ*, of which *Progonaster*, *Pholidaster* and nearby forms differ only in the large size, at least at the base of the arms, of the calicinals, longer than the other pieces of the arcs.

Linckiidæ has an arrangement very different. The adambulacrals are followed by one (*Ophidiaster ophidianus O. pyramidatus*, *Scytaster Novæ Caledoniæ*), three (*Linckia miliaris*, *Fromia milleporella*), or four (*Chætaster longipes*) longitudinal lines of plates corresponding nearly exactly to the adambulacrals and constituting the ventral arcs. Two of these arcs abut the same marginal plates, from which they can be separated (*Ophidiaster pyramidatus* and others) by small intermediary plates forming a series equal in number to that of the marginal plates. There is thus here, between the ventro-lateral arcs and the rest of the skeleton, a contrast that is not seen in *S. forcipulatæ*. It could be that this contrast is a secondary phenomenon, and that the typical number of the complete arcs is the same as that of the secondary plates. Effectively, in *Ophidiaster*

ophidianus, one regularly sees alternating complete arcs of large plates and of very small plates, as if each latero-ventral arc is continued by a dorsal arc.

Each adambulacral piece supports a complete arc, all of whose constitutive parts (ventro-laterals, marginal, dorso-laterals, carinals) correspond exactly in some *Echinaster* (*E. brasiliensis*). In *E. sepositus* and *Cribrella*, the adambulacals the number is the same as the latero-ventrals or marginals, but the dorsal network is irregular and the carinals are indistinct. One can thus only say in these types, no more than in *Solasteridæ,* there was acceleration in the development of the ambulacral skeleton in relation to other parts of the skeleton. This characteristic is applicable only to *S. forcipulatæ,* that are thus distinguished so clearly, as they are distinguished by the structure of the buccal apparatus (Viguier) and by the width of their ambulacrum that remains open when the animal at repose and not contracted into a simple slit that entirely hides the tube feet, as in *Echinasteridæ, Linckiidæ* and most *Phanerozonia.*

It is clear from the preceding:

1º *Linckiidæ* has nothing to do with *Stichasteridæ and* Zoroasteridae.

2º These two families cannot be separated from other *S. forcipulatæ* that form with it a perfectly homogeneous order.

3º While *Linckiidæ* is related to *S. valvuatæ, Asterinidæ, Echinasteridæ,* and *Solasteridæ* form, for their part, a natural order.

We thus have nothing to change up to here to our divisions of 1884, and what we just said is sufficient to show the eminently artificial character of *Cryptozonia.*

Sladen has established only two new families, that of *Porcellanasteridæ* that I had erected as family while he only made them a sub-family *Archasteridæ* and that of *Zoroasteridæ*, that I included in 1884 among the *Stichasteridæ*. He distingished *Zoroasteridæ*is from *Stichasteridæ* by their adambulacral plates developed with carina in the ambulacum, by the presence on these plates of several spines arranged in transverse series, by the persistence of fundamental calicinal plates, and by the tendency of the dermal skeleton to take a spinous character instead of remaining granulose. These distinctive characters are not always of absolute clarity. Perhaps it would suffice to make *Zoroasteridæ* a second tribe and unite it with *Stichasteridæ,* which would itself become a single tribe of a family having this latter name. *Zoroasteridæ* appears to be, in summary, *Stichasteridæ* from deep regions. We would maintain them however at the rank of family, the two types appear presently in process of diverging instead of converging. I have already had occasion, in my Mémoire sur les Echinodermes du cap Horn (**8**), to explain the relations of the families of *Gymnasteriidæ, Asterinidæ* and *Solasteridæ.* There are no doubtful forms of these families in the collections of the HIRONDELLE. I shall recall only that the ventro-lateral skeleton of *Porania,* formed of arcs equal in number to those of the marginal plates, approaches the genus *Asterina* more than *Pentagonaster* and seems to justify its attribution to the family *Asterinidæ.* As for the family *Pedicellasteridæ* that I attached in 1885 to the *Brisingidæ,* under the impression that the discovery of *Coronaster* and the study that I had done on *Labidiaster,* I saw no real inconvenience in maintaining it. The species collected by the HIRONDELLE can thus be separated into orders, families, tribes and genera in the following way[3]:

[3] In this table I give, as in my Mémoire sur les Etoiles de mer du TRAVAILLEUR and TALISMAN, a neutral plural ending to names of orders and superior groups, following the rule that I have equally adopted in my *Traité de Zoologie* for all the Animal Kingdom.

Class STELLERIDA Perrier 1875

Sub-Class EUASTEROIDEA Sladen 1886

I. Order *FORCIPULATA* Perrier 1884

I. Family *BRISINGIDÆ* Sars 1875

1. Genus: *Brisinga* Asbjörnsen. — *B. coronata* O. Sars.

II. Family PEDICDELLASTERIDÆ Perrier 1884

2. Genus: *Pedicellaster* Sars. — *P. parvulus* Perrier.

III. Family ZOROASTERIDÆ Sladen 1888

3. Genus: *Prognaster* Perrier — *P. Grimaldii* Perrier.

IV. Family STICHASTERIDÆ Perrier 1891

4. Genus: *Calycaster* Perrier — *C. monœcus* Perrier.
5. Genus: *Neomorphaster* Sladen — *N. Talismani* Perrier.
6. Genus: *Stichaster* (Müller-Troschel) *emend.* Perrier — *S. roseus* Müller and Troschel.

V. Family ASTERIIDÆGray 840

7. Genus: *Sclerasterias* Perrier — *S. Guernei* Perrier.
8. Genus: *Asterias* Linné — *A. polaris* Gray, *A. rubens* Linné.
9. Genus: *Stolasterias* Sladen — *S. neglecta* Perrier, *S. madeirensis* Stimpson.

II. Order SPINULOSA Perrier 1884

VI. Family ECHINASTERIDÆ Verrrill 1871

10. Genus: *Cribrella* Agassiz — *C. oculata* (Linck) Forbes.

VII. Family SOLASTERIDÆ Perrier 1884

11. Genus: *Crossaster* Müller and Troschel — *C. papposus* Bruzelius.

VIII. Family PTERASTERIDÆ Perrier 1884

12. Genus: *Hymenaster* W. Thompson — *H. pellucidus* Perrier.
13. Genus: *Hexaster* Perrier — *H. obscurus* Perrier.

IX. Family ASTERINIDÆ (Gray) *emend.* Perrier 1884

14. Genus: *Palmipes* Linck — *P. membranaceus* Linck.
15. Genus: *Porania* Gray — *P. pulvillus* (O. F. M.) Norman.

III. Order VALVULATA Perrier 1884

X. Family LINCKIIDÆ Perrier 1884

16. Genus: *Ophidiaster* L. Agassiz — *Ophidiaster ophidianus* Lamarck.
17. Genus: *Chætaster* Müller and Troschel — *Chætaster longipes* Bruzelius.

XI. Family PENTAGONASTERIDÆ Perrier 1884

18. Genus: *Astrogonium* (M. and T.) Perrier — *A. annectens* Perrier.
19. Genus: *Pentagonaster* Linck — *P. crassus* Perrier, *P. Gosselini* Perrier, *P. granularis* Retzius.
20. Genus: *Mediaster* Stimpson — *M. stellatus* Perrier.

IV. Order PAXILLOSA Perrier 1884

XII. Family ARCHASTERIDÆ (Viguier) *emend.* Sladen 1886

21. Genus: *Pontaster* Sladen — *P. venustus* Sladen, *P. limbatus* Sladen.
22. Genus: *Dytaster* Sladen — *D. intermedius* Perrier.
23. Genus: *Plutonaster* Sladen — *P. inernis* Perrier, *P. granulosus* Perrier, *P notatus* Sladen.
24. Genus: *Tethyaster* Sladen — *T. sublinermis* Philippi.

XIII. Family ASTROPECTINIDÆ Gray 1840

1. Tribe ASTROPECTININAE Sladen 1888

25. Genus: *Astropecten* Linck — *A. aurantiacus* Phil., *A. serratus* Müller and Troschel
26. Genus: *Psilaster* Sladen — *P. Andromeda* Müller and Troschel

2. Tribe LUIDIINAE Sladen

27. Genus: *Luidia* Forbes — *L. Sarsi* Düben and Koren.

LIST OF SPECIES

BY LOCATON AND BATHYMETRIC DISTRIBUTION

Bay of Biscay

Stichaster roseus Müller and Troschel ……	136–166 m
Sclerasterias Guernei E. Perrier ……..	240–300 m
Stolasterias neglecta E. Perrier ……...	166 m
Asterias rubens Linné ……..	63 –147 m
Palmipes membranaceus Linck …….....	130–248 m
Porania pulvillus (O. F. M.) Norman …….	136–180 m
Chætaster longipes Bruzelius …….	135–248 m
Pentagonaster crassus E. Perrier ……	248 m
Tethyaster subinermis Philippi ……	155 m
Astropecten serratus Müller and Troschel ……..	63–185 m
Astropecten aurantiacus Philippi ……..	63 m
Luidia Sarsi Düben and Koren …….....	134–300 m

Azores

Brisinga coronata O. S. Sars ……..	2870 m
Prognaster Grimaldii E. Perrier …….	2870 m
Calycaster monœcus E. Perrier …….	1557 m
Neomorphaster Talismani E. Perrier……..	1266–1348 m
Stolasterias madeirensis Stimpson …….	tidal
Asterias polaris Gray ……..	tidal
Cribrella oculata (Linck) Forbes ……..	1266–1557 m
Hymenaster pellucidus E. Perrier ……...	2870 m
Ophidiaster ophidianus Lamarck ……	tidal
Pentagonaster Gosselini E. Perrier …….	1266–1557 m
Pentagonaster granularis E. Perrier ……...	1384 m
Pontaster venustus Sladen ……..	1266–1557 m
Dytaster intermedius E. Perrier ……..	2870 m
Plutonaster granulosis E. Perrier ……	1384–1557 m
Plutonater notatus Sladen ……...	1266 m
Psilaster Andromeda Müller and Troschel …….	1300–1384 m

Newfoundland

Pedicellaster parvulus E. Perrier …….	155 m
Cribrella oculata (Linck) Forbes ……...	155 m
Crossaster papposus Bruzelius ……..	150 m
Hexaster obscurus E. Perrier ……..	155 m
Mediaster stellatus E. Perrier ……..	1267 m
Pentagonaster granularis Retzius ……..	1267 m

Pontaster limbatus Sladen …….. 1267 m

DESCRIPTION OF SPECIES

Class STELLERIDA Perrier 1884

Echinoderms with star-shaped or pentagonal form, with ventral ambulacrum, without protective calcareous plates, having two or four rows of smooth tube feet usually ending in a sucker. Arms ordinarily slightly mobile laterally.

Sub-Class EUASTEROIDA, Sladen 1866

Opposite ambulacral plates.

I. Order FORCIPULATA, Perrier 1884

Pedunculate straight and crossed pedicellariae. Skeletal plates with spines, often long and isolated, around which are usually arranged crossed pedicellariae. Marginal plates little apparent. Skeletal arcs separated from two or three adambulacral plates, formed of series of pieces corresponding in the ventral, marginal and dorsal regions of the body.

I. Family BRISINGIDÆ, Sars 1875.

Elongated, fusiform arms, slightly attenuated at the base, ending in an obtuse point, attached to a clearly distinct circular disk, and on the border of which rounded, large plates are very visible in the interradial angles. Biserial tube feet. Elongated ambulacral and adambulacral plates. Skeleton of the arms constituted by arcs often limited at their ovarian region, supported on adambulacral plates at the suture of two consecutive plates. One arc for every two sutures at a maximum. Sometimes with intercalated arcs but not reaching the adambulacrals. A large semi-circular plate at the end of the arms. Openings of the genital organs lateral.

Genus **Brisinga** Asbjörnsen 1856

Dorsal skeleton of the arms form of separated skeletal arcs, limited to the ovarian region Very apparent basals. No papulae on the disk.

Brisinga coronata O. Sars

Cruise of 1888: Stn. 248, depth 2870 m. To the north of the Azores.
Fragments of the arms of a young individual.

II. Family PEDICELLASTERIDÆ, E. Perrier 1885

Arms of average length, conical, continuing insensible with the disk. Basal plates of the disk indistinct. Biserial tube feet, ambulacral and adambulacral plates of average size. Reticulated dorsal skeleton, extending the entire length of the arms.

Genus **Pedicellaster**, Sars 1861

Pedicellasteridæ with five or six arms, with dorsal reticulated skeleton.

Pedicellasteridæ presently designated under the name of *Pedicellaster* have a very extended area of distribution. But as Sladen (**9**, p. 557) remarked, it is possible that the genus should be subdivided. The first known species of this genus has crossed pedicdellariae. The straight pedicellariae located in the ambulacra have been reported in *P. margaritaceus* Perrier, *P. sexradiatus* Perrier, *P. inæqualis* Perrier, *P. hypernotius* Sladen and in the following species, *P. parvulus*. The species having two kinds of pedicellariae appear, in summary, up to now, more numerous than the others.

Pedicellaster parvulus, Perrier

(Pl. I, fig. 3, 3a)

1891. *Pedicellaster parvulus* PERRIER (**5**), p 258.

Cruise of 1887: Stn. 162, depth 155 m. Fourteen specimens.

Five arms. — R = 18 mm; r = 4 mm; R = 4.5 4.

Tube feet very appressed at the base of the arms to appear staggered, then clearly biserial.

Each tooth with a very long cylindrical spine.

Adambulacral plates in each ambulacrum with a small straight pedicellaria and, on their ventral surface, two spines smaller than the tooth spines, obtuse of thin at the end, slightly divergent with one behind the other to form a double series on each side of the ambulacrum. External spine larger than the internal.

Immediately outside the ambulacral plates, a row of plates alternate with them, but occurs every two sutures only. Each has a cylindrical spine, thinner than the ambulacral spines, surrounded by a double or triple circle of crossed pedicellariae (ventral marginals or initials of the arcs).

Dorsal marginal plates correspond exactly to these initial plates and has like them a cylindrical spine, surrounded at its base with a multiple crown of crossed pedicellariae and resting on them by inferior apophysis. In the region occupied by these apophyses, the integument forms a groove without spines and pedicellariae, but having a row of very large isolated papulae, each located in the frame circumscribed by the marginal plates and the inferior apophyses of the marginal dorsals.

Dorsal integument very thick, allowing the plates to be distinguished only in an indistinct fashion.

III. Family ZOROASTERIDÆ, Sladen 1888

Forcipulata with skeleton formed of calcareous plates, thick, very large, often arranged in rows both longitudinal and transverse, giving to the wall and disk a very firm consistency and great thickness. Plates uniformly covered with granules often interspaced with spines.

Unequal adambulacral plates have every other one, in the adult, a projecting ridgde into the ambulacral grove. Skeletal arcs contiguous. Carinal plates of one arc most often encroaching on another. Plates of the actinal skeleton ordinary have small, flat articulated spines. Original calicinal plates ordinarily very distinct from others and can form nearly all the dorsal skeleton of the disk. Sparse straight pedicellariae on the dorsal skeleton. Other larger ones on the ambulacral spines. Suckers of the tube feet ordinarily small. Tube feet arranged most often in four rows at the base of the arms, two at the end that is ordinarily pointed.

It is because the biserial arrangement of the tube feet in the approximately last third of the arms that, seeing the importance of this character, I have attached *Zoroaster* to *Pedicellasteridæ* before establishing the family *Stichasteridæ*, principally based on the constitution of the skeleton. By simply mentioning that *Zoroasteridæ* have quadriserial tube feet, Percy Sladen does not give this characteristic sufficiently rigorous exactness. He figures *Zoroaster fulgens* without two rows of tube feet at the end of the arms.

Genus **Prognaster**[4]**,** Perrier 1891

Tube feet in two series, slightly sinuous, with normally developed sucker.

Arcs of the dorsal skeleton formed of eleven pieces. The carinals longer than their neighbors and often making part of two consecutive arcs. A lateral row of plates more conspicuous than the others because, instead of being imbricated, they cover in the part where they touch the borders of two plates of the same arc between which they occur. Calicinal pieces very conspicuous on the skeleton of the disk. The basals, larger than the infrabasals, nearly separate the radials. Abactial plates with sparse, long, thin, mobile spines.

By the arrangement of their skeleton, *Prognaster* recalls *Pholidaster* of Percy Sladen (**9**, p. 426, pl. LXVII, fig. 5–7 and pl. LXVII, fig 5–6). They have, like them, very large carinal plates and on each side a longitudinal series of plates, probably dorsal marginals, much larger than the others. The disproportion between the three series of plates and their neighbors is much more marked than in *Zoroaster* and, moreover, the arrangement of the large marginal plates is particular. In addition, the quadriserial arrangement of the tube feet is scarcely indicated at the base of the arms. The abactinal integumentary skeleton, spinous and not scaly, recalls that of *Zoaroaster* rather than of *Pholidaster*. *Prognaster* occupies thus an intermediary position between these two genera. It is necessary to add that *Prognaster* has straight pedicellariae like *Zoroaster*, while these organs are missing in *Pholidaster*, according to Sladen.

Prognaster Grimaldii, Perrier

(Pl. II, fig 1, 1[a], 1[b])

1891. *Prognaster Grimaldii*, Perrier (**5**), p. 258.

Cruise of 1888: Stn. 248, depth 2870 m. One specimen.

Five long, thin arms. R = 135 mm; r = 9 mm; R = 15 r.

[4] From Πρόχνη, Hirondelle.

Buccal area small. Biserial tube feet, but with slightly sinuous and tending, consequently, towards quadriserial arrangement. Sucker at the end of the tube feet nearly the same diameter.

Very large dental plates, each with an angular spine and a vertical adambulacral spine, and two subambulacral spines, one placed immediately behind the angular spine, the other at the level of adambulacral spine, *all perfectly independent. None of them with pedicellariae.* Two other very large spines are behind on the ventral surface.

Elongated adambulaclral plates perpendicular to the ambulacrum and approximately two times longer in that direction than in the direction parallel to the ambulacrum, separated by a wide ligamentous area. From the external side they are flush with the length of the same longitudinal line. From the internal side, they are slightly keeled and projecting into the ambulacral grove so that the keels pass between two consecutive tube feet. I have not been able *to distinguish any differences between the consecutive plates* that are present in most *Zoroasteridæ*. Each plate has at the end of the keel a very strong, pointed spine, usually folded onto the ambulacrum between two tube feet and with a bunch of straight pedicellariae. At the base of the arms, pairs of tube feet are alternatively placed at the level of the keels and into their interval. It results in a slight displacement that makes these tube feet appear quadriserial. But after the twentieth adambulacral, they appear simply biserial. On the ventral surface, each adambulacral plate has a transverse or slightly oblique comb of three flat, pointed spines, the point directed outside and towards the end of the arms. These plates nearly keep their length but decrease towards the ends of the arms so that their free surface is less and less apparent. Their spines persist however, but are reduced to simple tubercles. None have pedicellariae. The condition of the individual I examined could explain this absence.

The dorsal arcs correspond to about three adambulacral plates. These arcs are contiguous so that the dorsal surface is supported by calcareous plates. These plates of the arcs merge from one arc to the other. As a result, the dorsal plates can be considered either as arranged in longitudinal rows or transverse arcs.

Each of these arcs is formed, on each side, of plates that correspond exactly and the most elevated appear on a dorsal median. But the dorsal medians are longer than the adjacent plates so that the same median ordinarily is part two successive arcs.

Considering the ambulacrum as below, the four first plates of each arc (ventro-lateral plates) are imbricated so that the upper border of each one goes under the lower border of the following. The apparent surface of the first plate is small. That of the second plate is a little larger. That of the upper third is equal to the sum of the two preceding surfaces. The fourth plate is finally entirely visible. Its upper surface passes onto the lower border of the fifth plate, as its lower border passes onto the border of the third. The form of the plates of this fourth row is an oval whose two axes are nearly equal and whose small end is directed towards the base. These are probably the dorsal marginals.

Each of these four plates has, nearly in their center, a very long conical spine. The ensemble of spines corresponding to each arc thus forms, at the lower surface of the arms, a transverse row of four spines Some much smaller spines surround, on each plate, a single circle at the base of the large spine, so that the principal row of each arc is detached in the middle in a bunch of small spines.

The plates of the fifth and the sixth rows, larger than the preceding and keeping the mode of imbrication, can be considered as dorsal and ventral marginals. They are of slightly unequal form, with short and rounded arms. These plates are covered with small spines. *There is no central spine larger than the others*. In each longitudinal row of the marginals, the distal; border of a plate passes

under the proximal border of the following. Between the two rows of marginals are isolated papulae, located in the spaces circumscribed by the angles of the plates. The upper border of the dorsal marginal is free like their lower border, the complete surface of these plates is thus visible. The row of dorsal marginal is separated from that of the carinals only by a row of dorso-laterals with small spines and some isolated straight pedicellariae. These dorso-laterals correspond to the dorsal marginals that cover their lower border as the carinals cover their upper border. Isolated papulae alternate with these plates that are thus located between two regular rows of papulae, separating them on one hand from the dorsal marginal and on the other from the carinals. The carinals are notably longer than wide and have shallow notches that cut out six rounded lobes. *Each of them corresponds to approximately two ventro-lateral arcs*, or to at least one so that the row of carinals is perfectly distinct. These plates have in the center a mobile conical spine and are contiguous with each other rather than imbricated. The rest of their surface is covered with small spines. The first carinal is larger than the others. It is a *radial* separated from the centro-dorsal by a *sub-basal*. The *basals* alternate with the radials and appear a little larger. But in the specimen I describe, the arrangement of the calicinals is a little irregular.

In summary, the skeleton of the disk is composed of: 1º a dorso-central; 2º five very small radials (sub-radials); 3º five interradials (basals) that nearly reach and separate, consequently, the radials of the disk of the first carinals or first radials (true radials) of the arms These plates have small spines like those of the plates of the arms, but without a central spine or tubercle. They can have rare straight pedicellariae.

The madreporite is small, round, without a flange, marked with a small number of irregular projecting sides of the same width as the grooves.

On the disk are small isolated papulae between the radials and the interradials. On the arms, the papulae are also isolated and form three regular rows on each side of the arms. The papullae of the two lower rows are in the upper angles of the plates of the third and fourth row. The papulae of the upper row are in the angles of the dorsal medians. They are less constant than those of the two other rows.

Remark. — This species is one of the most beautiful that has been collected by the HIRONDELLE. I ask S. A. S Prince Albert de Monaco to kindly accept the dedication. I dedicate, at the same time, in its generic name the memory of the HIRONDELLE[5] whose cruises made it known.

It is in my Travail sur les Etoiles de Mer du TALISMAN that this genus was described. A very analogous species, which I first classified in the genus *Zoroaster*, was indeed collected by the TALISMAN in the waters of the Azores and the Cape Verde Islands. The new species is distinguished by its shorter and yet thinner arms and by other characters indicated in italics in the text.

IV. Family STICHASTERIDÆ E. Perrier 1884

The adambulacral plates are all alike, without a projecting keel into the ambulacrum. Contiguous skeletal arcs. Carinal plates do not overlaps from one arc to another. Actinal and abactinal plates covered with granules. Original calicinal plates of average size or indistinct.

Straight and crossed pedicellariae (at least in true *Sticihasteridæ*). Tube feet ordinarily quadriserial, especially at the base of the arms, with normally developed sucker.

[5] From Πρόχνη, Hirondelle.

In the family *Sticihasteridæ*, Percy Sladen placed the three genera *Stichaster, Neomorphaster* and *Tarsaster.* The characters of the genus *Stichaster* not being given in his *Report*, it is difficult to know the fundamental characters he used to create, at the expense of the initial genus of the family, the two new genera *Neomorphaster* and *Tarsaster.* I suppose that the great development of the calicinal plates, always very apparent on the dorsal disk in these two genera, is one of the most important characters that distinguishes *Stichaster*. In the same genera, the carinal plates form a very clear row that can be indistinct in the true *Stichaster*. The absence of ventro-lateral plates distinguishes *Tarsaster* from *Neomorphaster*, which has at least a series of them between the adambulacrals and the lower marginal. But I cannot reconcile fig 8 of Pl CIV from *Report on the Asteroida* (**9**) with the description given on page 441 in the same region in the text. The figure shows, indeed, outside the ambulacrum, a row of large spines, *almond shaped, inserted on two consecutive plates, one plate separating other pairs of plates*. There is nothing in the text about this remarkable arrangement. I find there only the following statemets:

"Immediately outside the ambulacral plates, contiguous and not separated by spines, is a longitudinal series of small plates that represent the inferomarginals. *Each has a short spinule, almond shaped, directed horizontally, forming a regular row of lateral spines at the extreme border of the ray. The adambulacral plates are very small. Their armature consists of two very long, cylindrical spines, slightly compressed, obtuse, one behind the other and forming two regular rows".* This discrepancy between the figure and the text leaves some doubt about the precise characters of the genus *Tarsaster*. There is no doubt one must not distinguish it from the genus *Neomorphaster*.

The separation of *Neomorphaster* and *Stichaster* is more difficult. The calicinal plates, that are the principal distinctive character, although accompanied on the disk of many other plates are, indeed, very distinctive. The basals are immediately recognizable in *Stichaster aurantiacus* by their size, their tangential extension and their tridentate external border. They touch the dorsal marginal plates of two adjacent arms, which become contiguous on the disk and form, from the interbrachal angles to the basals, a regular double that is apparent at first glamce.

Stichaster aurantiacus from Chile is thus very near *Neomorphaster*. These characters are no longer found in *Stichasater roseus*, which lives in the moderate depths in the cold regions of the North Atlantic. The plates of the disk have a very irregular form and arranged so that it possible to clearly distinguish the calicinals among them. The plates of the abactinal skeleton of the arms are likewise far from having the strict regularity that one sees in *Stichaster aurantiacus* so that the calicinal row is likewise not always apparent. It seems thus that *Stichaster roseus* is farther from *Stichaster aurantiacus* than it is from *Neomorophaster.* It is necessary to separate generically the two forms. I propose to restrict to *Stichaster roseus* the name of *Stichaster* and to resume for *Stichaster aurantiacus* the name *Tonia* that I have attributed Gray in 1840. This is not the only change that the genus *Stichaster*, very poorly defined, is susceptible. *Stichaster felipes* Sladen, with large papular areas at the angle of the abactinal plates and its large straight pedicellariae in its papular areas appears to have only very distant relations with the two former species. *Stichaster albulus* is still further from it

I believe, consequently, to be able to separate into four genera the species of which Sladen presently makes the genus *Stichaster*:

1º *Tonia* Gray, Type: *T. aurantiaca,* Meyen (Verrill);
2º *Stichaster,* (Müller and Troschel) *emend.* Perrier, 1891. Type: *S. roseus,* O.-F. Müller;
3º *Quadraster,* Perrier, 1896. Type: *Q. felipes* Sladen

4º *Nanaster*, Perrier, 1894. Type: *N. allbulus* Stimpson.

If, with the family of *Stichasteridæ*, one adds the new genus *Calycaster*, that is going to be described in this work, the genus *Cœlasterias* with multiple arms, and the genus *Granaster*, whose place is still doubtful (**7**, p. 123), this family has the following genera:

Cœlasterias, Verrill 1871 (1867); *Calycaster*, E.l Perrier 1891; *Neomorphaster*, Sladlen 1886; *Tonia*, (Gray) E. Perrier 1891; *Stichaster*, (Müller and Troschel) E. Perrier 1891; *Quadraster*. E. Perrier 1896; *Granaster*, E. Perrier 1894; *Nanaster*, E. Perrier 1894.

Genus **Calycaster**, Perrier 1891

Biserial tube feet. Adambucral plates armed with a double row of spines, placed transversely, one behind the other. Lateral and dorsal skeleton with five rows of large imbricated plates, corresponding transversely and longitudinally: the marginals and the carinals. The skeleton of the disk is exclusively formed by a dorso-central and five basals or interradials. Crossed pedicellariae. Rare granules on the plate. Isolated papulae.

Calycaster monœcus, E. Perrier

(Pl. II, fig 2, 2ª; Pl. III, fig. 3, 3ª)

1891. *Calycaster monœcus,* E. PERRIER (**5**), p. 262.

Cruise of 1888: Stn. 203, depth 1557 m. East of Flores (Azores).

Four individuals of different ages. The rays vary in the following way:

Nº 1	R = 5 mm,	r = 2.5 mm
Nº 2	R = 6 mm,	r = 3 mm
Nº 3	R = 11 mm,	r = 4 mm
Nº 4	R = 18 mm	r = 7 mm

Specimen nº 1. — Young individual. Biserial tube feet. Each adambulacral plate with two pointed spines, divergent, placed on behind the other to make a double row of adambulacral spines.

Ventral marginals corresponding to two or three adambulacrals, each with two robust spines on their border, placed side by side, flat and a nib or arrowhead at their end.

Dorsal skeleton of the arms constituted of five rows of plates. The carinals and the marginals imbricated. In each row, the distal end of each plate passes under the proximal end of the following plate, when one looks at from the base to the end of the arms. These plates correspond. The medians support on each side a ventral marginal. They are round or oval. The small end of the oval of the medians is towards the disk. On each plate, and principally near the border, some large, sparse granules. The six carinal plates nearly equal to the marginals. Large, demi-ellipse terminal plate with two or three spines on the border of each side.

Skeleton of the disk constituted of six plates, much larger than those of the arms. They are a pentagonal dorso-central and five interradials exactly joined laterally to each other. Four of them are joined to the dorso-central. The fifth is separated boy the anus. On t he external boder of these plates are two crossed pedicellariae.

There are no papulae on the disk. On the arms, these papulae are isolated, alternating with the plates and form a row on each side of the carinal plates. There are no marginals between these two rows.

The madreporite cannot be distinguished.

Specimen nº 2. — The preceding description is sufficient for specimen nº 2, except there are nine carinals.

Specimen nº 3. — The lateral spines of the ventral marginal are found with two pairs of spines on the ventral surface of the plate inserted parallel to the ambuacral groove

The carinals number fourteen.

The skeletal pieces of the disk, always six, have kept their orientation. But their dimensions are nearly the same as those of the arms. The first carinal is a little sunken between the radials and looks like a radial.

Specimen nº 4. — Specimen nº 4 has a different aspect than the others. There is always the same number of longitudinal rows of plates and the number of plates of the disk is not increased. But they are now less apparent and the importance of the skeleton of the disk is decreased in relation to the skeleton of the arms. All the plates are thick so that there a true pit between them, as in *Neomorphaster*. Their granules are large and more numerous.

The ventral marginal plates have the form of parallelograms and are appressed against each other. The dorsal marginals are oval, touching the ventrals in a way to leave a membranous space between them, probably for papulae.

At the base of the arms, five or six ventral plates form the beginning of a row between the adambulacrals and the ventral marginals.

The madreporite is invisible.

Observation. — It is evident the forms that we understand in the genus *Calaycaster* are still young. We do not know, at this time, if they stop in their development at the state described in nº 4 or if the development goes further. The fact that the fundamental constitution of the skeleton remains the same in the four specimens, whose ray increases from five to eighteen mm seems to indicate that this constitution is very permanent. On the other hand, specimen nº 4 has some traits of *Neomorphaster* and one could ask if *Neomorphaster* keeps its embryonic characters longer than other sea stars.

On the other hand, Sladen says that young *Neomorphaster*, where R = 13.5, already has the characters of the adult except that there are no pits between the calicinal plates. Here the dorso-laterals and the ventro-laterals are lacking. The sub-basals are not apparent.

Genus **Neomorphaster**, Sladen 1891[6]

1885. *Stichaster talismanni*, E. Perrier (**3**).
1885. *Glyptaster*, Sladen (**8**), p. 612.
1889. *Neomorphaster eustichus*, Sladen (**9**), p. 438, pl. LXVI, fig. 3 and 4; pl. LXVII, fig. 9 and 10.

[6] Originally named *Glyptaster* (**8**, p. 612). This name duplicates the *Glyptaster* already used in 1852 by Hall for a crinoid of the upper Silurien.

Cruise of 1888: Stn. 213, depth 1384 m. West of Flores. One individual. Stn. 244, depth 1266 m. One individual.

The *Neomorphaster eustichus* described in 1889 by Sladen in his *Report* on the asteroids collected by the CHALLENGER is nothing other than the species that I described completely in 1885, in my Notes préliminaires sur les Stellérides recueillis par le TRAVAILLEUR et le TALISMAN. At the same time, Sladen had simply indicated this form under the name of *Glypaster,* which was since changed because of duplication. The priority of the specific name that I had employed and that, since 1885, was followed by a complete description, leaves no doubt. *Neomorphaster eustichus* Sladen should become *Neomorphaster Talismani* Perrier.

The individuals described by Percy Sladen were collected in the same waters as those in question, to the west of Fayal (Azores) at 1,000 fathoms (1828 m) depth, between the Pico Islands and São Miguel (Azores) at 900 fathoms (1,645 m). This the region where the specimens of the TALISMAN were collected.

Genus **Stichaster,** (Müller and Troschel), *emend*. Perrier 1891

Tube feet quadriserial. Each adambulacral plates with three spines placed one behind the other and forming the length of the ambulacrum a single row. At the base of the arms, in each skeletal arc, two ventro-laterals that become rudimentary and disappear little by little towards the base. Marginal plates a little larger than the latero-ventrals, irregularly arranged. Latero-dorsals form an irregular network whose spaces are much smaller than the full parts. Longitudinal series of carinals not very apparent. Dorsal skeleton of the disk like that of the arms. Calicinal plates not apparent.

All the plates of the skeleton uniformly granulated. Crossed pedicellariae only.

Papulae isolated between the marginal in groups of two or three in the mail of the dorsal network.

Stichaster roseus, Müller and Troschel

Cruise of 1886: Stn. 42, depth 136 m. Three specimens. — Stn. 44, depth 166 m. Four specimens. — Stn. 45, depth 160 m, one specimen. — Stn. 46, depth 185 m. Two specimens.

V. Family ASTERIIDÆ, Gray 1840

Quadriserial tube feet. Ambulacral and adambulacral plates strongly compressed. Single or numerous ventro-lateral plates in each arc. Distinct marginal plates, more or less cruciform, often separated by intermediary plates, around the papular areas. Dorso-laterals forming the arcs united by longitudinal intermediary plates that can be regular or deform them to make with them an irregular dorsal network with side spaces. Small carinals, usually forming a very distinct median longitudinal row. Straight and crossed pedicdellariae. Numerous papulae, often isolated by the ventro-laterals and marginal, usually in groups in the meshes of the dorsal network.

The division of the *Asteriidæ* can be considered a question of current study. Percy Sladen (**9**, p. 560) placed the following five genera in it: *Asterias*, Linné, *Uniophora*, Gray; *Calvasterias*, Perrier; *Anasterias*, Perrier; *Pycnopodia*, Stimspon.

He established the following synoptic table with their characteristics:

SYNOPSIS

OF THE GENERA INCLUDED IN THE FAMILY *ASTERIIDÆ*

A. Abactinal skeleton well developed.
  a. — Abactinal skeleton reticulated.
    a. Abactinal plates with spines…….. *Asterias*
    b. Abactinal plates with large spherical tubercles……. *Uniophora*
  b. — Abactinal skeleton composed of large imbricated plates, covered with a thick membrane masking the plates and their appendices…….. *Calvasterias*
B. Abactinal skeleton more or less undeveloped.
    a. — Five rays. Subpentagonal form……. *Anasterias*
    b. — Numerous, elongated rays…… *Pycnopodia*

Of the five genera, five can be consider aberrant; the first, *Asterias*, has nearly all the species. Sladen has divided it in the follow way into groups or sub-genera:

A. — *Asterias*; *Asterias rubens* group. — Numerous abactinal spiones without definite arrangement, ordinarily small and more or less grouped. Numerous papulae in groups.
B. — *Comasterias, Asterias sulcifera* group. — Several series of ventro-lateral plates with spines that form regular longitudinal and transverse rows.
C. — *Smilasterias, Asterias scalprifera* group. — Armature of the adambulacral and infermarginal plates consisting of flat spines, forming transverse or oblique combs.
D. — *Hydrasterias, Asterias ophidion* group. — Abactinal plates forming a delicate network with wide square mesh. Few small, isolated spines. Isolated pedicellariae.
E. — *Leptasterias, Asterias Mülleri* group. — Abactinal spines small and isolated. Papulae isolated or in small groups.
F. — *Stolasterias, Asterias tenuispina* group. — Isolated large spines arranged in regular rows, surrounded by circles of pedicellariae.

In comparing these diagnoses with those that characterize the genera, it seems that the characters given generic value do not show an importance greater than those that remain subgeneric and that it is necessary to establish between them the traits of organization establishing a more rigorous sub-organization.

In most of the *Asteriidæ*, the ambulacral skeleton shows a great unity of composition. The presence of one or two spines, located one behind the other on the adambulacral plates, is the only character that it provides. This character is not to be neglected, but it scarcely affects the general aspect of the sea star and can have only a secondary rank. To the contrary, the modifications of the latero-dorsal skeleton are numerous and can completely change the physiognomy of the animals. As a consequence, it should be first in comparison.

These modification provide the following points:

1º Number of ventro-lateral plates in each arc;
2º Presence or absence of intermediaries between the marginal;

3º Arrangement of the dorso-laterals in longitudinal series;
4º Arrangement of the dorso-laterals in an irregular network;
5º Reduction of skeletal pieces;
6º Excess development of the skeletal pieces.

These are, it seems to us, characters of great important that permit arranging genera by groups. Only then should come characters taken from the integumentary skeleton, i.e.:

1º Form of the elements of the skeleton: spines, tubercles, granules, etc..;
2º Number of these elements on the same plate;
3º Arrangement of crossed pedicellariae, that can be grouped in circles around spines or scattered;
4º Thickness of the integument over the plates.

The character of the genera can then include the number of spines on the adambulacral plates land the arrangement of the papulae.

But it is, on the other hand, impossible to account for the structure of the arms without taking into account their number, particularly because this character is often the result of fissiparity. As the number of arms varies in the same species, that between species with five arms and those with numerous arms, on can find all transitions, we place this character only in the last place. One can, then, group the *Asteriidæ* in the following manner:

SYNOPSIS

OF THE GENERA OF THE FAMILY *ASTERIIDÆ*

I. — Ventro-lateral plates forming only one role, often rudimentar.

A. — Dorso-lateral plates forming regular rows.

a. — Each marginal, dorso-lateral and carinal plate has only one or two large spines, surrounded by a circle of crossed pedicellariae.

1. — More than six arms, fissiparity frequent, resulting in a great variability in number of arms. Genus *Polyasterias*, Perrier. Ex.: *P. tenuispina* Lamarck.
2. — More than seven arms; no fissiparity. Genus *Coscinasterias*, Verrill. Ex.: *C. calamaria*, Gray; *C. gemmifera*, Perrier.
3. — Five or six arms. Fissiparity rare.

α. — Isolated adambulacral spines. Genus *Stolasterias* (Sladen) *emend.* Perrier. Ex.: *S. glacialis*, O.-F. Müller; *S. madeirensis*, Stimpson.

β. — Two adambulacral spines per plate. Genus *Distolasterias*, Perrier. Ex.: *D. stichantha*, Sladen.

b. — Each marginal, dorso-lateral and carinal plate has only isolated small spines.

1. — Papulae in groups; sparse crossed pedicellariae. Genus *Hydrasterias*, Sladen. Ex.: *H. ophidion*, Sladen.

2. — Papulae isolated or in small groups. Genus *Leptasterias*, Stimpson. Ex.: *L. Mülleri*, Sars.

c. — Plates covered with a thick integument. Genus *Calvasterias*, Perrier. Ex.: *C. asterinoides*, Perrier.

d. — Only marginal and carinal plates visible, covered with a thick integument, infero-marginals with two spines, the other arcs are surrounded by pedicellariae. Isolated papulae. Genous *Sclerasterias*, Peerrier. Ex.: *S. guernei*, Perrier.

B. — Dorso-lateral arcs arranged in a network.

a. — Adambulacral and infero-marginal spines of ordinary form.

1. — Crossed pedicellariae in a circle around the spines that are small. One or two adambulacral spines. Genus *Asterias*, Linné. Ex.: *A. rubens*, Linné; *A. polaris*, Gray.

2. — Sparse crossed pedicellariae. Only one adambuolacral spine. Genus *Sporasterias*, Ex.: *S. rugispina*, Stimpson; *S. spirabilis*, Bell.

b. — Adambulacral and infero-marginal spines flat, arranged in oblique or transverse combs. Genus *Smilasterias*, Sladen. Ex.: *S. scalprifera*, Sladen; *S. triremis*, Sladen.

C. — Dorso-lateral plates more or less undeveloped.

a. — Numerous arms. Genus *Pycnopodia*, Stimpson. Ex.: *P. helianthoides*, Stimpson.

b. — Five or six arms. Genus *Anasterias*, Perrier. Ex.: *A. minuata*, Perrier.

II. — Several ventro-lateral plates in each arc.

a. — Marginal, ventro-lateral, dorso-lateral and carinal plates in longitudinal series with blunt spines. Genus *Comasterias*, Sladen. Ex.: *C. sulcifera*, Sladen.

b. — Dorso-laterals irregularly arranged. Genus *Podasterias*, Perrier. Ex.: *P. Lutkeni*, Perrier.

c. —,Marginal, dorso-lateral and carinal plates with spherical tubercles.. Genus *Uniophora*, Gray. Ex.: *U. globifera*, Gray.

Genus **SCLERASTERIAS,** Perrier 1891.

Tube feet barely quadriserial, with a normal terminal sucker. Adambulacral plates with two spines. No ventro-laterals visible. Ventral marginal with a pair of very large spines. Dorsal marginal and carinals with a blunt spine, surrounded by crossed pedicellariae. Between the dorsal marginal and the carinals probably a row of dorsal laterals, each with a small blunt spine. Thick integument, smooth, with a transverse groove between consecutive skeletal arcs Space between two consecutive grooves corresponding to three adambulacrals.

Sclerasterias Guerni, E. Perrier 1891

(Pl. I, fig. 1, 1[a])

1891. *Sclerasterias Guernei*, E. PERRRIER (**5**), p. 264.

Cruise of 1886: Stn. 57, depth 240 m. Two specimens. — Stn. 60, depth 300 m. Two specimens.

Tube feet nearly quadriserial at the base of the arms, so closely applied against each other to seem at first to form only one. Each adambulacral plate with two very large spines, one placed behind the other and forming thus two longitudinal rows.

Ventral marginal plates corresponding to approximately three adamblacral plates, each with a comb of three spines that obliquely crosses the plate from the distal internal angle to the external proximal angle.

Dorsal marginal plates corresponding to the ventrals, triangular at the end, turned towards the base and leaning on the corresponding ventral. Distal end of the base of each spine passing under the proximal end of the following plate, going towards the end of the arms; A robust spine near the middle of the base of each plate.

Each carinal plate with a spine similar to that of the marginals, forming together a solid barrier so that the dorsal region of the arms is supported by three longitudinal rows of plates closely united in each row and giving the skeleton an appearance of great solidity.

Median plates are united to the dorsal marginal by one or two small intermediary plates, without spines. One cannot distinguish when the integument is intact. These plates often have a small isolated blunt spine.

Each dorsal arc thus has two marginals, two small intermediaries, the median dorsal, then, on the other side, two intermediaries and two marginals

The deep grooves of the integument that, in individuals preserved in alcohol remain brown in color, alternate with the calcareous arcs and separate them.

The spines of the marginal and median dorsal plates are surrounded by a circle of pedicellaria Straight pedicellaria are scatter on the dorsal surface

Large isolated papulae form a longitudinal row on each side of the row of dorsal median plates, between these plates and the marginal. The papulae and the plates alternate. There are no papulae between the marginals on the same side.

The skeleton of the disk can be difficult to see through the integument It appears formed of plates smaller and more numerous than those of the arms. Each plate has one or two spines. The madreporite is large, round, marked with fine radiating grooves. It is surrounded by a circle of eight to ten spines.

The terminal plate is small but very distinct, oval, with a small end turned towards the exterior and with an unpaired spine. Six or eight other spines are distributed on the periphery of the plate.

Genus **Stolasterias**, (Sladen) *emend.* Perrier 1891.

Five or six arms. Adambulacral plates have only one spine. Marginal, dorso-lateral and carinal plates form regular longitudinal rows and have only two spines, surrounded by a circle of crossed pedicellariae. Papulae in groups.

Stolasterias madeirensis, Stimpson

Cruise 1887. Pim Bay, Fayal (Azores). Intertidal.
Cruise 1888. Stn. 216, low tide. East coast of Flores (Azores).

Stolasterias neglecta, E. Perrier

(Pl. I, fig 2, 2^a, 4^a, 4^b, 4^c)

1891. *Stolasterias neglecta*, E. PERRIER (**5**), p. 266.

Cruise 1886: Stn. 44, depth 166 m. One specimen.

Five unequal arms, very thin. R = 15 mm; r = 3 mm; R = 5 r. Tube feet arranged in pairs. But pairs alternatively placed to the right and to left, so that the ensemble of the tube feet approaches closer to the quadriserial arrangement of *Asteriidæ* than to the biserial arrangement of *Pedicellasteridæ* without completely being one or the other. Well-developed suckers. Each small, truncated tooth with two spines on their free border. Each adambulacral plate with two slightly divergent spines, spaced transversely one behind the other. No pedicellariae in the ambulacrum nor around the adambulacral spines that are cylindrical and very short.

The ventral marginal are in contact with the admabulacrals. Each of them corresponds to three adambulacrals and have two cylindrical spines, obtuse, contiguous, arranged a little obliquely in relation to the longitudinal line following which the plates are arranged. Between these plates and the adambulacrals are neither pedicellariae nor papulae. But on the dorsal side, each couple of spines is surrounded by a demi-circle of crossed pedicellalriae. The dorsal plates form a keel in the length of the arms. Each of them has a single spine, cylindrical, obtuse marginal spine, very long, surrounded by a circle of crossed pedicellariae. These plates are supported by a ventral apophysis on the corresponding ventral marginal. The quadrangular space between the marginal and their apophysis has an isolated papula. These isolated papulae form thus, between the ventral and dorsal marginals, a longitudinal row in which the papulae seem to alternate with the plates located above and below it.

The carinal plates also form a keel the length of the median line of the arms. Each has a spine surrounded by crossed pedicellariae, similar to the marginal spines. The carinal plates correspond exactly to the marginals, to which each is connected on each side by a transverse calcareous band. One cannot see across the integument of this very wide band whether it is formed only by the apophysis or if it contains intermediary plates. The existence of intermediary plates is probable, because one often observes, in the middle of the band, a spine much smaller than the medial and lateral spines and surrounded by pedicellariae. In the rectangular mesh that forms the various parts of the dorsal skeleton are, in general, three papulae.

The disk is small. Its skeleton is composed of few pieces, arranged in a network and has spines surrounded by crossed pedicellariae. One cannot describe it exactly because of the integument

I have not been able to see the madreporite with a microscope.

Genus **Asterias**, (Linné) *emend.* Sladen 1888

Five of six arms. Adambulacral plates can have one or two spines[7]. Rudimentary ventro-lateral plates. Ventral and dorsal marginals usually have several spines, separated by an intermediary plate. Dorso-lateral plates form an irregular network with thick trabeculae and a wide mesh, most with a small spine surrounded by crossed pedicellariae. Small carinal plates, but forming a distinct row, sometimes slightly sinuous. Papulae in groups.

Asterias polaris, Gray

Cruise of 1887: Pim Bay, (Fayal), intertidal. Two specimens.

[7] Sometimes in the same individual, as is frequently the case for *Asterias rubens.* It is thus impossible to split, as did I did in 1894 (**7**, p. 107) sea stars of the *Asterias rubens* group into two genera, one monocanthid (*Asterias*), the other diplacanthid

Asterias rubens, Linné

Cruise of 1886: Stn. 40, depth 63 m. One specimen. — Stn. 84, depth 147 m. One specimen.

II. Order SPINULOSA, Perrier 1884

Skeletal plates with isolated or multiple spines, the latter case, modified to constitute *pincer pedicellariae*. Biserial tube feet. Thick ambulacral and adambulacral plates, ordinarily close together to close the ambulacrum and hide, in the resting state, the tube feet. Marginal plates slighty apparent. Dorso-lateral plates in longitudinal rows, in a network or imbricated.

VI. Family ECHINASTERIDÆ, Verrill 1871

Echiniulata with arms ordinarily elongated and joined by sharp angles. Ventro-laterals invisible exteriorally or forming several regular rows. Ventral and dorsal marginals contiguous, in a number obviously equal to the adambulacrals. Dorso-laterals in regular rows or in a network.

Genus **Cribrella**, Agassiz 1835

Adambulacral plates with a compressed spine, recurved and pointed towards the ambulacrum. A group of small spines on the surface that can be separated from the compressed spine. A row of ventro-laterals, at least at the base of the arms. Small marginal plates, but distinct. Dorso-lateral plates form an irregular network with a tight mesh. Indistinct carinal plates. Very dense small spines on all the plates. Isolated papulae between the marginals, dorsal marginals and dorso-laterals. Isolated or in small groups in the meshes of the dorsal network No pedicellariae.

Cribrella oculata, (Linck) Forbes

Cruise of 1887: Stn. 162, depth, 155 m. Five specimens.

Cruise of 1888: Stn. 203, depth, 1557 m. Two specimens. — Stn. 213, depth, 1384 m. Four specimens. — Stn. 244, depth 1266 m. One specimen.

VII. Family SOLASTERIDÆ, Perrier 1884

Arms often numerous, joined in a sharp angle or by interbrachial arcs. Adambulacral plates elongated perpendicularly to the direction of the ambulacrum, in general having on their ambulacral border a row of spines parallel to the direction of the ambulacrum, and on their long free ventral surface another row of spines perpendicular to this groove. Well-developed marginal plates, but very often reduced to a single apparent row, most often compressed into a projecting crest perpendicular to the direction of the arms and with one or several rows of long mobile spines. Dorso-laterals form an irregular network and have a tubercle from which diverge a group of numerous spines. Indistinct carinals.

Genus **Crossaster,** Müller and Troschel 1840

Adambulacral plates with a longitudinal series of furrow spines and a transverse series of subambulacral spines. No ventro-laterals on the free part of the arms. A single row of marginals. Dorso-laterals and carinals from a network with large meshes, whose nodes have penicillated tubercles. In the mesh of the network of the isolated plates with tubercles likewise penicillated. Numerous papulae.

Crossaster papposus, Bruzelius

Cruise of 1887: Stn. 163, depth 150 m. Six specimens.

VIII. Family PTERASTERIDÆ, Perrier 1884

Adambulacral plates very developed in the direction perpendicular to the ambulcrum, with a longitudinal row of furrow spines and often a transverse subambulacral row of long spines. All the other pieces of the skeleton form a more or less loose network and raised in a projecting column, topped itself with long spines. Most often, a membranous web between the longitudinal ambulacral spines. A membrane in the form of a tent supported by the spines of other plates and leaving between it and the dorsal integument a vast nidamental cavity, open in the center of the dorsal surface.

Genus **Hymenaster,** Wyville-Thomson 1873

Body pentagonal. A transverse comb of spines on the adambulacral plates. Spines of these plates palmate. Large actino-lateral spines hidden on the ventral surface and united by a membrane. Dorsal membrane well developed, not crossed by the spines that support it. Spiracles and segmental orifices.

Hymenaser pellucidus, Wyville-Thomson

Cruise of 1888: Stn. 248, depth 2870 m. Two specimens.

Genus **Hexaster,** E. Perrier 1891

Six arms. Body convex above. A large isolated spine, free of any web on the ventral surface of each tooth. Adambulalcral plaltes with a transverse comb of palmate spines. Actino-lateral spines enveloped in the ventral membrane, not passing the boarder of the arms. Dorsal membrane thick, not crossed by the spines that support it, without fibrous network, but papular and pierced with many spiracles.

Hexaster obscurus**,** E. Perrier

(Pl. III, fig. 1, 1[a])

1891. *Hexaster obscurus*, E. Perrier (**8**), p. 267.

Cruise of 1887: Stn. 62, depth 155 m. One specimen.

Pterasterid intermediate between *Marsipaster* and *Calyptraster*.

Six short arms: R = 20 mm; r = 13 mm; R = 1.53. Teeth forming a projecting keel on the ventral surface; having on their adambulacral border four or five flat spines united by a web and each with a large isolated spine on the ventral surface, behind which begins the keel. Adambulacral plates have a transverse comb of four short spines, united by a web, and an actino-lateral spine buried in the floor of the actinal surface. Actino-lateral spines do not pass the border of the ams. They are flat and enlarge towards their free end that is abruptly truncated[8]. All the spinoes touch by their external border and make the membrane that unites them slightly festooned. There are approximately twenty of them.

The abactinal spines raise in places the dorsal membrane, but do not cross it. One does not see muscular bands in them. But, outside the projections that are the paxillae, the surface of the dorsal membrane is papillose. Most of the paxillae are at the end of a spine. Numerous isolated spiracles are distributed between the papulae. The dorsal integument is thick, brown in color and does not permit distinguishing the number of paxillar spines. The oscular orifice is small, surrounded by short spines that do not appear to be regularly arranged.

Nota. — In addition to the number of arms, *Hexaster* differs from *Marsipaster* by the shortness of their actino-lateral spines. Additional buccal spines. The number of these spines (two instead of three) distinguishes it from *Calyopteraster.*

IX. Family ASTERINIDÆ (Gray) *emend.* Perrier 1884

Pentagonal body, with sides more or less indented. Differentiated ventral surface without papulae, united with the dorsal surface by a sharp border.

Ventral-lateral plates form series that leave from the adambulacrals and abut with the marginals, often with spines arranged in groups. Small marginals, often scarcely differentiated. Dorso-laterals closely imbricated or arranged in a network, very often having on their free border a multiple line of small spines. Calicinal plates often recognizable, but separated by a more or less large number of intermediary plates. Pedicellariae, when they exist, of slightly modified spines.

I have explained in my memoir on the asteroids of Cape Horn the reasons that have led me to place *Porania* among the *Asterinidæ*. This conclusion does not extend to *Dermasterias* or *Asteropsis.*

Genus **Palmipes,** Linck 1733

Marginal plates barely equal to other plates. Thin abactinal plates, scaly, with long internal extensions. Star-shaped in the middle region. A single row of papulae on each side of the carinal line, No membrane or gannules on the abactinal surface.

Palmipes membranaceus**,** Linck

Cruise of 1886: Stn. 42, depth 136 m. One specimen. — Stn. 44, depth 166 m. One specimen. — Stn. 46, depth 155 m. Seven specimens. — Stn. 47, depth 130 m. One specimen. — Stn. 59,

[8] Some spines support a square or rectangular mobile piece, connected to the principal part of the spine by a suture and seems to be immediately continuous with it. This arrangement is not constant and perhaps is only to an accidental break of the spine that has it.

depth 248 m. One specimen. — Stn. 65, depth 165 m. One specimen — Stn. 84, depth 147 m. One specimen.

Cruise of 1887: Stn. 85, depth 180 m. Two specimens.

Genus **Porania,** Gray 1840

Ventro-lateral plates forming simpes rows of one adambulacral and one ventral marginal plate. Marginal plates clearly distinct, with truncated spines Dorso-lateral plates arranged in a regular network. The carinals and some of the dorso-laterals have one or two truncated spines, more or less projecting. The entire body surface covered with a smooth, thick integument that, on the abactinal surface, has a groove between the consecutive bands of the latero-ventral plates.

Porania pulvillus, (O.-F. Müller) Norman

Cruise of 1886: Stn. 42, depth 136 m. Two specimens. — Stn. 44, depth 166 m. Nine specimens. — Stn. 46, depth 155 m. Three specimens.

Cruise of 1887 Stn. 85, depth 180 m. Two specimens.

Because of the small number and spacing of the pieces of their skeleton, *Porania* can serve as the type for the study of the latter. Figure 4 of plate III shows, seen by transparency, the skeleton of *Porania antarctica*, which scarcely differs from the European species although it is found at Cape Horn.

III. Order VALVULATA, Perrier 1884

Biserial tube feet. Teeth slightly projecting onto the ventral surface, of small size in relation to the adambulacrals. Ambulacrum closed when the animal is inactive. Adambulacral plates very large. Ventro-laterals ordinarily well developed. Marginals very distinct, often very large. Dorso-laterals ordinarily large. Surface of all the plates covered with round granules often very fugacious. Some skeletal pieces hidden under the thick, smooth integument. Excavate or valvulate pedicellariae, lodged in a small cavity of pieces that support it.

X. Family LINCKIIDÆ, Perrier 1875

Arms elongated, with more or less sharp angles. Small disk. Ambulacrum very tight when inactive. Latero-ventrals very developed, sometimes tightly united and characterizing a very differentiated ventral surface. Marginal plates very developed, often papulae grouped between the ventral and dorsal plates. Large dorso-laterals, but of variable form. Carinals more or less distinct Excavate pedicellariae when they exist (*Ophidiaster*).

Genus **Ophidiaster,** Agassiz 1835

Long, cylindrical arms. Adambulacral plates with small spines in the ambulacrum. Parallel to them a single row of large spines. Some surambulacral plates. Lateral, dorso-lateral and carinal plates in arcs and regular longitudinal bands, not raised in paxillae, without supplementary internal plates. Large papular areas between the plates as well between the adambulacrals, vemtro-laterals

and infero-marginals. Excavate pedicellariae, sometimes more or less undeveloped. Integument entirely granulose.

Ophidiaster ophidianus**,** Lamarck

Cruise of 1888: Horta, Fayal (Azores). Six specimens.

Genus **Chætaster,** Müller and Troschel 1840

Arms long, conical, pointed, very thin, with ossicles raised as paxillae. Dorso-lateral plates with supplementary internal plates. Spines thin, divergent, numerous, crowned with paxillae. No pedicellariae.

Chætaster longipes**.** Bruzelius[9]

Cruise of 1886: Stn.53, depth 135 m. One specimen. — Stn. 57, depth 240 m. Two specimens. — Stn. 50. Depth 248 m. Two specimens.

XI. Family PENTAGONASTERIDÆ, Perrier 1884

Body flat, pentagonal, with sides more or less greatly indented. Ventro-lateral and dorso-lateral plates polygonal or irregular, forming a tight mosaic. Between them are isolated papulae. Large marginal plates, corresponding nearly exactly. All the plates covered in the young with short spines or transitory granules that, in many species, disappear in adults in the middle region of the plates. Valvular pedicellariae in most species.

Genus **Astrogonium,** (M. and T.) *emend.*Perrier 1885

Species with more or less concave sides, with narrow ends to the arms, with noumerous marginal plates, separated the entire length of the arms by carinals and several rows of dorso-laterals.

Astrogonium annectens, E. Perrier

Cruise of 1888: Sta. 213, depth 1384 m. Five specimens.

This species was directed also by the TRAVAILLEUR at 43º58’ north latitude and 7º50’ west longitude (Bay of Biscay).

Genus **Pentagonaster,** Linck 1733

[9] Sladen againl attributed to Retzius the naming of this species. Jeffreys Bell however showed that the *Dissertatio sistens species conitas Asteriarum* is an inaugural thesis, by a naturalist named Bruzelis and that it was simply defended under the presidency of Retzius whose name, for this reason, was in large letters on the cover. I have this work and I can confirm what Bell said.

Body obviously pentagonal, with nearly rectilinear sides, with usually few marginal plates, smooth or granulose. Abacatinal plates polygonal or rounded, smooth or granulose, but not paxillar.

Pentagonaster crassus**,** E. Perrier

Cruise of 1886: Stn. 59, depth 248 m. One specimen.

Pentagonaster Gosselini, E. Perrier

Cruise of 1888: Stn. 203, depth 1557 m. Two specimens. — Stn. 213, depth 1384 m. One specimen. — Stn. 244, depth 1266 m. Three specimens.

Specimen *a* from Station 203: Twelve decreasing marginal plates.

Specimen *b* from Station 203: Ten marginal plates. Six adambulacral spines. Dorsal granules only around the plates, nearly all with a pedicellaria. The dorwal marginal have several.

Specimen of Station 213: Ten marginal plates. Four adambulacral spines. Granules on both surfaces.

Specimens from Station 244" Sixteen marginal plates. Five adambulacral spines. Both surfaces granulose.

Pentagonaster granularis**,** E. Perrier

Cruise of 1887: Stn. 161, depth 1267 m. Sixteen specimens.

Cruise of 1888: Stn. 213, depth 1384 m. Three specimens.

Genus **Mediaster,** Stimpson 1853

Abaactinal areas consist of paxilliform plates, tabulated, with papulae or usually prismatic granules. Paxillae extend the length of the arms and form several rows between the two dorsal marginal series. Teeth a little projecting. No unpaired interradial marginals. Marginal plates large and very apparent. Small abactinals of usual form. Sometimes small and rare valvulate pedicellariae.

Mediaster stellatus, E. Perrier

(Pl. IV, fig. 1, 1^a, 1^b, 1^c, 1^d)

1891. *Mediaster stellatus*. E. PERRIER (**5**), p, 268.

Cruise of 1887: Stn. 161, depth 1267 m. Twenty eight specimens.

Five short arms, united by interbrachial aracs with a weak cuave. R = 34 mm; r = 14 mm; R = 2.43 r.

Dental pairs form an inconspicuous lozenge on the ventral surface, each tooth with eight adambulacral spines, of which the first are larger than the others and prismatic. On the ventral surface of the two, two flat or prismatic spines, pointed, next to the end of the tooth. Then a line of three similar spines, very slightly oblique in relation to the ambulacral border of the tooth. Four

large granules arranged parallel to the dental suture, three or four the length of the suture of the tooth with the adjacent adambulacral.

Adambulacral plates with a nearly square ventral surface, each with five adambulacral spines, thin, slightly compressed and divergent. Behind them are three divergent spines, flat, truncated, shorter and wider, sometimes replaced by prismatic spines. Then, one or two rows of granules similar to those of the ventral plates.

Latero-ventral plates keeled, polygonal, arranged in a very regular mosaic, but not arranged in bands going from the adambulacrals to the marginal plates, covered by three or four regular rows of large granules that make very clear the edges of the plates. Ventral marginal plates contiguous with the adambulacrals after the ninith, rectangular and elongated, at first perpendicular to the edge of the disk, then nearly square, covered with granules finer than those of the ventral--laterals. No pedicellariae. Twenty-five ventral marginal plates. Dorsal maraginal plates with the same number as the ventrals, nearly square, finely granulose.

Dorso-lateral plagtes in form of paxillae, larger, more clearly separated from each other and with larger granules in the central region of the disk and in the direction of the arms than on the other regions. Often, especially in the interradial region, a pedicellaria, slightly eccentric, formed of two, three or four valves have nearly the aspect and size of granules. At the base of the arms, numerous plates separate the two rows of marginals. The number of plates decreases litte by little towards the end of the arms, but no less than three. Ocular plate of average size, oval.

Small madreporite with large grooves, located near the center than the border of the disk.

IV. Order *PAXILLOSA*, Perrier 1884.

Biserial tube feet, sucker often undeveloped. Teeth usually large and projecting. Latero-ventral plates, when they exist, covered with small spines or scales that are modified very often to make pedicellariae. Dorso-lateral plates transformed into paxillae. Grooves of the madreporite usually wide and few.

XII. Family ARCHASTERIDÆ, (Viguier) *emend.* Sladen 1886

Large teeth, adambulacrals. Adambulacral plates large and not compressed, with numerous spines grouped in several series. No surambulacrals. Actinal areas formed by small spiny ventro-lateral plates. An anus.

I. Sub-family PARARCHASTERINÆ, Sladen 1888

No distinct carinal series. Papulae confined to the arms. No or few actinal plates. Marginal plates more or less alternating. Tube feet with a rudimentary sucker.

Genus **Pontaster,** Sladen 1885

No unpaired interbrachial marginal.

Pontaster venustus, Sladen

Cruise of 1887: Stn. 112, depth 1287 m. Fifteen specimens.

Cruise of 1888: Stn. 203, depth 1557 m. Eight specimens. — Stn. 213, depth 1384 m. Fifteen specimens. — Stn. 233, depth 1300 m. Seven specimens. — Stn. 244, depth 1266 m. Fifteen specimens.

Pontaster limbatus**,** Sladen

Cruise of 1887: Stn. 161, depth 1267 m. Fourteen specimens.

2. Sub-family PLUTONASTERINÆ, Sladen 1888

Actinal plates well developed. Marginals are corresponding. Papulae distributed on all the dorsal surface.

Genus **Dytaster,** Sladen

Abactinal plates without determined order. Marginals in two similar series, the upper confined to the border of the arms and with a spine. Pectinate or fasiculate pedicellariae.

Dytaster intermedius**,** E. Perrier

1891. *Dytaster intermedius,* E. PERRIER (**5**), p. 271.

Cruise of 1888: Stn. 248, depth 2870 m. Three specimens.

Elongate d arms. Interbrachial arcs. R = 40 mm; r = 9 mm; R = 4.4 4.

Tube feet end in a small conical sucker. Teeth very elongated, joined at their two ends leaving a fusiform integumentary space between them. Eleven spines on their ambulacral border, four rows of spines on their ventral surface.

Adambulacral plate with six to eight cylindrical furrow spines behind which on the ventral surface are successively from the first ambulacral four, three, two and finally one row of secondary spines.

Ventro-lateral plate very numerous, covered with small spines opposite to those that show their edges across the integument.

Marginal and ventral plates contiguous from the fifth with the adambulacrals *smaller* than these plates so that five adambuacrals correspond to six marginals, to number approximately forty. Densely covered with small spines, among which are two larger, curved spines on the plates in the interbrachial arcs. The following plates have only a single spine that disappears on the plates of the last third of the arms.

The dorsal marginal plates, small, nearly square, have a conical spine near their supero-distal angle. All the rests of their surface is spinose

All the dorsal surface is covered with small dense paxillae usually with six divergent spines around a central spine, both obtuse.

Madreporite hidden by paxillae.

Genus **Plutonaster,** Sladen 1888

Long, narrow adambulacrals, armed with parallel longitudinal series of spines. Abactinal plates arranged, at least on the borders of the arms, in transverse series. Large marginal plates, usually without spines. No pedicellariae. Madreporite hidden, compounded.

Plutonaster inermis**,** E. Perrier

Cruise of 1888: Stn. 244, depth 1266 m. One specimen.

Plutonaster notatus**,** Sladen

Cruise of 1888. Stn. 244, depth 1266 m. One specimen.

Plutonaster granulosus, E. Perrier

(Pl. IV, fig. 2, 2^a, 2^b, 2^c, 2^d)

1891. *Plutonaster granulosus*. E. PERRIER (**5**), p. 269.

Cruise of 1888: Stn. 203, depth 1557 m. One specimen. — Stn. 213, depth 1384 m. Ten specimens.

Pointed tube feet, with completely rudimentary sucker. Each pair of teeth forming an elongated pentagon, in which the posteriors are about ten times longer than the anteriors. On the small sides that form the buccal border, eight divergent spines, of which the two first or angulars are longer than the others. The actinal surface of the plate covered by three irregular rows of granules, a little elongated in the form of spines. Suture of the teeth very slightly wider in the middle.

Adambulacral plates, passing gradually from the trapezoid form to the rectangular form, with ambulacral side replaced by a convex arc toward the ambulacrum and with eight spines. Actinal surface of the plate covered with granules that one could consider it as arranged in three very irregular rows. Each has five or six granules. Those of the first row elongated, sometimes with spines. Latero-vemtrals developed up to the sixth ventral marginal on each side and forming nine rows, each leaving from an adambulacral. The first and second rows formed of five plates, third of four plates, fourth and fifth of three plates, sixth and seventh of two plates, eighth and ninth of one plate. The first three rows abut the first marginal, the two following the second marginal, the sixth the third marginal, the seventh and eighth the fourth marginal, the ninth the fifth marginal. These plates, very clearly separated from each other, are covered with about twenty small spines, which one could describe as elongated granules, in general, on the border of the plates, larger and short toward the center. The ventral marginals are contiguous with the adambulcrals after the sixth. There are twenty-eight on each arm and pass gradually from the rectangular form to the square form. They are covered with granules but have no trace of spines.

It is the same for the dorsal marginal plates, whose dorsal surface is nearly square. The dorso-laterals form, near the marginals, rows of which three or four correspond to the same marginal. These rows are no longer distinct in the middle region of the arms, where one can not recognize regular carinal rows.

The dorsal plates are clearly separated from each other, nearly paxillar, rounded or irregularly polygonal, a little smaller towards the center of the disk than on the arms.

The anus is a very recognizable slit. A group of six to eight paxilliform protuberances, larger than the plates of the disk, hide the madreporite.

Observation. — Near *Plutonaster notatus* of the Azores, but distinguished by the completely spineless ventral marginals

Genus **Tethyaster,** Sladen 1888

Wide adambulacrals, armed with spines arranged in organized groups. Madreporite exposed.

Tethyaster subinermis**,** Philippi

Cruise of 18886: Stn. 44, depth 166 m. Bay of Biscay. Youong specimen with thirty-six dorsal marginal plates. — Stn. 46, depth 155 m. One specimen measuring 0.55 m from the end of one arm to the other alive, 0.50 m dried.

XIII. Family ASTROPECTINIDÆ, Gray 1840

Tube feet ordinarily pointed. Short adambulacraals, more or less compressed. Surambulacrals. Actinal areas small or absent. Marginal plates well developed, covered with spines or papulae.

1. Sub-family ASTROPECTININÆ, Sladen 1888

Adambulacrals touching the inferomarginals the entire length of the arms, but without correspondence. Superomarginal plates well developed. No pedicellariae.

Genus **Astropecten,** Linck 1733

Marginal plates and actinal plates without membrane. Actinal areas small. Superomarginal plates elevated, with grooves (*fascioles*) between them with very small spines, nearly equal to the inferiors.

Astropecten serratus**,** Müller and Troschel

Cruise of 1886: Stn. 40, depth 63 m. Five specimens. — Stn. 49, depth 150 m. Four specimens. — Stn. 50, depth 150 m. Five specimens. — Stn. 53, depth 135 m. One specimen. — Stn. 61, depth 185 m. One specimen. — Stn. 65, depth 165 m. Four specimens.

Astropecten aurantiacus**,** Philippi

Cruise of 1886: Stn. 40, depth 63 m. Numerous specimens.

Genus **Psilaster,** Sladen 1885

Ambulacral armature forming, on the border of the ambulacrum, a rectilinear series of uniform spines. Actinal areas small. Superomarginal plates not separated by fascioles. Spines not enclosed in a membranous pouch.

Psilaster Andromeda**,** Düben and Koren

Cruise of 1888: Stn. 211, depth 1372 m. Three specimens. Stn. 213, depth 1384 m. Numerous specimens. Stn. 233, depth 1300 m. Two specimens.

2. Sub-family LUIDIINÆ, Sladen 1888

One row of small ventro-laterals. Adambulacrals and infero-marginals correspond in number.

Genus **Luidia,** Forbes 1839

Indistinct superomarginal plates.

Luidia Sarsi**,** Düben and Koren

Cruise of 1886: Stn. 44, depth 166 m. One specimen. — Stn. 46, depth 155 m. Two specimens. — Stn. 49, depth 150 m. One specimen. — Stn. 58, depth 134 m. One specimen. — Stn. 59, depth 248 m. One specimen — Stn. 60, depth 300 m. One specimen

Cruise of 1887: Stn. 85, depth 180 m. One specimen.

TABLES

OF THE

SPECIMENS COLLECTED

AT THE

DIFFERENT STATIONS

CRUISE OF 1886

Station number	Date	Locality		Depth (m)	Nature of bottom
40	15 July	47º 11' 35" N.	5º 27'30" W.	63	Sand, gravel, broken shells, fine sand
42	18 July	46º 47' N.	6º 12' 30" W.	136	Fine sand
44	20 July	46º 47' N.	6º 30' W.	166	Muddy sand, yellow bivales
45	21 July	45º 48' N.	5º 58' W.	160	Fine sand, no bivalves
46	26 July	46º 24' 42" N.	5º 55' 30" W.	155	Gray sand, yellow bivalves
47	26 July	46º 28' N.	5º 52' W.	130	Muddy sand, white and yellow bivalves
49	30 July	43º 48' 44" N.	8º 11' 15" W.	150	Muddy sand spotted with black
50	30 July	43º 50' 08" N.	8º 10' 35" W.	150	Muddy sand spotted with black
53	2 August	43º 44' 50" N.	8º 12' W.	135	Gray sand, shells, rock
57	5 August	43º 44' 30" N.	8º 32' 30" W.	240	Rock, large pebbles, sand
58	7 August	43º 40' N.	8º 55' W.	134	Sand, pebbles, broken shells
59	8 August	43º 53' N.	9º 01' W.	248	Fine sand
60	9 August	43º 57' N.	9º 27' W.	300	Sand, gravel and rock
61	10 August	43º 58' N.	10º 02' W.	182	Rock, fine sand
65	22 August	43º 32' 20" N.	10º 59' 15" W.	165	Fine sand
84	7 September	50º 02' 57' N.	12º 26' 19" W.	147	
		Grand Sole Bank			

Station number	Collection procedure	Species collected
40	Trawl	*Asterias rubens* Linné, *Astropecen serratus* M. T., *Astropecten aurantiacus* Philippi.
42	Trawl	*Stichaster roseus* M. T., *Palmipes membranaceus* (O.-F. M.) Norman
44	Trawl	*Stichaster roseus* M. T., *Stolaster neglecta* E. Perrier, *Palmipes membranaceus* (O.-F. M.) Norman, *Tethyaster subinermis* Philippi, *Luidia Sarsi* Düben and Koren.
45	Trawl	*Stichaster roseus* M. T.
46	Trawl	*Stichaster roseus* M. T., *Palmipes membranaceus* (O.-F. M.) Norman, *Porania pulvillus* (O.-F. M) Norman, *Tethyaster subinermis* Philippi, *Luidia Sarsi* Düben and Koren.
47	Trawl	*Palmipes membranaceus* (O.-F. M.) Norman.
49	Canvas dredge	*Astropecten serratus* M. T., *Luidia Sarsi* Düben and Koren.
50	Trawl	*Astropecten serratus* M. T., *Luidia Sarsi* Düben and Koren.
53	Trawl	*Chætaster longipes* Bruzelius, *Astropecten serratus* M. T, *Luidia Sarsi* Düben and Koren.
57	Trawl	*Sclerasterias Guernei* E. Perrier, *Chætaster lonogipes* Bruzelius.
58	Trawl	*Luidia Sarsi* Düben and Koren.
59	Trawl	*Palmipes membranaceus* (O.-F. M.) Norman, *Chætaster longipes* Bruzelius, *Pentagonaster crassus* E. Perrier, *Luidia Sarsi* Düben and Koren.
60	Trawl	*Sclerasterias Guernei* E. Perrier, *Luidia Sarsi* Düben and Koren.
61	Mop bar	*Astropecten serratus* M. T.
65	Trawl	*Palmipes membranaceus* (O.-F. M.) Norman.
84	Trawl	*Asterias rubens* Linné, *Palmipes membranaceus* (O.-F. M.) Norman.

CRUISE OF 1887

Station number	Date	Locality		Depth (m)	Nature of bottom
85	28 May	46º 31' N.	6º 52" W.	180	Muddy sand, white and yellow bivalves
104	22 June	Mooring of	Horta (Rayal)	Tidal	Rock and sand
112	1st July	38º 34' 30" N.	30º 26' 30" W.	1287	Fine sand
161	2 August	46º 04' 40" N.	49º 02' 30" W.	1267	Pebbles, sand, shells
		Newfoundland Bank			
162	3 August	46º 50' 06" N.	50º 11' 45" W.	155	Pebbles
163	4 August0	47º 33' N.	53º 28' 15" W.	150	Pebbles

Station number	Collection procedure	Species collected
85	Trawl	*Porania puvillus* (O.-F. Müller) Norman, *Luidia Sarsi* Dübin and Koren.
104	Trawl	*Stolasterias madeirensis* Stimpson, *Asterias polaris* Gray.
112	Trawl	*Pontaster venustus* Sladen.
161	Trawl	*Mediaster stellatus* E. Perrier, *Pentagonaster granularis* E. Perrier, *Pontaster limbatus* Sladen.
162	Trawl	*Pedicellaster parvulus* E. Perrier, *Criabella oculata* (Linck) Forbes, *Hexaster obscurus* E. Perrier.
163	Trawl	*Crossaster papposus* Bruzelius.

CRUISE OF 1888

Station number	Date	Locality		Depth (m)	Nature of bottom
191	20 July	Mooring of	Horta (Fayal)	Tidal	Rock and algae
203	30 July	39º 26' 30" N.	33º 23" W.	1557	Fine sand and white mud
211	1st August	39º 18' 05" N.	33º 32' 15" W.	1372	Muddy sand, broken shells
213	2 August	39º 22' 48" N.	33º 45' 30" W.	1384	Muddy sand, pteropod debris
216	3 August	39º 26' 30" N.	33º 29' 15" W.	Tidal	Algae and rock
		East coast of Flores			
233	18 August	38º 33' 21" N.	30º 28' 54" W.	1300	Mud and sand
		Between Pico and São Jorge			
244	27 August	38º 33' 37" N.	30º 39' 30" W.	1266	Gray, muddy sand
248	2 September	41º 40' 42" N.	29º 04' 23" W.	2870	White clayey sand

Station number	Collection procedure	Species collected
191	Trawl	*Ophidiaster ophidianus* Lamarck
203	Trawl	*Calycaster monœcus* E. Perrier, *Cribrella oculata* (Linck) Forbes, *Pentagonaster Gosselini* E. Perrier, *Pontaster venustus* Sladen, *Plutonaster granulosus* E. Perrier.
211	Trawl	*Psilaster Andromeda* Düben and Koren.
213	Trawl	*Neomorphaster Talismani* E. Perrier, *Cribrella oculata* (Linck) Forbes, *Astrogonium annectens* E. Perrier, *Pentagonaster Gosselini* E. Perrier, *P. granularis* E. Perrier, *Pontaster venustus* Sladen, *Plutonaster granulosus* E. Perrier, *P. inermis* E. Perrier, *Psilaster Aandromeda* Düben and Koren.
216	Trawl	*Stolasterias madeirensis* Stimpson.
233	Trawl	*Pontaster venustus* Sladen, *Psilaster Andromeda* Düben and Koren.
244	Trawl	*Neomorphaster Talismani* E. Perrier, *Cribrella oculata* (Linck) Forbes, *Pentagonaster Gosselini* E. Perrier, *Pontaster venustus* Sladen, *Plutonaster notatus* Sladen.
248	Trawl	*Brisinga coronata* O. Sars, *Prognaster Grimaldii* E. Perrier, *Hymenaster pellucidus Wyville-Thompson, Dytaster intermedius* E. Perrier.

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LEGENDS OF PLATE I

Plate I

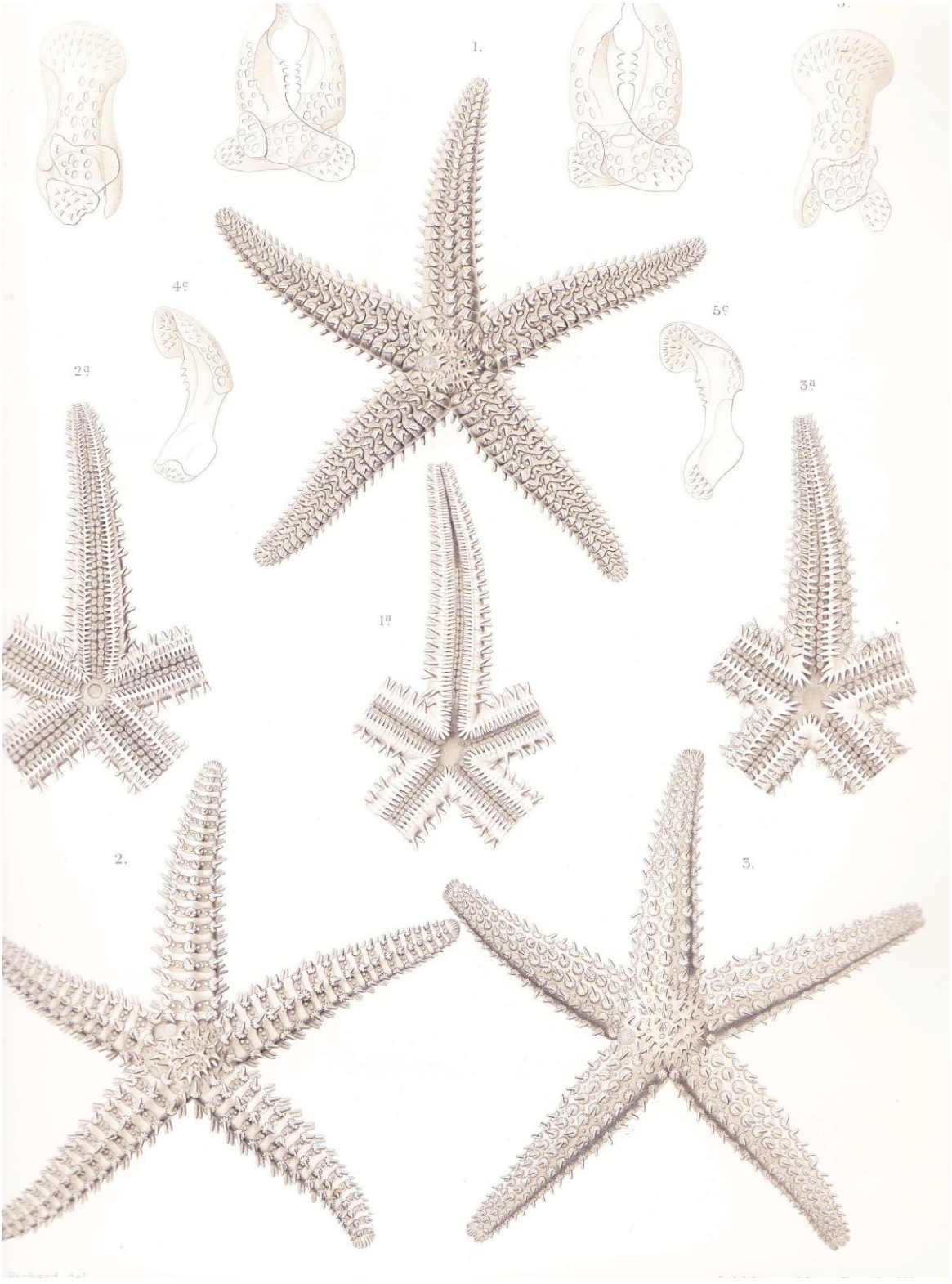

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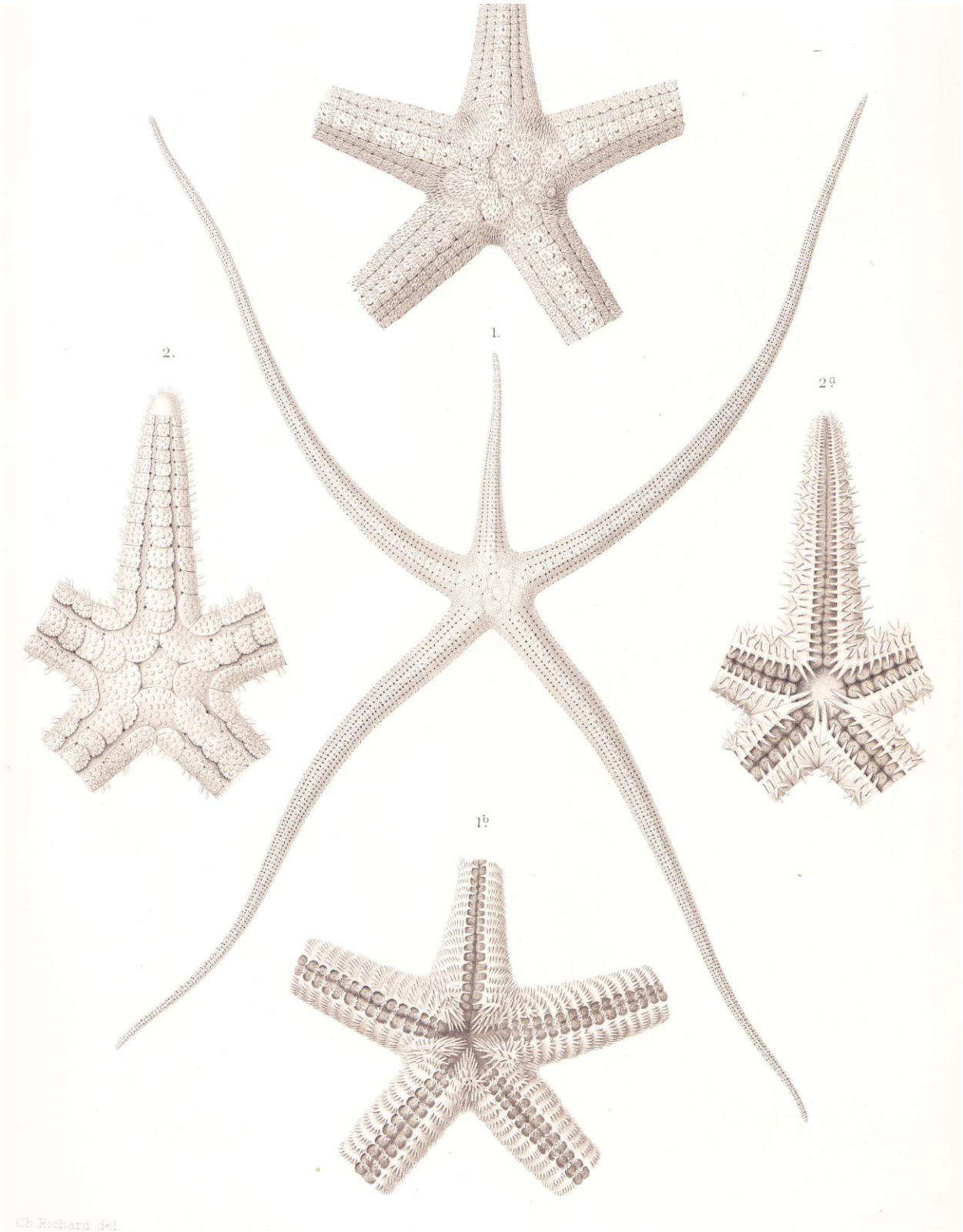
Plate II.



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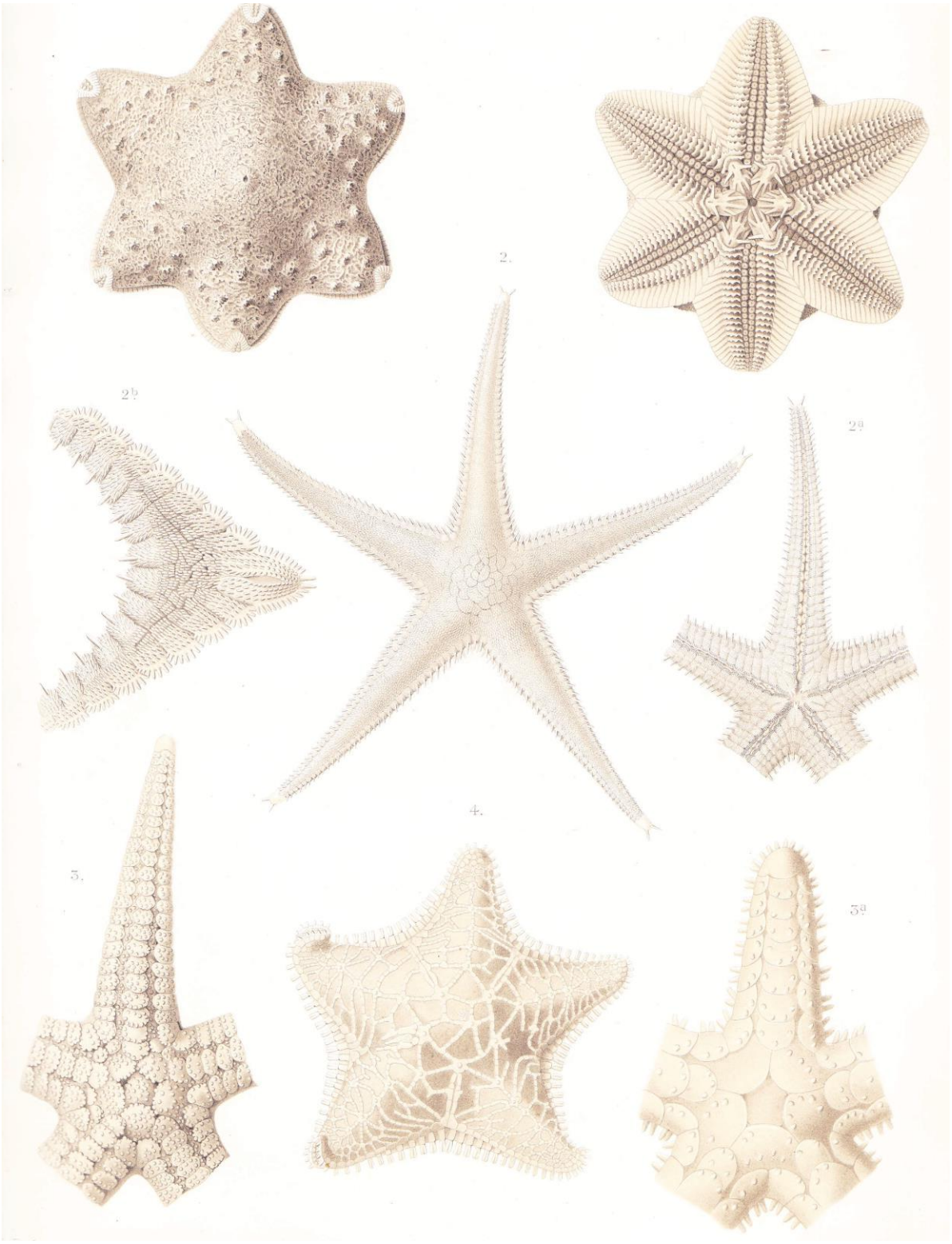

LEGENDS OF PLATE IV

Plate IV.