

Revision of the Collection of Asteroids  
of the Museum of Natural History of Paris

by

Edmond Perrier

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Natural History

Translated by John M. Lawrence

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

## Translator's Note

“You have to know the past to understand the present.” — Carl Sagan

According to Hyman (1955, p. 245), Linnaeus confused all the stellate echinoderms (i.e., sea stars, serpent stars, and comatulids, under the one name, *Asterias*. Lamarck introduced the taxon, Stelleridae, to include *Asterias*, *Ophiura*, *Comatula*, and *Euryale*. Burgmeister combined sea stars and serpent stars in the Asteroidea. Forbes separated them into distinct orders. Perrier used the term, Stellerides, for only the sea stars.

Perrier noted the collection of asteroids in the Paris museum had not been examined since Müller and Troschel in 1840. He also examined the collection of asteroids in the British Museum. He had access to all the publications on asteroid taxonomy. His excellent bibliography of 145 studies ranges from 1620 to 1872 is amazing and indicates he was cognizant of pertinent information. The taxonomy of asteroids has changed considerably since 1875. Recognition of species, genera and families is much different today. Although the taxonomy is obsolete, the observations are not.

I have translated morphological terms using those given by Hyman (1955) and Clark and Downey (1992).

I have not altered Perrier's spellings of taxonomic names, nor have I changed his bibliography that is inconsistent in style and sometimes in spelling. Pages and volumes are sometimes indicated but not given. The variety of abbreviations of the works cited in the lists of species is astonishing. I have not changed any of these inconsistencies.

Clark, A.M., and Downey, M.E. 1992. Starfishes of the Atlantic. Chapman and Hall, London.

Hyman, L.H. 1955. The Invertebrates: Echinodermata. MacGraw-Hill Company, Inc., New York.

# Revision of the Collection of Stellerides of the Museum of Natural History of Paris

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The collection of Stellerides has been the object of important works. Lamarck, Louis Agassiz and Müller and Troschel have successively studied it. The latter revised what it contained dating to the publication of their *System der Asterides*. Unfortunately, the study of these two German naturalists of the Stellerides in the Museum in 1840 was necessarily rapid. Many of the specimens were unidentified. Unattached labels placed on others were sometimes transposed so that the collection and science had not changed for thirty-five years. A revision of the Stellerides of the Museum was already necessary.

But science and collection have gone on. Neglected for a long time because their study was difficult, because their identification absolutely requires anatomical knowledge and methods of investigation, less necessary though often useful for the identification of many other animals. Zoophytes and worms are today the object of more ardent and more detailed investigation. It is sufficient to look at any foreign collection to recognize the important place of these two groups of animals in the work of contemporary zoologists and appreciate the preponderance of information they provide to the most advanced speculations of science.

In the midst of this movement, to which most advanced French zoologists have contributed, ECHINODERMS have not remained stationary. Stellerides, like the other classes, have been the object of numerous studies.

The *System der Asteriden* of Müller and Troschel and the *Synopsis of the Class of the Hypostoma* of Gray appeared, after the great work of Linck, in 1733. They were the only general works where the study of Stellerides was extended to the analysis and description of species. These two works, appearing nearly simultaneously<sup>1</sup>, were conceived very differently. The families and genera were completely differently defined. Those of Gray, very numerous, were often based on characters of little importance. They were adopted primarily by English and American zoologists. But most look to the work of Müller and Troschel as a guide. It has the advantage of describing species in a sufficiently recognizable fashion. A simple phrase, often very ambiguous, takes place of a description in the work of Gray. The *System der Asteridea* and the *Synopsis* were none the less the starting point of all subsequent work, which was principally due to Verrill, Stimpson, von Martens, and especially Doctor Ch. Lütken, aide-naturalist at the museum of Copenhagen.

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<sup>1</sup> The *Synopsis* of Gray appeared in the *Annals and Magazine of Natural History*, vol. VI, in November and December, 1840. The *System der Asteriden* of Müller and Troschel appeared only in 1842, but a kind of summary of this work giving the characteristics of the genera had already appeared in April, 1840 in *Wiegmann's Archiv für Naturgeschichte*.

These works have modified some of the original genera, given minute descriptions and in depth studies a complete authenticity to some species that inadequate descriptions made absolutely doubtful. They established a number of new species.

For the collection of the Museum, work stopped at 1840, although numerous specimens were subsequently introduced. A reorganization was thus absolutely necessary. I not only had to reestablish in the collection the types of Müller and Troschel, but make a more complete study of these types. This sometimes led me to some different opinions of the German scholars. I was able to demonstrate, for example, that their *Asteropsis pulvillus* and their *Asteropsis ctenacantha* were the same species with different states of preservation; that their *Asteracanthion striatus* (the *Asterias striata* of Lamarck) is not really an *Asteracanthion* but must be placed beside *Echinaster* because the tube feet form not four but only two rows; likewise *Asterias obtusangula* must be removed from their genus *Oreaster* to be closer to *Anthenea* and *Hippasteria* of Gray; that their *Astrogonium australis* that they considered identical with *Tosia australia* of Gray was, to the contrary, a very different species, etc.

Often it was possible for me to definitely identify doubtful types of Lamarck or to identify those of Müller and Troschel with species subsequently described as new. It is thus that the *Asterias echinophora* of Lamarck is found to be identical to the *Othilia crassispinga* of Verrill, that the *Oreaster Desjardinsii* of Michelin is found to be nothing other than a poorly preserved *Scytaster zodiacalis* of Müller and Troschel and *Scytaster stella*, described by the same author in collaboration with Duchassaing, *Ophidiaster ornithopus* of Müller and Troschel. Several described new species were found to be simple varieties of other species of Lamarck. Such are the *Ophidiaster asperulus* and *Linckia nicobarica* of Doctor Lütken, which were found to be the *Asterias cylindrica* and *laevigata* of Lamarck.

The determination of the types of Lamarck by a detailed description was an important point to which I have given all my care. These types are found most often described only by a short phrase. It was nearly impossible to distinguish close species. From the numerous uncertainties, it sometimes happened that some stars generally considered identical to those described by Lamarck were really very distinct.

The same uncertainties existed regarding the species of Gray that have a small priority over those of Müller and Troschel. I went to the British Museum to study the types of the English scholar to establish their identity, when it was there, with those of Lamarck and of Müller and Troschel in the collection of Paris, and completely describe still doubtful species. I must thank Günther and his aides, Smith and Miers, for their hospitality and the warm welcome they gave me at the British Museum.

All that resulted in some sort of verification of the former collection. This work has not been, as will be seen, without producing some useful results to science. The value of old labels once determined, the modifications necessitated by the progress of science or by a more complete study of the specimens once made, there still remained a considerable work, that of classifying specimens not identified or identified in a doubtful fashion and entries at the Museum since 1840. There was first the complete collection of Michelin that, besides the specimens that the Museum already possessed, had to be identified again. This exposed a very considerable contingent of types that were missing in our collection or that were absolutely unknown. The Museum of Comparative Zoology at Cambridge (Massachusetts) has made a gift to that of Paris of a complete collection of Stellerides from the east coast of the United States and of the Gulf of California. These species, described since either by Doctor Lütken or by Verrill and Stimpson, arrived with nearly all unidentified. It was necessary to identify them. Aimé Bouvier gave us Stellerides from Cape

Verde; Germain and Balanzzaa, those of New Caledonia; Baillieu, those of the Hawaiian Islands; Darby, some of those of China; Grandidier, several from Madagascar. I found several new species that I have described. Others were lacking in the Museum. Others I identified by comparison with specimens already present in the collection.

In all these cases, whenever there was doubt, I made every effort to take advantage of all the resources of the Museum that could help to clarify them. I have thus made a critical examination of the synonymy and the validity of many species. This is one of the most important and most extensive parts of this memoir. Finally, for each species, I have believed it necessary to indicate in addition to special characteristics of some specimens, the number of specimens in the Museum, the mode of preservation, their condition, and finally the locality of provenance, the name of the donor, proof in some circumstances, and the date of their entry into our collections.

Every time I have had to make a change in the labels of the Museum, which have been doubtlessly frequently consulted. I have believed it necessary to report here the change and give the reasons for it. Whenever possible, I have kept the trail on the new label of everything written.

This work represents in a complete manner a detailed catalog of the collection of Stellerides of the Museum of Paris. I have attached a list and the description of species in the British Museum. In addition to the scientific goal that I have followed in writing it, the knowledge of the Stellerides that presently live in the seas and their geographical distribution, it should serve as the basis for exchanges that will occur in the future with foreign museums.

In summary, the Museum presently has 498 species of sea stars, represented by a little more 1,200 specimens.

I have separated these species into nearly forty genera, some of which I have defined anew. I must, before beginning the specific part of this work, indicate the rules that guided me in the choice of names to give to genera. These rules are quite naturally explained by the historical discussion of my predecessors.

I will note in this history only works that have the goal improving the systematic arrangement of asteroids. Those that are only simple descriptions of species will be indicated sufficiently in the bibliographic index that accompanies this memoir, by the synonymy of different species, and the discussion of their validity.

## HISTORY — DISCUSSION OF THE PROPOSED CLASSIFICATIONS

Until the 18<sup>th</sup> century, the sea stars were not the object of any synthetic work.

The naturalists, curators of museums and of natural curiosities have however described and figured a certain number.

Aldrovande spoke of some species from Senegal. Borellier, Petiver, Columna, and Seba described and figured some from diverse localities. The plates of the *Thesaurus* of Seba relating to these echinoderms can still be consulted profitably today. The species they represent are very recognizable and some have not been figured otherwise.

The first work devoted exclusively to the animals that concern us dates to 1733. It is due to Linck with the title *De Stellis marinis liber singularis*. Supplemented with his own work, this author adds the work of Luidius on the same subject, those of Kade, and finally an unedited memoir of Réaumur on the structure of sea stars.

This is time that the work of Linck appeared, the binary nomenclature not having yet been specified as it was two years later in the *Systema naturæ*. But one can say that it was in the air, and we already find the notion very clear in the *De Stellis marinis liber singularis*. The species are

separated into clearly circumscribed genera and those of the same genus are always designated by the name of the genus ordinarily followed by a qualitative one. Most of the names of Linck fit perfectly into the binary nomenclature. It is not surprising that they depart from it as when he says *Astropecten regularis major* in contrast to *Astropecten regularis minor*. These names are applied in Linck's meaning to two perfectly distinct species and not to two varieties of the same species. Outside of species, Linck accepts however varieties. It is thus that he distinguishes several, designating each by a special name in his *Pentaceros gibbus*. These varieties have become true species in the successors of the naturalist. As each species, or even each variety of a species, is represented in natural size in one or several figures, as these figures are generally very well executed, it is without doubt Linck spoke of the Stellerides and it is necessary to consider his work as the beginning of our knowledge of Stellerides. Although his work preceded the first edition of *Systema naturæ* by two years, it is absolutely unjust not to treat Linck as one treats subsequent authors to Linné. His manner of naming species and genera is that we will follow. They can be delimited by very clear characteristics. It is a duty, whenever possible, not to allow to disappear names created by the first naturalist who spoke in detail about sea stars.

The system of classification created by Linck is completely artificial. He first has recourse, to characterize his genera, to the number of arms of the star. Now the number of arms of the same species often varies. Our common sea star, *Asterias rubens*, can have four to seven arms, although ordinarily there are only five. Linck was thus led to place them into several different genera. It is the same for *Solaster papposus* and *endeca*, whose arms are large in number and very variable. One cannot accept in any way the genera of origin so defective with different names so that there could be up to three for the same species. Species that have arm loss, having several different names, could also be considered as not having been sufficiently distinguished by Linck. It is the name created by the first of his successors who has given a good diagnosis that it is necessary to adopt. But, happily, the number of arms is not sufficient to characterize genera. The great majority of asteroids have only five arms, and Linck has perfectly understood the necessity of subdividing in genera of five-armed asteroids by other characters. He thus defined genera that could be more clearly circumscribed, that could even be different, that sometimes combine several of our present genera, but that cannot disappear because of these imperfections, no more than one can make disappear the genera created by naturalists after Linné when one comes to discard these genera. Four genera of Linck thus seem to us to be conserved. These are *Pentagonaster*, whose characteristics need to be more defined; *Pentaceros*, which corresponds exactly to the *Oreaster* of Müller and Troschel, that Linck had not introduced because of its general form of an *Asterina*; *Astropecten*, which contains only *Ctenodiscus*, which is so close; finally *Palmipes*, where there is nothing to change. In these four general, the proportion of foreign elements introduced by Linck is nothing or very weak, relatively to those that really should constitute the genus. It would be an injustice to not completely accept them. There is no other serious problem in the nomenclature. Some zoologists have nearly always used these four names. As to the specific names, there are three kinds: those formed of three names and not in the binary nomenclature although they differ very little. These often must be rejected. Some authors indicate in a species divisions corresponding to our varieties. But these varieties have been accepted as species. This is the case with the species *Pentaceros gibbus*. Linck distinguished the varieties *hiulcus*, *turritus*, etc. Now, according to a principle that is always followed that when a previously named varied is elevated to a species, the name of the variety becomes, as far as it goes, the new specific name. This rule should be applied to Linck, and Müller and Troschel have themselves conformed to this in regard to *Pentaceros* (*Oreaster* Müller and Troschel). There remain the names that are completely in

binary nomenclature. These should always be accepted, unless as a result of modifications in the extent of the genera, they do not duplicate another specific name of Linck himself.

This is, it seems to me, the only equitable manner of treating an excellent work, and that, at the moment it appeared, was certainly ahead of its time. The immediate successors of Linck, far from improving his work, to the contrary only destroy it. The genera he established are forgotten. And during a century the asteroids, whose number increases very rapidly, are combined into a single genus. Linné, Retzius, Lamarck, de Blainville even, accepted for all sea stars only the genus *Asterias*. However, in his *Manuel d'actinologie*, de Blainville established some divisions in the genus, to which he gave particular names that correspond to true genera. These are 1. *Oreillers*, corresponding nearly to our culcitids; 2. *Palmasterias*, to our genus *Palmipes*; 3. *Scutastéries*; 4. *Platasterias*, such as *Pentagonaster*; 5. *Pentasterias*, including the species with five arms such as *Asterias rubens*, *Echinaster sepositus*, *Ophidiaster ophidianus*, etc.; 6. *Solastéries*, species with numerous arms such as *Solaster*.

This classification is not very felicitous. It combines very different species and separates others that are very close. The same year, 1834, Nardo published in *Isis*, directed by Oken, another classification of sea stars. He divided them into six genera: *Stelleria* (*Astropecten* Linck), *Stellonia* (*Asteracanthion* M. T.), *Asterina* (*Asteriscus* M. T.), *Anseropoda* (*Palmipes* Linck), and finally *Linckia* (*Ophidiaster*, *Scytaster* etc. M. T.). From the point of view of separating the genera, this classification, incomplete as it is, is an improvement. Two of the names that it introduces have been preserved: *Asterina*, that the genus *Asteriscus* Müller and Troschel does not displace, and *Linckia*, a genus that will undergo numerous modifications.

The subsequent year, 1835, in the *Mémoires de la Société des sciences de Neufchâtel*, Louis Agassiz published his *Prodrome d'une Monographie des Radiolaires*. He accepted in part the genera of Nardo. But he added others, bringing the number to nine: 1. *Asterias* (*Astropecten* Linck); 2. *Cœlaster* (fossil species); 3. *Goniaster* (*Pentaceros* Linck); 4. *Ophidiaster*; 5. *Linckia* or *Cribrella* (*Scytaster* M. T.); 6. *Stellonia*, or *Uraster* (*Asteracanthion* M. T.); 7. *Asterina* (*Asteriscus* M. T.); 8. *Palmipes* Linck; 9. *Culcita* (*Oreillers* of de Blainville).

With this impulse, five years later in April 1840, appeared in *Wiegmann's Archiv* a memoir, precursor of the *System der Asteroiden*, where Müller and Troschel described their manner of conceiving the methodological arrangement of asteroids and characterized most of their genera.

Using the number of series of tube feet and the presence or absence of an anus, they divided the asteroids into three families. The first, with the tube feet arranged in four rows and with the digestive tube with an anus, included the two genera *Asteracanthion* and *Stichaster*.

In the two others, the tube feet are in two rows. The character distinguishing the second and third family is the presence or absence of an anus.

The second family contains the genera *Echinaster*, *Crossaster*, *Chætaster*, *Ophidiaster*, *Linckia*, *Goniaster*, *Asteropsis*, *Culcita*, *Asteriscus* and *Archaster*. The third family is reduced to two genera, *Asterias* and *Hemicnemas*.

Some of these names raise objections. First, the genus *Asteracanthion* had been named *Uraster* by Forbes, considered by Agassiz, but then discarded by this scholar for that of *Stellonia*. Nardo designated *Asteracanthion* and *Echinaster*. The name *Asteracanthion* cannot be retained. It is the same for the names of *Crossaster* and *Hemicnemis* applied to these animals for which Forbes in 1838 had created the names of *Solaster* and *Luidia*. The *Goniaster* of Müller and Troschel corresponds then more strictly to the *Pentagonaster* of Linck than the *Goniaster* of Agassiz. It is also a name that should not be accepted. Likewise, Nardo had changed *Asteriscus* to *Asterina*. And it is not because Müller and Troschel combined *Palmipes* with this genus that the name is not

acceptable. As for the *Asterias* of Müller and Troschel, already in 1733 they had been combined by Linck into one of his best genera, the genus *Astropecten*, which should be accepted. The name of *Asterias*, given by Agassiz to *Astropecten* and accepted for these animals by Müller and Troschel, thus remains vacant. As it is good to preserve it in nomenclature because it was the first used. It is generally agreed today to give it to the *Asteracanthion* of Müller and Troschel, among which are the most common asteroid of our coasts. Moreover, Müller and Troschel have not preserved most of the names that we have just criticized. In the *System der Asteriden*, that appeared two years later, their classification underwent some changes.

In the first memoir, Müller and Troschel did not describe any species. We will discuss a little later the validity of their three families in considering their definitive work.

At the end of 1840, at the beginning of which had appeared the memoir *Ueber Gattungen der Asterien*, Gray published in volume 16 of *Annals and Magazine of Natural History*, a *Synopsis of the Genera and Species of the Class Hypostoma (Asterias Linnæus)*, reprinted in 1866 with some additions and plates.

Gray first divided asteroids into two sections based on the number of rows of tube feet, which could be four or two. The first section contained only one family, *Asteridæ*, in which Gray placed the genera *Asterias* and *Tosia*, corresponding to the *Asteracanthion* of Müller and Troschel, and finally *Mithrodia*. The last genus was created for one of the species of *Ophidiaster* of Müller and Troschel, *Ophidiaster echinuatus (Asterias clavigera Lmk)*.

The second section contained three families, *Astropectinidæ*, *Pentacerotidæ*, and *Asterinidæ*. The first contained six genera; the second, thirty one genera; the third, four for a total of forty six. One can see there the extreme degree Gray divided the class of asteroids. This number of genera is obviously very large. Moreover, the names of genera of Gray are after those of Müller and Troschel. It will necessary to consider them only when they correspond either to an entirely new genus or to a division of one of the old genera that appears natural. It is not the same with species. In 1840, Müller and Troschel did not describe any species. Gray named many and gave to each some characters he did not describe. However, these characters are sometimes sufficient to recognize them. Moreover, some figures were published in a new *Synopsis* in 1866. I have been able to make a careful study of the types of Gray in the British Museum. Very often, his names are preferable to the subsequent ones of Müller and Troschel.

We finally reach the work that has remained a classic to this day, the *System der Asteriden* of Müller and Troschel, 1842.

In this work, Müller and Troschel preserve the divisions they had first adopted and established the following classification.

## CLASS OF ASTEROIDS

*First family.* — Four rows of tube feet; an anus. Genus *Asteracanthion* M. T.

*Second family.* — Two rows of tube feet, an anus. Genera: *Echinaster* M. T.; *Solaster* Forbes; *Chætaster* M. T.; *Ophidiaster* Agassiz; *Scytaster* M. T.; *Culcita* Agassiz; *Asteriscus* M. T.; *Oreaster* M. T.; *Astrogonium* M. T.; *Goniodiscus* M. T.; *Stellaster* Gray; *Asteropsis* M. T.; *Archaster* M. T.

*Third family.* — Two rows of tube feet, no anus. Genera: *Astropecten* Linck; *Ctenoodiscus* M. T.; *Luidia* Forbes; *Pteraster* M. T.

In all, three families and eighteen genera. We are far from the forty six genera of Gray, which are not as bad as many naturalists appear to believe.

One notes that in their definitive work, Müller and Troschel have replaced correctly the name of *Crossaster* M. T. for the older *Solaster* Forbes. In contrast, the name of *Linckia* Nardo has been without a plausible reason replaced by the new name *Scytaster*; *Goniaster* has been divided into two genera: *Astrogonium* and *Goniodiscus*, for which one should have preserved the original name. Finally, *Hemicnemis* has replaced the name *Luidia* that Forbes had given. In a supplement, *Pteraster* has been added to the list.

In 1862, in *Histoire des Echinodermes* that was part of *Suites à Buffon* of Roret, Dujardin and Hupé only reproduced the method of classification of Müller and Troschel while adding however some genera such as *Acanthaster* Gervais and *Cribrella* Agassiz, separated from *Echinaster*; the genus *Nectria* Gray, separated from *Goniodiscus* and the genus *Palmipes*, separated from *Asteriscus*.

But not all authors have been as accommodating and in fact the classification of Müller and Troschel is wrong in several points. In the first place, it is sufficient to compare an *Archaster* with an *Astropecten* to recognize that the only essential difference that separates the two genera is the presence of an anus in one and its absence in the other. I noted this fact in 1869 in my thesis on pedicellariae, adding however that in *Archaster typicus* and *angulatus* that I have examined there are always some pedicellariae that are lacking in *Astropecten*. I said in addition that the presence or absence of an anus in asteroids that seems to characterize families so natural does not appear basically very important, the anus being very reduced in this group. In 1871, Dr. Lütken made the same remark, insisting more on the resemblances of *Archaster* and *Astropecten* and preserving these two genera because of the ease with which the presence or absence of an anus could be observed. "As a matter of fact, if one finds an anus in an *Astropecten*, it must pass into the genus *Archaster*." I remain struck by the fact that, in the old *Astropecten* with an anus that one would pass into *Archaster*, the pedicellariae are always lacking while they are found, as I have just reassured myself again, in the three species of *Archaster* of Müller and Troschel. It is a character that would well be worth considering.

Whatever it is, we can only agree with the opinion of Doctor Lütken when he stated that *Archaster* and *Astropecten* should necessarily be in the same family. The two last families of Müller and Troschel should be greatly modified. As for the first, we will see soon if it is not possible to modify its characteristic. The arrangement of paxillae of the dorsal ossicles appears very characteristic of the family *Astropectinidae* and then it is necessary to place there the genera *Chataster*, *Archaster*, *Astropecten*, *Ctenodiscus* and *Luidia*. One can note, it is true, that the dorsal ossicles covered with scales of *Nectria* are basically very large paxillae, so that it would be necessary, perhaps, also to place these *Stellerides* into this family. But numerous transitions connect them either to *Pentagonaster* or to *Linckia*, and one should place them into the first of the two families.

So one of the basic characters of Müller and Troschel, the presence or absence of an anus, would not be considered as a characteristic of the family. Is the number of rows of tube feet better? It does not seem so.

In 1861, in proposing to create his family of *Pycnopodidae*, Stimpson<sup>2</sup> expresses himself about this: "Müller and Troschel give as a basic character that distinguishes this family *tube feet arranged in four rows*, the other sea stars having only two rows. But the increase in number of rows is simply the result of the growth necessary for the arrangement of the larger number of tube feet in some species. There are some *Asteracanthion* that have only two rows of tube feet (not

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<sup>2</sup> On New Genera and Species of Starfishes of the Family Pycnopodidae (Proceedings of the Boston Society of Natural History, v. VIII, December 1861.

exactly linear) and others that, at the base of the arms, have to the contrary six or eight perfectly clear rows.”

Stimpson thus rejected the character invoked by Müller and Troschel, a character that is not absolute but however has a very large generality. Unfortunately, we have not been able to observe *Asteracanthion* with two sinuous rows of tube feet, and we cannot say consequently to what degree these Stellerides are separated from their congeners. It seems, however, according to Stimpson, that in them the rows of tube feet are never absolutely rectilinear as in other asteroids. But it remains to be known if some genera with only two perfectly rectilinear rows of tube feet should not be close to the *Asteracanthion* of Müller and Troschel. In this case, the character of the family they proposed must disappear. But there is another reason it cannot be used: it is that in a *Pteraster* discovered by Sars, *Pteraster multipes*, the tube feet are arranged in more than two rows, although they are biserial in other Stellerides of the same genus and that *Pteraster* has no relation to *Asteracanthion*.

So, in the present state of science, no basic characters of the families accepted by the authors of *System der Asteriden* can be preserved as absolute characters.

The name of *Pycnopedidæ* given by Stimpson to the first family of asteroids of Müller and Troschel gives only the multiplicity of the number of tube feet as characteristic of this family. If it is necessary to place asteroids with absolutely biserial tube feet in this family, the name *Pycnopedidæ* is not applicable to them. To the contrary, it would be to *Pteraster multipes*. Consequently, the reasons for rejecting the characters proposed by Müller and Troschel should equally reject the new name of the family proposed in 1861 by Stimpson. We much prefer the older and easier to understand name of *Asteriadæ* proposed in 1840 by Gray.

The only reason that one can make against this name is that it can be confused with the term Asterides that is usually used for sea stars. But this confusion can occur only in ordinary language. In the establishment of scientific nomenclature of asteroids it is easily avoided: the terms ASTERIDA or ASTEROIDA, which designate the entire class, are sufficiently distinct from *Asteriadæ* by which is designated the family of this class that corresponds to the genus *Asteracanthion* of Müller and Troschel.

How is the last family characterized? In 1869, studying the collection of the Museum where there is only *Asteriadæ* with quadriserial tube feet, we were struck<sup>3</sup> by the constant coexistence of four rows of tube feet with certain forms of pedicellariae that we named *straight pedicellariae* and *crossed pedicellariae*. The latter are especially characteristic. We concluded to the equivalence of characters of pedicellariae and those of tube feet. However, it was very evident that the two characters that do not necessarily control one another could very well not be exactly superimposable. We will consider this fact as a remarkable coincidence that we must report, but not otherwise, knowing very well that coincidences of this type have only a relative generality. The *straight and crossed pedicellariae* and the *quadriserial tube feet*, characteristic of the family *Asteriadæ*, are independent of each other. In 1871, Lütken, summarizing and expanding the remarks of Stimpson, made the correct observation that the two types of characteristics are not in fact exactly superimposable because there more than two rows of tube feet in *Pteraster multipes* but neither *straight pedicellariae* nor *crossed pedicellariae* while there are only *crossed pedicellariae* in *Pedicellaster* and *Labidiaster* there are *crossed pedicellariae* only or combined with *straight pedicellariae* and biserial tube feet.

However, Dr. Lütken has slightly modified our proposal in saying that according to us “the existence of *crossed pedicellariae* only or associated with *straight pedicellariae* should associated

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<sup>3</sup> *Recherches sur les Pédicellaires et les Ambulacres des Astéries et des Oursins (Ann. des sc. Nat., 5<sup>th</sup> serie, vol. X)*

with four rows of tube feet.” This proposal substitutes a morphological relation that we have never had in view, having no explanation for it and stating a simple coincidence, which is very different. We have said only: “*The group of asteroids with four rows of tube feet* is characterized by the presence of *crossed pedicellariae* that can be associated with straight pedicellariae.” This indicates that this is for us that one of the distinctive characters of the first family of asteroids of Müller and Troschel of the family *Asteriadae*. It clearly comes from the terms that we have used and that are emphasized in the preceding proposal. It is quite evident by these words: *the group of asteroids with four rows of tube feet* we meant to designate only the *Asteracanthion* of Müller and Troschel and that we do not place *Pteraster multipes* in this group, all of whose characters pertain to another group. There thus remain two groups, each represented by a single species, *Pedicellaster* and *Labidiaster*. We have not been able to study these types in nature. But Doctor Lütken brings together *Pycnopodia*, which are true *Asteriadae*, and *Acanthaster*, which themselves are not without some affinity to the same *Asteriadae*. We thus believe we stretch the truth in considering *Pedicellaster* and *Labidiaster* as members of the family *Asteriadae*, in which the tube feet are biserial as shown in true *Asteracanthion*. In the family *Asteriadae*, the character taken from the arrangement of the tube feet in four rows gradually decreases and finally disappears. In this family and in the group or asteroids with two rows of tube feet, we find all the transitions. Thus this character cannot be used to clearly distinguish the *Asteriadae* and then it is necessary to return to the character taken from the pedicellariae, a character whose proof has been made moreover in the echinoids. We must therefore say “The family *Asteriadae* is characterized by *crossed pedicellariae* that can be alone or accompanied by *straight pedicellariae*”. This family of *Asteriadae* was once characterized also by the presence of four rows of tube feet. But this character on one hand gradually disappears and finally ceases to apply to all members of the family, and on the other hand it belongs to a few sea stars that are attached to other groups. Therefore it cannot be considered distinctive. It should be indicated a family characteristic only as the usual arrangement in *Asteriadae*.

So the expressions *family Asteriadae* and *group of asteroids with four rows of tube feet* cease to be synonyms. But our proposal of 1869, modified, not in its sense, but in its revision, as we said earlier, not only remains true but, even more importantly, to the fact that pedicellariae provide henceforth the only external character, easy to see without preparation, that distinguishes the family *Asteriadae* from all the other families of sea stars.

In summary, the first divisions proposed by Müller and Troschel in the class of asteroids, nothing remains, so to speak, because the characters proposed to distinguish these families have nothing absolute. We shall see below the observations that give the characteristics of genera. The work of Gray with four families (*Asteriadae*, *Astropectinidae*, *Pentacerotidae*, and *Asterinidae*) is incontestably preferable in the whole. But in the class *Asteroidea*, Gray has two sections characterized by the number of rows of tube feet. These two sections should obviously disappear. Moreover, the distribution of the genera of Gray into his four families is sometimes defective. Finally, the family *Pentacerotidae* including *Echinaster* M. T., *Ophidiaster* Ag., *Astrogonium* M. T., *Oreaster* M. T., and *Culcita* Ag., is obviously not homogeneous and can be subdivided into three others, that of *Echinasteridae*, *Linckiadae* and *Goniasteridae*. We prefer the latter name instead of *Pentacerotidae* proposed by Gray because the genera making up this family are very near those making of the genus *Goniaster* Agassiz. *Pteraster* M. T., is not easily classed into any group and they have characteristics sufficiently great that one is justified in forming a distinct family of them. Consequently we accept the following seven families in the class *Asteroidea*: 1. *Asteriadae*, 2. *Echinasteridae*, 3. *Linckiadae*, 4. *Goniasteridae*, 5. *Asterinidae*, 6. *Astropectinidae*, 7. *Pterasteridae*.

These seven families appear to us to meet all the present requirements. All the asteroids of the Museum of Paris are easily arranged, but it is doubtlessly necessarily to add an eighth for *Brisinga* with the name *Brisingida*.

How are these different groups characterized?

I previously insisted on the characters furnished by the pedicellariae. In the family *Asteriadae*, where all that is known to now indicates that the *crossed pedicellariae*, always present, are a good character. It is remarkable in addition that in this family they are related in a very indirect fashion to the skeleton and the pieces appear to be associated with the dermis itself. In all the other families, to the contrary, the pedicellariae make in some way a part of the skeleton itself. While in the first case the basal piece that supports the jaws is always independent of the skeleton and is not connected to the body of the animal by a muscular peduncle, the whole organ being enveloped by a particular dermal extension. In the other asteroids, the basal piece of the pedicellariae makes in some way part of the skeleton. Sometimes it is a kind of cupule embedded among the other ossicles, but its exclusive role is to receive the jaws of the pedicellariae. Sometimes it is an ordinary ossicle of the skeleton that is crossed by one or several alveoli into which the pedicellariae are sunk. As a result, there is a close relation of the skeleton in all the modifications, accidentally or otherwise, can affect their presence. As the principal pieces of the skeleton are a little more developed, the cupules between them disappear. As the calcite in these same pieces becomes more abundant, the alveoli with crosses then are combined and the pedicellariae then disappear. It follows that the existence of these organs, because of their subordination to the skeleton is, in some way, more uncertain in families than in the *Asteriadae*. Also we see them absent or present in species in the same genus and in the same species varying in number and position in different individuals and perhaps in the same individual of different ages. It is particularly in species or genera with small pedicellariae, with several enclosed together in the same ossicle, that the variations are numerous. It is no longer possible to use these organs to characterize genera in an absolute manner, still less for families. However, when pedicellariae are present, their form and arrangement do not depart from certain rules. It is first to note that constantly, in all sea stars other than the *Asteriadae*, the branches of the pedicellariae, whether they are *valvular* or with *pinchers*, are enclosed in a cavity of the basal piece, while in the *Asteriadae* they are simply *supported* by this piece. I do not speak of the *crossed pedicellariae* of this family whose arrangement is so special that it has no analogy elsewhere. I shall add that ordinarily the pedicellariae with pinchers of adambulacral ossicles are remarkable in their constancy in certain genera, such as *Pentaceros* or *Oreaster*, and can consequently provide good characters. So these genera are not sufficiently distinct on the other hand. They show in all cases that it is justified to use them when the more apparent characters are missing and that, in doubtful cases, they can provide important elements for decision. This justifies the solution that we proposed relative to the zoological position of *Pedicellaster* and *Labidiaster* and to the limits that we have attributed to the family *Asteriadae*. This family perhaps merits even to be placed in a special section, as Müller and Troschel implied and Gray did not hesitate to make.

So in the four last families of *Asteroida*, the pedicellariae cannot be used as characters. There is scarcely one assemblage that can be the bases of a methodical arrangement. It is the skeleton and diverse pieces that we have to use. I speak here of the dermal skeleton to which are attached and are subordinated the spines, tubercles, granules etc., whose arrangement can provide characters more or less valid, but usually subordinate.

Actually, it usually this type of character that authors used to establish their principal divisions. This is quite obvious in the classification of Gray and even, although less so, in that of Müller and Troschel. Unfortunately, our knowledge of the skeleton of asteroids is very imperfect, in spite of numerous and important studies, as those of David Kade, Tiedemann, Delle Chiaje, Meckel, Agassiz, de Blainville, Duvernoy and Albert Gaundry. The anatomical point of view dominates in these studies that generally have too few types to make it possible to make precise applications to systematics. There thus remains in the characteristics of families according to the arrangement of their skeleton some vagueness that future work will without doubt resolve. However, by restriction to the most general arrangement of the skeletal pieces, these characters can be briefly described in this way:

Echinasteridæ. — Skeleton formed of a network of elongated ossicles, with a space between them of a mesh at least as large as the ossicles making a network that has more or less elongated spines. Arms usually very elongated, conical or cylindrical in form. Pedicellariae, when they occur, with pincers. One genus with valvular pedicellariae.

Linckiadæ. — Skeleton formed of rounded or elliptical ossicles, contiguous or connected by elongated trabulae, arranged at least on the ventral surface in longitudinal rows more or less numerous and perfectly regular. — No spines, but surface of the body smooth or uniformly granulose. — Pedicellariae, when present, having the form we will describe later under the name of *excavate pedicellariae*.

Goniasteridæ. — Skeleton formed, at least on the ventral surface, of rounded or polyhedral ossicles arrange to form a kind of pavement, dermis naked or covered with granules. Usually two rows of marginal plates, one dorsal, the other ventral, larger than the usual plates. — Pedicellariae with *pincers* and *valvular* when they occur, which is the most frequent case.

Asterinidæ. — Ossicles of the skeleton have the form of flat plates, usually imbricated, arranged in more or less regular series, most often indented, rarely and completely separated, usually having on the ventral surface a variable number of sometimes very large or small spines, more or less elongated. — pedicellariae, when present, with pinchers, never valvular (in known species) and little different from spines.

Astropectinidæ. — Skeleton formed, at least on the dorsal region, of tight, contiguous ossicles, often hourglass shaped, often covered with tubercles with small radiating spines and the basis of the name *paxillae*. — Pedicellariae, usually lacking, with pinchers. Valvular pedicellariae are not known.

Pterasteridæ. — Sufficiently characterized by the well-known arrangement of the dermal appearance. The Brisingidæ need new studies.

The families having been established, it is now necessary to examine how the genera can be divided. We have pointed out the genera of Linck, Nardo, de Blainville, and Agassiz. We know which should be preserved and those that should be modified. The total number is too small to consider them other than a first attempt of a division of asteroids. In creating the genera *Solaster* and *Luidia*, Forbes had made progress in the history of European sea stars. But his works considered only the species of our seas, and the first general work on the entire class that had been tentative in relation to the requirements of present science is that of Müller and Troschel, whose program was published in 1840 but took the definitive form in 1842 in the *System der Asteriden*.

It is appropriate to discuss the genera adopted by these authors that have priority over those of Gray. We so not abstain for this reason our resumption, in more detail, our evaluation of each family. At the moment, we want only to establish the system of classification that we have adopted and to give a synoptic table.

In their first family, that which corresponds to our Asteriadæ, Müller and Troschel had only one genus, *Asteracanthion*, which corresponds to our *Asterias*. It is easy to establish very good divisions in this family. This has been done by several authors whose point of view we must examine.

First, in 1840, Müller and Troschel created a genus *Stichaster* that they have since abandoned for two species remarkable for the large compact granules that replace the sharp or blunt spines of other species. I want to discuss *Asteracanthion roseus* and *aurantiacus* of the *System der Asteriden*. It is not only the ornamentation of the dermis that is remarkable in these species. It is also the arrangement of the ossicles of the skeleton that, instead of forming as usual an irregular network, are elongated transversally, arranged in longitudinal rows and imbricated in each row. This arrangement is especially striking in *Asteracanthion aurantiacus* from Chile.

The genus *Stichaster*, abandoned by Müller and Troschel, preserved by Gray under the name *Tonia*, resumed by Norman, Verrill and others. It seems necessary to preserve it because of important characters that provide the form and arrangement of the skeletal pieces in this genus. Gray had formed another section in his genus *Asterias*, equivalent to the *Asteracanthion* of the German authors, for *Stellerides* with four rows of tube feet. It contains, with the name *Heliaster*, asteroids remarkable for the number of arms that can reach 40 cm, fused for most of the length to form a very large disk and free only for a length of some centimeters. In the true *Asteracanthion* with more than five arms, the arms to the contrary are free their entire length and the disk is very small. This results in *Stellerides* close to *Asteracanthion helianthus* M.T., a very characteristic physiognomy that justifies very well the adoption of the genus *Heliaster* that appears moreover to contain several species very difficult to distinguish. I understand less the necessity of the genera *Leptasterias*, *Coscinasterias* and *Cælasterias* of Verrill. But the genus *Pycnopodia* of Stimpson certainly merits consideration. It has been created for *Asterias helianthoides* of Brand, remarkable for the number of arms and extreme reduction of the dorsal skeleton, formed of thin sparse ossicles with small spines. These ossicles are united into a network only on the disk.

It is this genus that establishes a transition to *Labidiaster* and *Pedicellaster*, that we consider belonging to the family Asteriadæ. To these genera we have added two small species that have a skeleton formed of imbricated ossicles like those of Asteriadæ and covered with a naked skin with spines, while the other has only five arms and the form of an *Asterina* like the preceding, lacks nearly completely a dorsal skeleton. I have named these genera *Calvasterias* and *Anasterias*. We thus accept into the family Asteriadæ the genera *Asterias* Linné (with *Leptasterias* and *Coscinasterias* as sub-genera); *Stichaster* (with *Cælasterias*) M. T.; *Calvasterias* E. P.; *Anasterias* E. P.; *Heliaster* Gray; *Pycnopodia* Stimpson; *Labidiaster* Lütken; and *Pedicellaster* Sars. We must refer to the next family, that of Echinasteridæ, in creating for it a new genus, *Asterias striata* of Lamarck, that Müller and Troschel incorrectly placed in their genus *Asteracanthion*, as we shall see in the specific part of this work. This new genus, for which we propose the name *Valvaster*, is remarkable for the presence, along each side of the arms, of a row of large valvular pedicellariae, that which is absolutely exceptional in the Asteriadæ and in the Echinasteridæ. Moreover, by their biserial tube feet, the pedicellariae with pincers and by the texture of their skeleton, *Valvaster* is as close as possible to other Echinasteridæ. This last family corresponds nearly exactly to the genus *Echinaster* of Müller and Troschel, which seems to us cannot remain undivided. *Asterias echinites* Lamarck is the type of a group very clearly characterized by the large number of arms and the arrangement of its spines. At the beginning of 1840, Müller and Troschel combined it with *Echinaster*. At the end of the same year, Gray created for it the genus *Echinaster*, placing the other *Echinaster* of Müller and Troschel into the genera *Othilia*, *Rhopiia* etc. The name *Echinaster*

duplicates one with a different meaning previous proposed<sup>4</sup> by Müller and Troschel. It should be rejected. Paul Gervais replaced it in 1841 by *Acanthaster*. Finally, in 1844, Müller and Troschel accepted this generic division and proposed for it the name *Echinites*, that cannot be substituted for the older one given by Gervais and that was accepted by Lütken and authoritative authors regarding Stellerides. We also believe, as Forbes, Dujardin, Hupé and Doctor Lütken, that it is necessary to preserve the genus *Cribrella* (sens. restr.) of Agassiz. Its species have an appearance so characteristic and whose type is *Echinaster oculatus* of Müller and Troschel. Finally, after the example of von Martens<sup>5</sup>, we think that *Ophidiaster echinulatus* Müller and Troschel has more affinity with *Echinaster* than with *Ophidiaster* and we have replaced it into the family Echinasteridæ. However, we cannot accept with von Martens that it is a true *Echinaster* and we preserve for it the genus *Mithrodia* proposed by Gray in 1840. *Ophidiaster echinulatus* M. T. should be *Mithrodia clavigera* Lmk. Sp. — This animal is the same as *Mithrodia spinulosa* that Gray placed incorrectly in the Asteriadæ as *Heresaster papillosus* Michelin.

In summary, the genera in the family Echinasteridæ are:

*Acanthaster* P. Gervais; *Echinaster* M. T.; *Cribrella* Agassiz; *Valvaster* Ed. Perrier; *Mithrodia* Gray.

The Linckiadæ corresponds in part to the genus *Linckia* of Nardo, the genera *Ophidiaster* and *Linckia* of Agassiz, and the genera *Ophidiaster* and *Scytaster* of Müller and Troschel. The boundary of these last genera has been the basis for numerous discussions. Müller and Troschel had distinguished them by the arrangement of the papullae which would be grouped in *Ophidiaster* and isolated in *Scytaster*, which they first named *Linckia*. But they did not take into account this character when they placed *Asterias variolata* Lamarck, whose characters are very similar to those of their *Ophidiaster ruberculatus*, with *Scytaster*. This same observation can be made in regard to *Scytaster zodiacalis* Müller and Troschel whose pores are also united in groups. More *Ophidiaster* have their pores isolated at a young age and consequently would be *Scytaster*. This is the same fact that led Duchassaing and Michelin to name *Scytaster stella*, which is nothing but *Ophidiaster ornithopus* Valenciennes. The genus *Scytaster* of Müller and Troschel cannot keep its original characteristic.

The species of the two genera, *Ophidiaster* and *Scytaster* of Müller and Troschel, have been divided differently by Gray. In 1840 and 1866, he accepted for them the genera *Dactyloaster*, *Linckia*, *Tamaria*, *Cistina*, *Nardoa*, *Ophidiaster*, *Narcissia*, *Gomphia* and *Fromia*. This is a lot. Also these genera, some of which were known, have not received much acceptance. von Martens has even, in 1864, proposed purely and simply the combination into a single genus the *Ophidiaster* and *Scytaster* of Müller and Troschel, which is the opposite excess. As Doctor Lütken said very well, from 1864, it is sufficient to compare *Ophidiaster ophidianus*, and *Scytaster variolatus* to see that it is a matter of three very different types. Doctor Lütken characterized these three types by the different arrangements of the adambulacral spines. To the Stellerides that are close to *Ophidiaster ophidianus* of Müller and Troschel, he kept the name *Ophidiaster*. Those close to *Ophidiaster miliaris* M. T. became *Linckia*, and the name *Scytaster* was given to *Ophidiaster tuberculatus*. To the *Scytaster* of Müller and Troschel, to which Doctor Lütken joins with all the

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<sup>4</sup> Gray says however to have made use of this name in *Synopsis* of the British Museum before 1840. But this work remains unknown to most naturalists and the genus *Echinaster* does not appear to have had precise characteristics. The question of priority remains doubtful. It would be inconvenient to adopt the significance given the name by Gray in the presence of nearly general acceptance of the name of Müller and Troschel.

<sup>5</sup> *Ost-Asiatische Echinodermen*, (Troschel's *Arch. Für Naturg.*, jahrg. XXXII).

more reason, *Oreaster Desjardinsii* of Michelin that is nothing more than a slightly deformed *Scytaster zodiacalis* of Müller and Troschel.

We shall see in the specific part of this work that the three genera proposed by Doctor Lütken can be distinguished by still more important characteristics than those used by the Danish scholar. But we shall also see that some transitions exist between these three genera. If it is possible to accept them at this time, it is also necessary to have some reservations for the future. It can happen that we will be required to combine them into a single genus, that it will always be necessary to divide them into sub-genera corresponding to the three types defined by Doctor Lütken. In this regard, it is necessary to make another remark. If *Ophidiaster ophidianus*, *Linckia miliaris* and *Scytaster variolatus* are three distinct types, we believe we can add that *Scytaster milleporellus* differs still more from *Scytaster variolatus* than the latter from Linckiadæ belonging to the two other genera. Its flat form, its double row of large marginal plates, its rounded skeletal ossicles, its isolated papular pores are characteristics that separate true Linckiadæ and brings it much closer to *Pentagonaster*, from which it differs only by its profoundly notched arms. The same observation applies to *Scytaster subulatus* Lamarck sp., whose aspect recalls in some ways those of *Goniodiscus* and whose spines of the dorsal plates have a special type. I thus believe that it would be advantageous from the point of view of homogeneity of genera to keep for *Scytaster milleporellus* the generic name of *Fromia* proposed by Gray, and for *Scytaster suulatus* that of *Mitrodira* proposed by the same author. We could even move these two genera to the Goniasteridæ so that, if this view should prevail, the family Linckiadæ has only the genera *Ophidiaster* Agassiz (pars), *Linckia* Nardo (pars), and *Scytaster* Müller and Troschel (pars), to which are added *Leiaster* Martens and *Lepidaster* Verrill that do not exist at the Museum. In any case, the genera *Fromia* Gray and *Mitrodira* form a natural transition from the Linckiadæ to the Goniasteridæ.

We assured ourselves that the *Dactylosaster* and *Tamaria* of Gray are only *Ophidiaster*; *Gomphia* and *Narcissia* as *Scytaster*, the same as *Nardoa*. There remains *Cistina* for which we have been unable to have any information at the British Museum, but which is probably near *Ophidiaster*. It is also in the family Linckiadæ, near *Scytaster*, that is placed in the curious genus *Ferdina* Gray, a genus we keep.

The family Goniasteridæ is where we find the greatest number of diverse forms. It corresponds to the genera *Pentagonaster* and *Pentaceros* of Linck, *Goniaster* and *Culclita* of Agassiz; and *Astrogonium*, *Goniodiscus*, *Stellaster*, *Asteropsis*, *Oreaster* and *Culcita* of Müller and Troschel. This is the family Pentacerotidæ, less the genera constituting the families Echinasteridæ and Linckiadæ. The genera of Müller and Troschel, that we attach to this family, do not all have equal validity. Müller and Troschel distinguished *Astrogonium* from *Goniodiscus* by the fact that the marginal skeletal plates of the former have granules only on their border while they are uniformly granulated in the second. Now, we find all possible intermediaries between these two arrangements. It thus is impossible to distinguish thus these two genera. We also saw in 1864 Dr. Lütken<sup>6</sup> proposed to combine *Astrogonium*, *Goniodiscus* and *Stellaster* of Müller and Troschel, as well as some others of Gray, under the name *Goniaster*. In 1866<sup>7</sup>, von Martens expressed the same view. But we recognize, however, that the genus *Goniodiscus* of Müller and Troschel is conspicuously artificial and should be completely broken up. First there are species whose skeletal ossicles, although entirely granular, are rounded or polygonal as in *Goniodiscus regularis* and *mammillatus*. Actually these Stellerides do not differ from the true *Astrogonium*, to which it is appropriate to restore the old name of Linck. Some species are remarkable for the

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<sup>6</sup> Vidensk. Meddel.

<sup>7</sup> Ost-Asiatische Echinodermen. (Troschel's Arch. für Naturgeschichte.)

ossicles of their skeleton variously notched to provide space for the papular pores and their anus is surrounded by four skeletal plates. Their arms are generally very distinct. Such are *Goniodiscus Sebæ*, *pleyadella* and *cuspidatus*. These species have a physiognomy very special and merit constituting a generic division to which we give the name *Goniodiscus*. *Goniodiscus pentagonulus* with a reticulated dorsal skeleton, a ventral skeleton formed of ossicles, each with a large valvular pedicellaria, and very developed dermis also constitute a very distinct type that has generic value. This is the type of the genus *Anthenea* of Gray that we keep. *Goniodiscus occelliferus*, type of the genus *Nectria* of Gray, is still more distinct. The genus *Goniodiscus* of Müller and Troschel is separated into four parts. One is attached to *Astrogonium* to form the genus *Pentagonaster*, while the three others remain as distinct genera.

On the other hand, the genus *Astrogonium* itself, although infinitely more homogeneous than that of *Goniodiscus*, contains at least one form, *Astrogonium phrygianum*, that appears to us must be isolated and that, in addition to a completely particular physiognomy, has on each ossicle of its ventral surface a large valvular pedicellariae. We accept for this species the genus *Hippasteria* of Gray. It should have the name *Hippasteria plana*. *Calliaster Childreni*, which is also near this form, lacks valvular pedicellariae. It is sufficient to form for it a simple section in the genus *Pentagonaster*. Finally, it is necessary to bring together the forms of *Asterias obtusangula* Lamarck that Müller and Troschel placed incorrectly among *Oreaster*. This species has a ventral surface constituted like that of *Anthenea* and *Hippasteria* and has the same pedicellariae. But its dorsal surface, covered with large granules, is very different. We believe it is necessary to create a new genus for this species with a name separate from *Goniaster*. *Hippasteria* Gray, *Anthenea* Gray and *Goniaster* form a distinct section of the family Goniasteridæ, like *Pentagonaster* and *Goniodiscus*. The third section is constituted by the genera *Asterodiscus* Gray, *Culcita* Agassiz, and *Oreaster* M. T. The latter should retake the name *Pentaceros* given it by Linck.

There remains a very embarrassing genus, *Asteropsis*. The forms that Müller and Troschel have combined in this genus have in common only the fact of having skeletal ossicles covered by a naked skin without spines or granules. But this character is found accidentally in other groups and does not appear us of a nature to characterize a genus. Also, the genus *Asteropsis* of Müller and Troschel combines very disparate forms that Gray had, with very good reason, separated and placed in distinct families. For him, *Asteropsis pulvillus* became *Porania*; *Asteropsis vernicina*, *petricia*; and finally *Asteropsis carinifera*, *Gynasterias*. To these genera, it is necessary to add *Dermasterias*, which we believe new and which Müller and Troschel had certainly made an *Asteropsis*. The affinities of *Gymnasterias* are certainly towards *Pentagonaster*. Those of *Dermasterias*, with their large marginal plates, are also on the same side. As for *Porania* and *Petricia*, is it necessary, like Gray, to bring them closer to the Asterinidæ? We do not think so.

In summary, the family Goniasteridæ has three sections and the following genera:

A. *Pentagonaster* Linck, *Goniodiscus* M. T. (emend.), *Gymasterias* Gray, *Asteropsis* M. T. or *Petricia* Gray, *Porania* Gray and *Dermasterias* E. P.

B. *Hippasteria* Gray, *Anthenea* Gray, *Goniaster* Agassiz (sens. nov.).

C. *Asterodiscus* Gray, *Culcita* Agassiz, *Pentaceros* Linck.

The Asterinidæ correspond exactly to the genus *Asteriscus* of Müller and Troschel, who had combined *Palmipes* and *Asterina* of Nardo into a single genus. In reality, in spite of the very intimate affinities of these two genera, the extreme thinness of *Palmipes* separates it from all other asteroids so that this genus is not preserved.

But these are not the only genera of this interesting family and some of the genera of Gray, modified only in their limits, naturally find their place there. These genera are *Patiria*, *Nepanthia*

and *Ganeria*. At least two of these, after the examination we made at the British Museum, merit keeping their identity although Gray has them, from the point of view of species, bizarrely arranged. *Patiria* does not have imbricated dorsal ossicles. All their dermal ornamentation is that of *Asterina*. *Nepanthia* and *Ganeria*, to the contrary, have imbricated dorsal ossicles like *Asterina*, but the thin form of the first recalls *Chætaster*, with which Gray combined them. By their double row of spinous marginal plates, their physiognomy looks like *Astropecten*.

I shall finally add to this family another genus that I created for a species from New Caledonia, remarkable for the thin, rounded and completely unconnected calcareous plates that constitute its skeleton. This genus, for which I propose the name *Disasterina*, the *Asterina* of Nardo, with *Nepanthia* as sub-genus, *Patiria* of Gray, and *Palmipes* of Linck constitute the family Asterinidæ

I have not been able to find the type of the genus *Socomia* Gray, which, according to its author, would be in the same family.

The genera *Chætaster* M. T., *Luidia* Forbes, *Astropecten* Linck, and *Ctenodiscus* M. T. constitute the family Astropectinidæ as we have defined it. Gray placed *Solaster* Forbes there, but we have seen other reasons tending to make them approach Echinasteridæ. *Nectria* Gray likewise has some relation with the asteroids of this group and notably with *Chætaster*. But these are certainly in Goniasteridæ. They were *Goniodiscus* to Müller and Troschel while Gray related them to Linckiadæ. These are strange forms, of which we know too a small number to state their affinities definitively. The genus *Nepanthia* Gray contains, besides the Asterinidæ, the only *Chætaster* known to this scholar. His *Petalaster* is only *Luidia*. I have not been able to find his *Nauricia* at the British Museum.

Peterasteridæ contains up to now only the genus *Pteraster*.

Brisingidæ is not represented in either the Museum of Paris or that of London, whose specimens we have seen in this discussion of genera that it is possible for us to accept.

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Having reached the end of the general part of this work, we must pass to the specific part and make a summary in a synoptic table the system of classification that we have adopted. We extend this table up to the analysis of genera. We include, with two or three exceptions, only the genera that we have examined ourselves.

#### CLASS OF STELLERIDES

(*Asteroida*)

FIRST DIVISION. — PEDICELLARIAE PEDUNCULATE, STRIAIGHT OR CROSSED. TUBE FEET  
ORDINARILY QUADRASERIAL.

- |  |      |  |
|--|------|--|
| One single family  | F. 1 | Asteriadae                                   |
| 1. Tube feet quadraserial or arranged into two sinuous lines   |      |  |
| a. Dorsal skeleton reticulated; number of arms ordinarily five, to ten, twelve or more, disk very small when the arms are more numerous. | 1.   | <i>Asterias</i> Linné 1733                   |
| b. Dorsal skeleton reticulated; number of arms to thirty to forty, fused for the greater part of their length to form a very large disk  | 2.   | <i>Heliaster</i> (Gray, 1840)                |
| c. Dorsal skeleton nearly absent, very numerous arms   | 3.   | <i>Pycnopodia</i> (Stimpson 1861)            |
| d. Dorsal skeleton formed of transversely elongated pieces arranged in longitudinal series   | 4.   | <i>Stichaster</i> (Müller and Troschel 1840) |
| e. Dorsal skeleton formed of imbricated plates as long as wide and covered with a naked skin   | 5.   | <i>Calvasterias</i> (E. P. 1875)             |
| f. Dorsal skeleton nearly absent. Five arms.   | 6.   | <i>Anasterias</i> (E. P.)                    |
| 2. Tube feet biserial  |      |  |
| a. Pedicellariae straight and crossed  | 7.   | <i>Labidiaster</i> (Lütken 1871)             |
| b. Peidicellariae crossed only   | 8.   | <i>Pedicellaster</i> (Sars 1860)             |

SECOND DIVISION. — PEDICDELLARIAE SESSILE, PINCELLATE OR VALVULATE. —  
TUBE FEET ORDINAILY BISERIAL.

- |  |       |  |
|--|-------|--|
| 1. Dorsal skeleton reticulate  | F. II | Echinsteridæ                           |
| a. Arms very numerous, with long spines; many madreporites                                   | 9.    | <i>Acanthaster</i> (Gervais 1841)      |
| b. Arms numerous with ossicles with radiating spines   | 10.   | <i>Solaster</i> (Forbes 1838)          |
| c. Arms usually five, ossicles with isolated spines  | 11.   | <i>Echinaster</i> (M. T. 1840, emend.) |
| d. Arms usually five, ossicles covered with very small spines their entire length            | 12.   | <i>Cribrella</i> (Agassiz 1834)        |
| e. Arms five, isolated spines, a row of large valvular pedicellariae the length of each arm. | 13.   | <i>Valvaster</i> (E. P. 1875)          |

f. Arms five, skeleton with robust spines covered with small scales.	14	<i>Mithrodia</i> (Gray 1840)
II. Dorsal skeleton formed of rounded or quadrangular ossicles arranged in longitudinal series, at least on the ventral surface: skin generally granulose.	F. III	Linckiadae
a. External spines of the adambulacral plates form an elongated row, many larger and less numerous than those or the internal row. Arms rounded, Poriferal areas found on the ventral surface.	15.	<i>Ophidiaster</i> (Agassiz 1835)
b. Adambulacral spines forming a tight double row. Ventral surface of arms flat, formed of at least three longitudinal rows of plates between which the papular pores cannot be seen.	16.	<i>Linckia</i> (Nardo 1834, emend.)
c. Adambulacral spines arranged in two or more rows and pass gradually to the granules of the ventral surface. No more than two rows of ventral plates not separated by papular pores.	17.	<i>Scytaster</i> (Müller and Troschel 1842, emend.)
d. Adambulacral spines arranged in only one row.	18.	<i>Ferdina</i> (Gray 1840)
e. Adambulacral spines a little like <i>Scytaster</i> . Arms flat. Ventral and dorsal marginal plates larger than others. Papular pores isolated.	19.	<i>Fromia</i> (Gray 1840)
(This genus is a transition to the following family.)		
III. Skeleton formed, at least on the ventral surface, by ossicles formed to make a kind of pavement. Dorsal and ventral marginal plates very distinct.	F. IV.	Goniasteridae
a. Dorsal and ventral skeleton formed of plates arranged in a pavement. Pedicellariae small in relation to the plates or not numerous.		
1. Skeletal plates rounded or polygonal.	20.	<i>Pentagonaster</i> (Linck 1733)
2. Dorsal skeletal plates star-shaped.	21.	<i>Goniodiscus</i> (M., T. 1842, emend.).
b. Each ventral skeletal plate with a large valvular pedicellaria.		
1. Dorsal skeleton formed of rounded, naked plates.	22.	<i>Hippasteria</i> (Gray 1840).
2. Dorsal skeleton reticulated, covered with very large granules arranged in groups.	23.	<i>Goniaster</i> (sens. nov.).

3. Dorsal skeleton reticulated or formed of rounded plates. Dermis covered with skeletal plates and giving the animal a glazed appearance. 24. *Anthenea* (Gray 1840).
- c. Ventral plates covered with large granules often interspersed with small pedicellariae. Dorsal skeleton reticulated or formed of elongated ossicles.
1. Body pentagonal. Almost no brachial keel, a large number of ossicles with enormous spines. Marginal plates very distinct. 25. *Nidorellia* (Gray 1840).
2. Arms very distinct, generally keeled. Dorsal marginal plates not conspicuous. 26. *Pentaceros* (Linck 1735).
3. Body very thick, pentagonal without arms, marginal plates not distinct. 27. *Culcita* (Agassiz 1835).
4. A pair of marginal plates only at the end of the arms. 28. *Asterodiscus* (Gray 1840).
5. Five large, short arms; marginal plates not apparent, papular areas as in culcitids. 29. *Choriaster* (Lütken 1869).
- d. Dermis smooth, entirely covering the ossicles.
- Genera:
30. *Gymnasterias* (Gray 1840).
31. *Porania* (Gray 1840).
32. *Asteropsis* (M., T. 1840, — *Petricia* (Gray 1847).
33. *Dermasterias* (E. P. 1873).
- IV. Skeletal ossicles imbricated with spines on their free border or rounded and completely covered with small spines arranged in brushes or completely separate. F. V. Asterinidæ.
- a. Ossicles not imbricated but covered with a considerable number of small spines arranged in brushes. 34. *Patiria* (Gray 1840, pars).
- b. Ossicles imbricated.
- α. Marginal plates smaller than the others, at most equal.
1. Body very flat 35. *Palmipes* (Linck 1735).
2. Body more or less convex, arms robust and short. 36. *Asterina* (Nardo 1834).
3. Arms thin, more or less elongated. 37. *Nepanthia* (Gray 1840).
- β. Body bordered with a double row of marginal plates larger than all the dorsal and ventral plates. 38. *Ganerias* (Gray 1840).

b. Ossicles separated. Skin naked.	39.	<i>Disasterina</i> (E. P. 1875).
V. Skeleton formed of paxillae.	F. VI.	Astropectinidæ
1. No distinct marginal plates.	40.	<i>Chætaster</i> (M., T. 1840).
2. Ventral marginal plates only.	41.	<i>Luidia</i> (Forbes 1838).
3. Dorsal and ventral marginal plates.		
α. No anus.	42.	<i>Astropecten</i> (Linck 1735).
β. An anus.	43.	<i>Archaster</i> (M., T. 1840).
4. Ventral surface covered with several rows of naked, transverse plates.	44.	<i>Ctenodiscus</i> (M., T. 1840).
VI. Dermal covering supported by radiating spines around projecting ossicles of the skeleton.	F. VII.	Pterasteridæ
A single genus.	45.	<i>Pteraster</i> (M., T. 1842).

The genera not found in this table are *Leiaster* Peters 1852; *Meidaster* Stimpson 1857; *Lepidaster* Verrill 1861; *Amphiaster* Verrill 1867 and the genera recently created by Wyville Thomson, *Hymenaster*, *Corethraster* and *Zoroaster*.

#### FAMILY I. — ASTERIADÆ (GRAY 1840).

##### I. GENUS ASTERIAS (LINNÉ).

1735. *Asterias* Linné. *Systema naturæ*.

1733. *Stella coriacea*, Sol, *Pentadactyloaster* (pars), *Hexaktin*, *Helptakfi* Linck. *De Asteriis*, p. 33 and 34.

1834. *Stellonia*, Nardo. *Oken's Isis*.

1834. *Stellonia*, Agassiz. *Prodr. Rad., Mém. Soc. Sc. nat.*, Neufchâtel, t. 1er.

1839. *Uraster* Forbes. *Mem. of Wern. Soc.*, v. VIII, p. 114.

1840. *Asteracanthion* (pars), Müller and Troschel. *System der Ast.*, p. 14.

1862. *Asteracanthion* (pars). Duj. and Hupé. *Suites à Buffon, Echinod.*, p. 330.

The opinions are relatively very divided as to the name that should be given this genus.

In the *System der Aseriden*, that still serves as a guide for most zoologists concerned with the sea stars, the generic named adopted for all the Stellerides by Linné, Lamarck, O.-F. Müller, de Blainville and many others, has completely disappeared. A reaction however has since occurred and many authors have come to the view of Gray who, while breaking up the genera *Asterias* of Linné and Lamarck, has nevertheless preserved this generic name for one of the most common species of our coasts, *Asterias rubens* Linné. It is obvious that a completely arbitrary manner has applied the name *Asterias* to this group and not another. Nevertheless, as remarked by the

Reverend Norman in 1865, accepting the principle that, when breaking up a genus, one should preserve the original name to the new section having the species that can be considered as the type of the former genus, the generic name of Gray's conforms with all the rules and should obviously prevail. If not, we have to go back to Linck, one of whose genera, the genus *Sol*, includes the two single species of *Asteracanthion* M. and T., *Asteracanthion rubens* and *Asteracanthion glacialis*, described in his book. Unfortunately, Linck placed only one of the varieties of *Asteracanthion rubens* in his genus *Sol*. The others are mixed with *Echinaster* M. and T. and *Ophidiaster* M. and T., in his genus *Pentadactyloaster*. But this should not prevent adopting his genus *Sol*, whose only species illustrated is actually part of the same genus. After this come, by order of date, the names of *Stellonia* and *Uraster* of Nardo and Agassiz, who show that, in any case, the name *Asteracanthion*, nearly their synonym, cannot be preserved. In discussions that could promote the name of Linck, no other author has used it after him and forces abandoning the name of Müller and Troschel. We believe it is best to return to the non-Linneéan name, defined by Gray, adopted by a large number of zoologists, and that has the advantage of changing as little as possible the nomenclature in use, while perfectly respecting the established rules for the determination of genera.

Agassiz also gave the name of *Asterias* to *Astropecten*. But the name *Astropecten*, created by Linck in 1773, should be preserved, and *Asterias* is consequently available.

## 1. ASTERIAS GLACIALIS

1713. *Stella hibernica echinata*, Petiver. *Gazophylacium*, pl. XVI, fig. 6.  
 1733; *Sol echinatus cancellatus*, Linck. *De Stellis marinis*, p. 33 and pl. XXXVIII and XXXIX, n° 69.
1776. *Asterias glacialis*, O.-F. Müller. *Prodr. Zool. Daniæ*. p. 234.  
 1783. *Asterias glacialis*, Retzius. *Vetensk. Akad. Handl.*, v. IV, p. 236.  
 1788. *Asterias angulosus*, O.-F. Müller. *Zool. Danica*. Pl. XLI.  
 1792. *Asterias agulosa*, Bruguières. *Enc. Méth.*, pl. CXVII, CXVIII and CXIX, fig. 1.  
 1815. *Asterias glacialis*, Lamarck. *Anim. Sans vert.*, v. III.  
 1823. *Asterias echinophora*, Delle Chiaje. *Memorie, etc.*, vol. II, pl. 356.  
 1826. *Asterias glacialis*, Risso. *Hist. nat. des prod. de l'Europe*, p. 268.  
 1834. *Stellonia glacialis*, Nardo. *Oken's Isis*, v. I, p. 716.  
 1835. *Stellonia angulosa*, Agassiz. *Prod. d'une monogr. Des Radiaires, Soc. Sc. nat. de Neufchâtel*, t. I, p. 5.  
 1840. *Asterias glacialis*., Gray. *Ann. Nat. Hist.*, v. VI, p. .  
 1841. *Uraster glacialis*, Forbes. *British Starfishes*, p. 78.  
 1842. *Asteracanthion glacialis*, Müller et Troschel. *System der Asteriden*, p. 14.  
 1844. *Asteracanthion glacialis*, Düben et Koren. *Mém. Acad. Stockholm*, p.240, n° 17.  
 1857. *Asteracanthion glacialis*, Sars. *Middeth. Littoral Fauna*, p. 51, n° 26.  
 1862. *Asteracanthion glacialis*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 330.

At times it was impossible to determine other than by the date when individuals entered into the collection, Valenciennes gave the following names to specimens specifically identified to this species but of different provenance, and scarcely distinct by any important variation in the arrangement of the spines:

*Asteracanthion Rissoi* to some individuals from the Mediterranean (Savigny, 1825; Kiener, 1829; Coste, 1841).

*Asteracanthion frigidus* to some individuals from the coasts of Spain and Algeria (Deshayes scientific expedition of Algeria, 1842; Quatrefages, 1848).

*Asteracanthion, gelidus* to an individual from Algeria (Guichenot, 1842).

*Asteracanthion, inernis* to an individual also from Algeria, with rows of irregular spines (Guichenot, 1842).

*Asteracanthion echinatus* to two small individuals from Iceland (Quoy and Gaimard, *Expedition de la Recherche*, 1835).

*Asteracanthion angulosa*, to another larger individual of the same provenance.

*Asteracanthion glacians* to an individual from Teneriffe.

Two individuals in good condition were reported from the Cape Verde islands in 1873 by Bouvier.

Numerous specimens dried and in alcohol. — Some from the Michelin collection labelled *Echinaster brasiliensis*.

Three specimens from the seas of the North, labeled *Asteracanthion Linckii*, in the collection of the Museum and whose name I used in my *Recherches sur les Pédicellaires des Astéries et des Oursins* (p. 38), appears to me to be nothing other than a large *Asterias glacialis*. Two came from Bergen (Norway), the other from Cadiz.

## 2. ASTERIAS MADEIRENSIS

1861. *Asterias madeirensis* Stimpson. *On New Genera and Species of the Family of Pycnospodidae*. *Proceedings of Boston Society of Natural History*. v. VIII, p. 2.

We have been able to examine in the British Museum several examples of this species, one dried, others preserved in alcohol. It is really very distinct from *Asterias glacialis*. All the observed individuals came from Madeira.

## 3. ASTERIAS RUDOLPHI (SP. NOV.).

A species near to *Asterias glacialis*. — Seven arms, very long, nearly the same as those of the last species. — Adambulacral spines isolated and of ordinary form; outside is a triple row of very large and obtuse spines. Then comes an empty space, and finally a lateral row of spines supported by very distinct skeletal plates. Not all these plates have spines. In general, those that have them are separated by two spineless plates.

On the dorsal median line is a complete row of very long, pointed spines. Between this row and each lateral row is only an incomplete row of spines nearly the space of each half of the dorsal surface. Crossed pedicellariae form a circular brush around each of the spines. I saw no straight pedicellariae. There is only one madreporite, located in the middle of one of the minor radii of the disk.

The distance from the ends of two alternate arms is approximately 2 decimeters.

Kermadec Islands (British Museum).

## 4. ASTERIAS GELATINOSA.

1834. *Asterias gelatinosa*, Meyen. *Reise um die Erde, Zoolg. Bericht*, v. I, p. 222.  
 1840. *Asterias rustica*, Gray. *Ann. Nat. Hist.*, v. VI, p. 179.  
 1842. *Asteracanthion gelatinosus*, Müller and Troschel. *Syngtem der Asteriden*, p. 15.  
 1862. *Asteracanthion gelatinosus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 331.  
 1865. *Asterias rutica*, Gray. *Synopsis*, p. 1.  
 1869. *Asteracanthion gelatinosus*, Edm. Perrier. *Pédicellaires*, p. 30 and pl. I, fig. 4.

An individual in alcohol reported by Lesson and Garnot (Duperrey Expedition, 1825) and another by Eydoux, 1832, one by Gaudichaud, 1837. These three individuals come from Chile and are preserved in alcohol. Another of very large size was reported from Valparaiso by Gray in 1837. It is dry; an individual from Chile, another from Peru in the British Museum.

#### 5. ASTERIAS TENUISPINA.

1616. *Stella marina echinata*, Columna. *Aquatiliuom et terrestriuom aliquot animalium obs.* VI.  
 1713. *Stella marina alatera, Echinata, seu Cometa marina*. Pl. CXXVI, fig. 13.  
 1813. *Asterias tenuispina*, Lamarck. *An. S. vertèbres.* v. III, p. 250.  
 1823. *Asterias Savaresii*, Delle Chiaje. *Mem. sulla soria*, etc. Pl. XVIII, fig. 6.  
 1840. *Asterias glacialis*, Grube. *Echinodermen des Mittelmeeres und Adriatisches*, p. 21.  
 1840. *Asterias glacialis*, Gray. *Ann. Nat. Hist.*, v. VI, p. 179.  
 1842. *Asteracanthion tenuispina*, Müller and Troschel. *System der Asteriden*, p. 16.  
 1857. *Asteracanthion tenuispinus*, Sars. *Middelh. littoral fauna*, p. 52.  
 1862. *Asteracanthion tenuispinus*, Dujardin and Hupé. *Echinodermes*, *Suites à Buffon*, p. 333.  
 1865. *Asterias tenuispina*, Gray. *Synopsis*, p. 1.  
 1869. *Asteracanthion tenuispinus*, Edm. Perrier. *Pédicellalire*, p. 32 and pl. I, fig. 3, a, b, c.

Numerous individuals dried or in alcohol from the Mediteranean.  
 One from Madeira in alcohol, de Castelneau, 1849.  
 One from the Adriatic, Michelin collection (dried).  
 Three from the Cape Verde islands, Bouvier, 1873.

#### 6. ASTERIAS CALAMARIA.

1840. *Asterias calamaria*, Gray. *Ann. Nat. Hist.* v. VI, p. 179.  
 1842. *Asteracanthion calamaria*, Müller and Troschel. *System der Asteriden*, p. 19 (description translated from Gray).  
 18.... *Asteracanthion australis*, Val. Coll. Mus., manuscript.  
 1862. *Asteracanthion calamaria*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 339.  
 1865. *Asterias calamaria*, Gray. *Synopsis*, p. 1.  
 1867. *Coscinasterias muricata*, Verrill (?). *Transact. Of Connect. Academy of arts and sciences*, vol. I, part II.  
 1869. *Asteracanthion australis*, Edm. Perrier. *Pédicellaires*, p. 28 (the name only cited).

In spite of the briefness of the description of Gray, it seems to me scarcely doubtful that the animal is really his *Asterias calamaria*. But it has been impossible for me to find the type, although that of *Asterias aster*, which approaches it, is in the collection of the British Museum. The label

of Gray does not exist and there are in the collection numerous specimens with many arms coming either from Australia, New Zealand or Mauritius. There are also individuals apparently donated by Verrill that could be considered types of his *Coscinasterias muricata*. All these individuals have not seemed to me to belong to a single and unique species, but they are not all unfortunately in a state of preservation sufficient for a serious study. Thus I do not give here a description of these specimens, one that would be necessarily incomplete and would only encumber the synonymy perhaps uselessly. I will limit my description to the specimens in good condition in the Jardin des Plantes with analogs in the British Museum and that consequently become now the types of *Asterias calamaria*.

Arms varying in number from six to twelve, frequently seven: long, narrow, indented a little at the point of insertion on the disk, of which they are three and a half to four times the diameter. The adambulacra spines are in a single row, long, thin and slightly conical. At a slight distance outside the groove is a double row spines much thicker and conical, contiguous two by two at their base, one being superior, the other inferior, and diverging then in a manner that the plane of angle they form is nearly perpendicular to the axis of the groove. The superior spine of each row has exteriorly a nearly semi-circular fringe of crossed pedicellariae. A large number of straight pedicellariae of large size exists in some individuals between the adambulacra spines and outside the double row that follows them. Five other longitudinal rows of more or less regular spines are arranged nearly at equal distance from each on the rest of the dorsal surface of the arms. These spines are very elongated, conical and each surrounded by a corona of multiple crossed pedicellariae. The disk has a very large number of irregularly arranged spines. Most of the individuals with seven arms have only one madreporite. However, one of them has one very regular and another obliquely elongated in relation to the ray of the disk and separated into two halves by a transverse groove. An individual with twelve arms, with six much shorter than the others, has a regular madreporite separating the group of six small arms into two equal halves. Exactly opposite, sharing consequently also in two equal halves the group of large arms was a group of three madreporites, one circular and completely separate from its two neighbors that are, to the contrary, contiguous, one placed behind the other in the direction of a ray of the disk. The grooves of one extend onto the other so that a simple constriction separates the two plates. The arrangement of the madreporites is still more complex in a specimen with eleven arms. There are four of them. One is very small and circular; another is larger and elongated radially, located in the second following interbrachial interval; the following one is very elongated and irregular, opposite to the fourth interbrachial space that follows the latter; finally the last, larger and more apparent than the others, is elongated perpendicularly to the disk ray and constricted in its middle as if it were at the point of dividing in two.

The irregularities of this genera are found, as it known, in *Asterias brevispinosa*, which it greatly resembles. It is remarkable that this multiplicity of the madreporites is found in two species with a large number of arms. Often half of the body of most individuals is in a very obvious matter regenerating.

It is not without interest to reconcile these facts to the hypothesis of Lütken that some asteroids are susceptible to reproduce by fissiparity.

Seven dried specimens. Six from New Zealand with four to seven arms, one with six and one with eleven (Quoy and Gaimard, expedition of Urville, 1829). — A dried specimen from Australia (Kraft, June 1886) with twelve arms.

Four individuals in alcohol (New Zealand, Quoy and Gaimard, 1829).

We report, although with doubt, a very deteriorated specimen of this species, preserved in alcohol, but whose disk is a little larger relative to the disk. It comes from Australia. — expedition of Quoy and Gaimard, 1829.<sup>8</sup>

*Observation.* — By the number of arms and their dimensions, *Asteracanthion polyplax* of Müller and Troschel seems to be near the preceding species, that is from the same locality. The name *polyplax* given to this species also implies the presence of several madreporites. But we have seen at the British Museum several individuals that correspond perfectly to the description of *Asterias polyplax* and that we consequently assign to this species. They differ very clearly from the preceding species by the characters that we have just described. We recognize *Asteracanthion tenuispinus* as coming from Australia. Is there any confusion with the species of Gray that reaches a much greater size?

#### 7. ASTERIAS GEMMIFER.

18.... *Asteracanthion gemmifer*, Val. Collection of the Museum, manuscript.  
1869. *Asteracanthion gemmifer*, Edm. Perrier. *Pédicellaires*, p. 45 and pl. I, fig. 12, a, b, c.

A single individual in alcohol in good condition. — Chili, Eydoux, 1832.

#### 8. ASTERIAS STELLIONURA.

18.... *Asterias stellionura*, Val. Coll. Mus., manuscript.  
1869. *Asterias stellionura*, Edmond Perrier. *Recherches sur les Pédicellaires*, p. 48, pl. I, fig 10, b and d.  
1871. *Asteracanthion stellionura*, Lütken. *Videnskab. Meddelelse*, p. 300.

This interesting species, which I first described after the individual named by Valenciennes in the collection of the Museum, is indicated to have been collected in Iceland by Quoy and Gaimard (expedition of *La Recherche* in 1825. But Lütken observed that *Asteracanthion stellionura*, that seems to have been collected in a locality where it was very abundant because the Museum has five specimens of the same origin, is not found on the coasts of Norway, whose well-known fauna is the same as that of the coasts of Iceland. This same species is known, to the contrary, among those collected by Steenstrup at Spitzberg. I found it undescribed in the British Museum, but coming also from Spitzberg where therefore the location is very certain. It is thus necessary to consider as doubtful the locality of the specimen in the Museum.

Five specimens in good condition, preserved in alcohol.

#### 9. ASTERIAS JEHENNESII.

18.... *Asteracanthion Jehennesii*, Val. Manuscript. Coll. Museum.

Valenciennes also designated in the collection of the Museum a very deteriorated individual from Madagascar that had seven arms and collected by the captain of the vessel Cloué in 1847. The arms are thin and nearly cylindrical. The ambulacral spines are in only one row on each plate. Those of the ventral plates are in pairs and their ensemble forms a very regular row outside

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<sup>8</sup> Ed. Perrier. *Recherches sur les Pédicellaires*, p. 47, n° 16.

of which are seven equidistant rows of extremely elongated, pointed spines, surrounded at their base by a fringe of numerous moderately long crossed pedicellariae. Moderately elongated, isolated straight pedicellariae are dispersed in large numbers between the spines. Two madreporites are located near the edge of the disk.

The description given by Gray of his *Asterias calamaria* is suitable for this species as an Australian species. In fact, Gray indicated the marine fauna of Mauritius is similar to that of Madagascar and Australia as the origin of *Asterias calamaria*. The specimen we examined shows its spines are very large relative to the size of the individual.

#### 10. ASTERIAS RUBENS.

1710. *Stella marina*, Réamur. *Histoire de l'Académie*.

1733. *Stella coriacea acutangulai*, Linck. *De Stellis marinis*, p. 34, pl. XXXVI, n° 64; pl. IX, n° 19; pl. XXXVII, n° 67.

*Ibid.*, pentapetalos. *Loc. Cit.*, p. 32, pl. XXXVII, n° 67.

*Pentadactylosaster asper*, var. *hispidus* Linck. *Loc. cit.*, p. 35, pl. XXXV and XVI, n° 18.

*Eraktiin sol hexapetalos*, Linck. *Loc. Cit.*, p. 37, p. XL, n° 70.

*Heptaktin heptapetalos corio hispido*, Linck. *Loc. Cit.*, p. 38, pl. XXXIV, n° 58.

1735. *Asterias rubens*, Linné. *Syst. Nat.*, p. 1099.

1776. *Asterias rubens*, O.-F. Müller. *Faunæ danicæ Prodromus*, p. 2830.

1777. *Asterias clathrata*, Pennant. *Brit. Zool.*, v. IV, p. 61, n° 55. *Junior*.

1780. *Asterias rubens*, Fabricius. *Fauna groënlandica*, p. 369.

1783. *Asterias rubens*, Retzius. *Anmarkningar v. d. Asterias genus, Vetenskaps Akad. Stockholm Hand.*, v. IV.

1788. *Asterias rubens*, Linné Gmel. *Syst.*, p. 3161.

1792. *Enc. meth.*, pl. CXII, fig. 3 and 4, and pl. CXIII, fig. 1 and 2.

1815. *Asterias rubens*, Lamarck. *An. Sans vertèbres*, v. III, p. 160.

1826. *Asterias rubens*, Risso. *Hist. nat. des princip. Product. de l'Eruope mer.*, v. V, p. 269.

1834. *Asterias rubens*, de Blainville. *Manuel d'actinol.*, p. 230, pl. XXII, A and B.

1834. *Stellonia rubens*, Nardo. *Isis*.

1835. *Stellonia rubens*, Agassiz. *Prodr. Radd. Sod. Des sc. nat. de Neufchâtel*, V. I.

1839. *Stellonia rubens*, Forbes. *Echinod. of Irish Sea., Mem. Of Wern. Soc.*, VII, p. 121.

1840. *Asterias rubens*, Gray. *Ann. Nat. Hist.*, v. VI, p. 179.

1841. *Uraster rubens*, Forbes. *British Echiol.*, p. 83.

1842. *Asteracanthion rubens*, Müllelr and Troschoel. *Syst. Der Asteriden*, p. 17.

1844. *Asteracanthion rubens*, Düben and Koren. *Mem. Akad. Stockholm*.

1862. *Asteracanthion rubens*, Dujardn and Hupé. *Echinod.*, Suites à Buffon, p. 331.

1865. *Asterias rubens*, von Martens. *Ost. Echinod., Troschel's Archiv*, Jahrg.. XXXI, v. I, p. 354.

1866. *Asterias rubens*, Norman. *Brit. Assoc. Reports*, p. 104 and 195.

1865. *Ibid.*, *ibid.* — . *Annals and Mag. of Nat. Hist.*, 3e series, vol. XV, p. 128.

1869. *Asteracanthion rubens*, Edm. Perrier. *Pédicell*, p. 36.

Numerous examples dried or in alcohol from all the seas of Europe.

*Observation.* — In a recent memoir on the circulation of asteroids, published in the first issue of *Archives néerlandaises*, Hoffmann states that this species lacks an anus. We remember stating the contrary in some number of living individuals we observed in 1869. We have examined again

specimens well preserved in alcohol in the Museum and we are convinced that the anus, although small and often masked by the spines that surround it, actually exists in all.

This is quite certainly an error on the part of the clever anatomist of Holland that moreover easily explains the difficulty to always confirm the presence of a very small orifice in the very irregular surface of the disk of *Asterias rubens*.

## 11. ASTERIAS VIOLACEA.

1733. *Sol coriaea planus* ? Linck. *De Stellis marinis*, p 33, pl IX, n° 15.  
1733. *Stella marina halsaatica coloris violaci*, Dav. Kade, dans Linck. *De Stellis marinis*, p. 97.  
1788. *Asterias violacea*, O.-F. Müller. *Zool. Danica*, pl XLI.  
1788. *Asterias violacea*, Gmelin. *Systema naturæ*, p. 3163, n° 2.  
1805. *Asterias holsatica et Asterias miniuta*, Retzius. *Dissertatio sistens species cognitas Asteriarum*, p. 24.  
1815. *Asterias violacea*, Lamarck. *An. S. vertèbres*, v. III, p 256.  
1834. *Asterias violacea*, de Blanville. *Manuel d'actinologie*, p. 235.  
1835. *Asterias glacialis*, Johnston. *Mag. of Nat. Hist.*  
1839. *Stellonia rubens*, Forbes. *Mem. of Wernerian Society*, v. VIII, p. 122. (*Asteriadae of Irish Sea*).  
1840. *Asterias holsatitca*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 179.  
1841. *Uraster violaceus*, Forbes. *British Starfishes*, p. 91.  
1842. *Asterias violaceus*, Müller and Troschel. *System der Asteriden*, p. 16.  
*Asteracanthion rubens*, var., Müller and Troschel. *System der Asteriden*, p. 126.  
1862. *Asteracanthion violaceus*, Dujardin and Hupé. *Suites à Buffon, Echnodermes*, p. 332.  
1865. *Asterias holsataica*, Gray. *Synopsis*, p. 1, and *Asterias violacea*, Norman, *loc. cit.*  
1869. *Asteracanthion violaceus*, Edm. Perrier. *Pédicellaires*, p. 33.

It is, according to Müller and Troschel, a simple variety of *Asterias rubens*. The collection contains an individual from Iceland with this name that is certainly an *Asterias rubens*. Another individual in the collection from Iceland differs from the typical *Asterias rubens* by the slightly larger size, the shortness and number of dorsal spines that resemble in form those of *Asterias polaris*. Each ventral plate has a transverse row of four or five short, obtuse spines similar to ordinary *Asterias rubens*, where the number of spines however can also be five. Each marginal plate has a row of three slightly oblique spines compared to the marginal line of the arm itself. Each of these plates usually has only two spines in the type. Finally, the pedicellariae are more numerous around the adambulacral spines and on the ventral surface, less perhaps on the dorsal surface, and the constancy seems greater. Having only one individual available to me with this character, I dare not affirm, knowing moreover the extreme variability of *Asterias rubens*, that this individual is specifically different. It has moreover some changes evidently associated with death that makes identification most difficult. Other specimens collected by the same voyagers (Gaimard and Robert), perhaps coming from the same locality, have more numerous straight and crossed pedicellariae than *Asterias rubens*. Although Iceland is indicated as the locality for these individuals, it is necessary to accept with reserve the *Asterias stellionura* that were collected at the same time and with the same geographic indication as coming from Spitzberg, according to the observations of Lütken that I have since confirmed.

Finally, three individuals from Senegal are still identified in the collection as *Asteracanthion violaceus*. But they are distinguished from *Asterias rubens* only by the small number of their irregularly distributed spines and forming only an indistinct series on the medial line of the arms. To the contrary, the spines of the lateral plates, two per plate, larger than those of the dorsal surface and surrounded, like them by a double circle of pedicellariae, form a very apparent line. The ventral plates have three spines in a transverse row each as in ordinary *Asterias rubens*. All the characters remain exactly the same. I do not believe there is a specific distinction.

The examination of all these specimens indicate simply polymorphism and the great geographical extension of *Asterias rubens*. But the various types that one can observe and that one would at first use to separate them are united by so many intermediary forms that it soon becomes impossible to establish any distinct division. I would not accept at this time *Asterias violacea* as a distinct species.

#### 12. ASTERIS ANTARCTICA.

1856. *Asteracanthion antarcticus*, Lütken. *Vidensk. Meddel.*, p. 105.

We have been able to refer to this species several unidentified individuals of the British Museum given by the English admiralty. They come from the Antarctic expedition of the British navy. Some individuals are dried, the others in alcohol.

#### 13. ASTERIAS AMURENSIS.

1871. *Asterias amurensis*, Lütken. *Vidensk. Meddel.*, p. 596.

A good example in alcohol in the British Museum.

#### 14. ASTERIAS FORBESI.

1848. *Asteracanthion Forbesii*, Desor. *Proc. of Boston Society of Natural History*, v. III, p. 67.

1863. *Asteracanthion berylinus*, Alex. Agassiz. *Embryology of Echinoderms*, *Proc. of Americ. Acad. of Arts and Sciences*.

1865. *Ibid. Seaside Studies*. p. 108, fig. 141 and 145.

1866. *Asteris Forbesii*, Verrill. *Proc. of Boston Soc. of Natural Hist.*, v. X, p. 345.

Ten dried examples in very good condition given in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts), directed by L. Agassiz.

A good dried example without indication of provenance from the Michelin collection with the label *Asteracanthion rubens*.

#### 15. ASTERIAS LITTORALIS.

1866. *Asterias littoralis*, Verrill. *Proc. of Boston Society of Nat. History*, vol. X, p. 334.

Three dried examples given in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts) directed by Louis Agassiz. — East Port (Massachusetts).

## 16. ASTERIAS ARENICOLA.

- 18.... *Asteracanthion Novæ Boracensis*, Val. Coll. Muséum, manuscript.  
1861. *Asterias arenicola*, Stimpson. *On New Genera and Species of Starfishes of the Family of Pycnopodidæ*, *Proceed. of Boston Society of Nat. Hist.*, v. VIII, p. 268.  
1869. *Asteracanthion Novæ Boracensis*, Edm. Perrier. *Pédicellaires*, p. 41 and pl. I, fig. 9, a.

A dried example from Charlestown (South Carolina) given in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts), directed by Louis Agassiz. The comparison of this example of two specimens, one alcohol and one dried given in 1821 by Milbert and designated by Valenciennes as *Asteracanthion Novæ Boracensis* leaves scarcely any doubt about their identity. The species are indicated as coming from New York on a recent label by Louis Rousseau. But an older label with the dried specimen has the simple statement: northern America, Milbert, 30 September 1822, which is necessary to maintain.

The specimens of Milbert appear to me to have arms a little more elongated and straight pedicellariae a little larger than those of the specimens of the Museum of Cambridge. But they are without doubt individual differences. The adambulacral spines, as well as those of the individual of Agassiz and the individuals of Milbert, frequently with small straight pedicellariae ordinarily located very near the top of the spine. However Stimpson says in his description that the spines have no pedicellariae. Finally, the madreporite is large and remarkably near the border of the disk. The American author merely says: "Rather nearer to the margin than to the centre of the disc." I will refer, but with a little doubt, to this species three small individuals, likewise due to Milbert and labeled *Asterias Novæ Boracensis*, that is distinguished by very long spines, a little thin and having a tendency to be arranged in rows that, moreover, are never absolutely regular. These are very probably characters related to the age of these small specimens. Finally, another individual purchased in 1852 by Richard and coming from East Port (Canada, apparently is this species.

The Museum has six dried specimens and one in alcohol.

Var. *Asterias Lacazii*, E. P. *Pédicellaires*, page 54. — (*Echinaster echinura*, Val., manuscript, coll. du Muséum). — An attentive comparison of the asteroids of South Carolina that I described in 1869 under the name *Asteracanthion Lacazii*, with the type of *Asterias arenicola* sent by Agassiz to the Museum led me to see in the species I first distinguished as a variety of that of Stimpson. There are however some differences between them that it is good to report. In *Asterias Lacazii*, the arms are a little less swollen than in *Asterias arenicola* and are not indented at their point of insertion on the disk. The ventral spines are a little longer and less thick. The lateral spines are little different from the ventral spines, very obtuse like them. Finally, all the spines of the disk and the dorsal surface of the arms are longer than in *Asterias arenicola* and reach nearly the length of the lateral spines. This gives the animal a physiognomy at first very different from that of the type. But the arrangement of the spines is fundamentally the same. The form and distribution of the two types of pedicellariae are identical in the two species and the location is the same. Both are found on the sandy coasts of South America and various other places on the east coast of the United States. There are four of these individuals. Mistaken by the lateral compression of the tube feet and the median line resulted in the sinking of the two series belonging to these tube feet, Valenciennes had made these four individuals into a new species of *Echinaster* that he named *Echinaster echiniura*. This name remains in the manuscript in the collection of the Museum.

## 17. ASTERIAS PALLIDA.

1863. *Asterias pallida*, Alex. Agassiz. *Embryology of Starfishes, Proc. Americ. Acad. of Arts and Sciences.*

Verrill gives with doubt this species as identical to *Asterias vulgaris* Stimpson that he had minutely described. However, he declared he had not seen *Asterias pallida* of Alex. Agassiz, who had not given a description. His identification is thus only a pure hypothesis. Moreover, the minute comparison of six individuals of the Museum, which were given by Agassiz himself, with the description of Verrill indicates very clearly that it is a matter of two very distinct species.

From Cape Cod up to the coast of Labrador, *Asterius vulgaris*, confused by Desor and then at first by Stimpson himself with *Asterias rubens*, is the most common asteroid. It reaches a very large size and it is not rare to find some individuals fifteen inches in diameter in the Bay of Fundy. Now, all the individuals of *Asterias pallidus* that Agassiz gave us are an infinitely small size. The largest is not nine cm in diameter. It thus seems that here it is a matter of a species never reaching the size of *Asterias vulgaris*. The spines of the latter species are moreover short, thin and often pointed. While on all individuals of *Asterias pallida* that we have examined, we have always seen the spines short, but scarcely thinner than the ossicle supporting them, swollen at the top and covered in this section with small serrated spines ordinarily arranged in a manner to produce excessively fine crenelated stripes. These spines are articulated on small mamelons of dorsal ossicles that are perforated in the center as those supported the spines of *Cidaris*. These are consequently excellent mobile spines. Also, on dried individuals they are all embedded on the back of the animals and ordinarily more or less away from their basal tubercle instead of upright in their place as in most other species. These characteristics are very obvious and Verrill did not overlook them in the long description he gave of *Asterias vulgaris*. I thus do not believe I can reunite *Asterias pallida* Agassiz with *Asterias vulgaris* Stimpson. Completely to the contrary, these two species seem to me very distinct. It thus would be useful to give here a description of *Asterias pallida* according to the individuals sent to the Museum of Paris, identified by Agassiz and that are all unfortunately dried and very deformed by desiccation.

The ratio R/r varies from 3 ½ to 4 ½. Each adambulacral plate has two very long, cylindrical spines, one behind the other and thus making a double row of adambulacral spines. Usually these spines have towards the middle of their height one or two straight pedicellariae. These spines are not always so exactly placed at the same point of the plates that one can consider the rows they form as absolutely regular. It does not seem to me however, as far as we can judge on the dry individuals, in life the alternation in position of the spines of two consecutive plates was not so marked to suggest four rows. The ventral plates, arranged obliquely from the outside to the inside from the base to the top of the arms, have on each two or three spines larger than those of the adambulacral plates, nearly as long and each with a wreath of crossed pedicellariae on their external side. Each of the marginal plates has two divergent, mobile spines located in the plane of the disk, slightly swollen at the top like those of the disk and the surface of the arms. This distinguishes the spines of the ventral surface that are simply cylindrical and striated. All these spines, as well as those of the back are surrounded by a single circle of crossed pedicellariae. Numerous small straight pedicellariae are spread on the dorsal surface between the spines.

The dorsal skeleton is formed of a network of ossicles with an irregular mesh about 2 mm in diameter. The ossicles in the nodes of this network are those that have the umbilical mamelons on which articulate the spines. On the median dorsal line, the ossicles are always contiguous or

imbricated, but their spines are not different from the others. The madreporite is circular, very large, finely grooved and near the edge of the disk.

The color of dried individuals is a uniform clear yellow.

I relate to this species four individuals from Chelsea (near Boston) purchased by Richard in 1852 that differ only in the very large ambulacral groove, occupying nearly all the lower surface of the arms with a slightly narrower form. But these are all the characters that can be related to their desiccation.

It is the same for two other individuals from New Jersey, one with an arm of 7 cm from the mouth to the end, the radius of the disk being 14 mm giving an  $R = 5 r$ . The form is narrower in these individuals. Moreover, the lateral carinals are very marked and their spines are more distinct than those of the ventral and dorsal plates. But these characters are not sufficient to establish specific distinctions, every thing else being equal, when one can compare only dried individuals. These last individuals were acquired by the Museum by exchange with Wagner in July 1842.

## 18. ASTERIAS VULGARIS.

1825. *Asterias spinosa*, Say. *Journal of Philadelphie Academy*, v. V, p. 142 (pars).

1827. *Ibid.* *Bull. des sc. nat. de Férussac*, v. XII, p. 401.

1840. *Asterias rubens*, Gould. *Invert. Anim. of Mass.*, p. 435 (pars).

1848. *Asteracanthion rubens*, Desor. *Proc. of Boston Soc.*, v. III, p. 67.

1854. *Asteracanthion rubens*, Stimpson. *Invert. Grand Menan*, p. 14.

1863. *Asterias vulgaris*, Stimpson. Manuscript.

1863. *Asterias vulgaris*, Packard. *Canadian Nat. and Geol.*, December.

1865. *Asteracanthion*, sp., Tenney. *Nat. His.*, p. 503, fig. 488.

1866. *Asterias vulgaris*, Verrill. *Proc. of Boston Society*, v. X, p. 347.

I refer to this species a large individual whose arms have, from the mouth, 11 cm in length. It was sent to the Museum in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts) with this simple indication: "*Asteracanthion*," Biverlely.

It is a matter here of individuals of very large size that Verrill speaks in his description of this species. A similar specimen is in the British Museum. It has the name we attribute to ours and its label is the original with the notation "Exploration of the West. Coast of the United States." This species is, as we have seen, very distinct from *Asterias pallida* of Alex. Agassiz.

## 19. ASTERIAS FABRICII.

18.... *Asteracanthion Fabricii*, Alex. Agassiz. Manuscript.

In describing *Asterias vulgaris* Stimpson in the *Proceedings of Boston Society of Natural History*, p. 348, Verrill related to this species two individuals of the Museum of the Essex Institute, labeled by Alexander Agassiz, one as *Asteracanthion rubens*, the other as *Asteracanthion Fabricii*, Ag., mss. We find in the Stellerides sent in 1864 to the Jardin des Plantes, by the Museum of Comparative Zoology of Cambridge (Massachusetts), an individual with the latter name countersigned by Verrill whose identification is authentic because it was made, if not by the Agassizs, at least under their eyes. This individual certainly is not the species described by Verrill under the name *Asterias vulgaris*, and as it is absolutely impossible to confuse it with *Asterias*

*pallida*. This is good confirmation that the opinion we gave that this latter species is itself distinct from *Asterias vulgaris*. The result is that *Asteracanthion Fabricii* of Alex. Agassiz is a distinct species, whose specimen we are going to describe perhaps considered as the type.

R = 90 mm, r = 18 mm, R = 5r. Greater width of the arms, 26 mm. The diameter of the disk measured from the interbrachial angle to the middle of the line of the junction of two opposite interbrachial angles = 33 mm, exceeding a little consequently the maximum width of the arms. Those with five arms are very clearly less at their base and end in an obtuse point.

The adambulacral plates have alternatively one or two very elongated and nearly cylindrical spines. Most of these spines have at mid-height one to three straight pedicellariae. The isolated spine is found by its position intermediate between the two spines of the preceding plate and that which follows so that the adambulacra spines can appear, although in a very obscure manner, arranged in three rows. Each of the three ventral plates has two and very often towards the top of the arms three spines larger than those of the adambulacral plates. These are a little curved outside and end in an obtuse point and each having on the external side a fringe of crossed pedicellariae. The regular double row formed by these spines at the base of the arms is separated from the adambulacral row by a very clear interval. The calcareous trabeculae uniting the ventral plates to the adambulacral plates cut the area into a rectangle, each with three papular pores. A very large number of isolated straight pedicellariae are in addition in this interval. Each marginal plate has a single spine, rarely two, that ends in an obtuse point. The ensemble of these spines form a very regular row separated from the very double row by a very large interval at the base of the arms. It remains very obvious to the end of the arms. We see in this interval only rectangular poriferous rectangles, separated from each other by calcareous trabeculae having areas with some straight pedicellariae. Each of the marginal spines is surrounded by a circle of straight pedicellariae especially numerous on the external side. An interval nearly as large as that separating the row of ventral spines separates the row of marginal spines of the first dorsal spines. This interval reproduces exactly, moreover, the arrangement of the first. The dorsal part of the arm is supported by an irregular calcareous network whose nodes each support a very short spine that is very thick and ends in an obtuse point. These spines are irregularly dispersed and only form an indistinct irregular median line of the arms. They are about 4 mm apart in the transverse direction, two or three in the longitudinal direction, but without a fixed number.

The madreporite is relatively small, rounded, a little convex, and finely marked with radiating sinuous grooves. It is located near the border of the disk.

The dorsal spines are surrounded only by one or two circles of crossed pedicellariae. A very large number of isolated straight pedicellariae are distributed on the entire surface of the disk and arms. These pedicellariae are small, end in a point, and nearly two times longer than wide.

The very large ambulacral pores are very clearly arranged in four rows.

A single dried individual in very good condition from the coast of Labrador, was given in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts).

## 20. ASTERIAS SULCIFER

18 .... *Asteracanthion sulcifer*, Valenciennes. Coll. Mus., manuscript.

1869. *Asteracanthion sulcifer*, Edmond Perrier. *Pédicellaires*, p. 43, pl. I, fig. 14, a, b, c.

Four individuals in good condition, preserved in alcohol, from Porto Famine: Hombron and Jacquinot; voyage of the *Astrolabe*, 1842.

Numerous individuals of the same provenance at the British Museum. They show very numerous variations in the quantity and arrangement of the spines.

## 21. ASTERIAS POLARIS

1842. *Asteracanthion polaris*, Müller and Troschel. *System der Asteriden*, p. 16.

1862. *Asteracanthion rubens* (pars), Dujardin and Hupé. Suites à Buffon, *Echinodermes*.

1865. *Asteracanthion polaris*, Verrill. *Proceed. Bost. Soc. of Nat. Hist.*, v. X, p. 33.

1869. *Asteracanthion polaris*, Edm. Perrier. *Pédicellaires*, p.33 and pl. I, fig. 6, a and b.

Müller and Troschel had only extremely small individuals (1.4 mm in diameter) of this species. They repeatedly expressed their doubts about the effectiveness of the preservation.<sup>9</sup> Dujardin and Hupé, on their side, quite simply assigned it to *Asterias rubens*, as a young individual with six arms. Actually, Müller and Troschel appear to have had young of a very distinct Greenland species. There are at present in the Museum of Paris three specimens, all with six arms, two given in 1870 by Professor Paul Gervais and one in 1856 by the expedition of Prince Napoleon. This well known species that we ourselves have given a detailed description is clearly distinguished from *Asterias rubens* by the number of arms, their more rounded, nearly cylindrical, their obtuse end, the size and nearly spherical form of the dorsal tubercles that are deeply grooved and each surrounded by a tight crown of crossed pedicellariae. The form of the two types of pedicellariae is moreover more evident in this species than in *Asterias rubens*. This is thus a specific distinction that should be preserved.

Three individuals in alcohol, all from Greenland.

## 22. ASTERIAS BOREALIS.

Under the name of *Asterias polaris*, the Museum of Paris has received from Cambridge (Massachusetts), an asteroid coming from Labrador that is quite distinct from that we have just described. It differs especially by the longer extension of its arms. In this species,  $R = 112$  mm,  $r = 20$ , which gives  $R = 5.6 r$ . In our *Asterias polaris*,  $R = 72$ ,  $r = 24$ ,  $R = 3 r$ . So the length of the arm from the mouth is nearly double in the species from Labrador than that of the Greenland species.

The ambulacral spines are in two rows, slightly alternate, thinner, longer and with an appearance more separated from the surrounding tissue than in *Asterias polaris*, where the bunches of pedicellariae fill the entire interval that separates them. Here, however, each spine also has on the external side a mixed bunch of straight pedicellariae and crossed pedicellariae, these being in the majority and placed below the other. Outside the ambulacral grooves, the ventral surface has three simple regular rows of spines. The spines corresponding to these three rows are located on the same transverse line. Each of those of the first two rows have on the outside a bunch of crossed pedicellariae. This bunch is replaced by a crown for the spines of the outside row. Between the ossicles that support these spines are poriferous areas that, between the ambulacral groove and the first row of spines, has only one to three papulae, the following, five or six and the external, seven or eight. In these areas are also some isolated and elongated straight pedicellariae. These papulae are very large and appear relatively less numerous than in *Asterias polaris*. On the back, the tubercles are thick, very numerous, of variable size. Several of them have the size of true spines and even end in a point, particularly towards the lateral parts of the arms. On the disk and the

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<sup>9</sup> See *System der Asteriden*, p. 16 and 126 (Supplement).

basal part of the median line of the arms, the tubercles are shorter, nearly spherical, and some small ones are arranged around the large ones, without however forming very clear groups. The crossed pedicellariae form a simple circle around each of these spines. The small straight pedicellariae are very elongated and are distributed over the entire dorsal surface of the disk and arms. These pedicellariae are smaller than those of the lateral surface. The very large, rounded madreporite is located nearer the border than the center of the disk.

A single dried individual in good condition from Caribou (coast of Labrador), 1864.

### 23. ASTERIAS PAUCISPINA.

1861. *Asterias paucispina*, Stimpson. *Proc. of Boston Society of Natural History*, v. VIII, p. 266.

There is a specimen of this species, originally from Puget Sound and with a label of the *Smithsonian Institution*. We can thus consider it as a type.

### 24. ASTERIAS RUGISPINA.

18 .... *Asterias rubescens*, Val. Manuscript, collection of the Museum.

1861. *Asterias rugispina*, Stimpson. *On New Genera and Species of the Family of Pycnopoidea*. *Proc. of Boston Society of Natural History*, v. VIII, p. 267.

This small species, coming from the expedition of Dumont d'Urville, has been at the Museum since 1841 and named a little later *Asterias rubescens* by Valenciennes that has never been fixed by a description. It is advisable to turn to the name given it by Stimpson in 1841. The description of Stimpson, made on individuals from Orange Harbor in the Strait of Magellan, relates perfectly to the three individuals of the Museum that moreover came from a nearby locality, Port Famine. Only in the latter the spines appear more numerous than in those of Stimpson so that the arrangement of the spines in the form of a pentagon or a circle of spines on the disk, as frequently indicated by this author, is much less obvious. But the arrangement of the crossed pedicellariae that are very numerous and thick between the spines instead of being, as usual, ranged in a circle around them, their size proportionally larger and the enlarged form of their jaws permitting only to suggest that it is a matter here of another species. These pedicellariae recall moreover only very superficially the valvular pedicellariae of *Pentagonaster*, *Hippasteria* and *Anthenea* (*Goniaster* Stimpson), or of *Pentaceros* and *Culcites*. They have in common with them only the enlarged form of their prehensile portion. In all their other characteristics they are identical to the crossed pedicellariae so characteristic of the old genus *Asteracanthion* of Müller and Troschel. This is so true that the description that Stimpson gave of some of them that he believed exceptional,<sup>10</sup> is precisely the first substantially exact description of the arrangement of the parts that make up this type of pedicellariae.

Three specimens in good condition, preserved in alcohol; Port Famine in the Strait of Magellan; expedition Dumont d'Urville, 1841.

R = 24 mm, r = 8 mm.

### 25. ASTERIAS BORBONICA.

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<sup>10</sup> "Double forms occur, in which a thick ventral valve has two others lapping against it from opposite directions, one on each side."

Five arms indented at the base, ending in an obtuse point.

R = 17 mm, r = 5 ½ mm, R = 3r. Diameter of the arms at the base, 3 mm.

Adambulacral spines in one row, cylindrical and very elongated. Ventral plates with only one or two very elongated spines, cylindrical, obtuse, forming a regular row. In the groove that separates this row from that of the adambulacral spines, there is a row of papular pores. These pores are isolated and the interval that separates them corresponds to that of five ambulacral spines. There is one, to the contrary, between two consecutive spines. The marginal plates have likewise only one spine per plate. These shorter spines are shorter than the ventral spines and together form a perfectly regular row. On the back of the arms are three less regular rows of spines, still shorter and obtuse. Between these spines are a small number of crossed pedicellariae, scattered and not forming a circle at the base of the spines. In the poriferous area located in the interstices of the dorsal and lateral calcareous network, are only two or three papular pores. The madreporite, small, triangular and marked by a very small number of grooves, is located nearly equal distance from the center and border of the disk.

This species is remarkable by the rarity of its pedicellariae. However, it appears to have been dried before being placed in alcohol and its dermal system submitted to alterations that make me have some reservation in this regard.

One single specimen from Reunion Island; Maillard, 1862.

## 26. ASTERIAS AFRICANA.

1842. *Asteracanthion africanus*, Müller and Troschel. *System der Asteriden*, p. 15.

1862. *Asteracanthion africanus*, Dujardin and Hupé. *Suites à Buffonn, Echinodermes*, p. 333.

1869. *Asteracanthion africanus*. Edm. Perrier. *Pédicellaires*, p. 33, pl. I, fig. 5, a and ab.

Six dried specimens, nine in alcohol. All from the Cape of Good Hope. Raynaud; expedition of *La Chevrette*, 1829.

This species has numerous varieties in the arrangement of its rows of truncated spines that can be together in three, one median and two lateral, or reach nine, or in irregularly distributed spines.

## 27. ASTERIAS RARISPINA. Sp. nov.

A species resembling a little by its general physiognomy *Asterias glacialis*, but with arms a little shorter, more angular and especially with fewer spines. These arms are five in number. R = 5r. The adambulacral spines are arranged in a single row. They are cylindrical and obtuse at the end. Outside is immediately a row of spines, larger and obtuse at the end. This single row soon becomes double. Each of the spines that compose it has outside a very voluminous tuft of crossed pedicellariae. After this row of spines is a longitudinal naked band. Then a single row of isolated spines supported by lateral plates and some without them. A circular tuft of crossed pedicellariae surrounds these spines and this tuft remains even when the spines are absent. Between this row of lateral spines and the dorsal median line are very numerous crossed pedicellariae, but isolated and spread out on all the dorsal surface. Among them are no straight pedicellariae but a large number of these are spread out between the lateral row of spines and the subambulacral row, as between it and the adambulacral spines. The entire length of the dorsal median line has an irregular row of spines. These spines sometimes come from two or three ossicles together that are arranged

the length of the median line. They are then so close that they seem fused together. The madreporite is circular, very large and has a multitude of very fine rayoning grooves. This interesting species, remarkable as *Asterias paucispina* Stimpson for the small number of spines, comes from the Cape of Good Hope and is perhaps an extreme variety of the preceding. They were collected during the voyage of the *Herald* and is part of the collection of the British Museum.

## 28. ASTERIAS POLYPLAX.

1844. *Asteracanthion polyplax*, Müller and Troschel. *Wiegman's Archiv für Naturgeschichte*, p. 178.

1862. *Asteracanthioni polyplax*. Dujarden and Hupé. *Suites à Buffon, Echinodermes*. p. 335.

We have studied many dried individuals of this nice species in the collection of the British Museum. The description given by Müller and Troschel is very accurate and is sufficient to recognize it. We add only that it can have five madreporites, which the authors of the *System der Asteriden* that the authors probably wanted to express in their specific name but neglected to mention in their description. After the double row of adambulacral spines is a band of ventral spines, longer and thinner, arranged by transverse rows of two or three. Then a naked band with very numerous scattered straight pedicellariae. The sides of the body that are very elevated and vertical are formed of contiguous nearly rectilinear calcareous plates, each with a spine on the inferior border and a spine on their superior border. These spines thus form two lateral rows of isolated spines separated by a naked space with numerous straight and crossed pedicellariae. Then are five dorsal rows of spines arranged in groups of three to six rows on the dorsal plates. These spines are small, short, and obtuse or even a little swollen at the end. Numerous crossed pedicellariae are scattered in their intervals, but are not arranged in circles around the spines.

The individuals of the British Museum came from Port Dalrymple, Tasmania.

## 29. ASTERIAS VANCOUVERI. Sp. nov.

This resembles a little in form and ornamentation *Asterias polyplax* M. and T. Arms number six or seven. Adambulacral spines long, pointed at the end. There are two on each adambulacral plate, but these spines are not in the same place on two consecutive plates. They seem to alternate, though not regularly, and the ensemble has the appearance of two consecutive rows. Each of these spines has one or two small straight pedicellariae at mid-height. Then are two rows of pointed isolated spines, larger than the adambulacral spines, surrounded at the base by crossed pedicellariae that are not numerous. The imbricated rectangular plates that form the sides of the body of *Asterias polyplax* are reduced here to usual proportions in *Asterias* and have ossicles much less in size. On the back are five rows of groups of small obtuse spines. Each row corresponds to a row of ossicles and each ossicle has three or four spines in the middle. Trabeculae unite the ossicles so that these first groups appear confluent, although the arrangement is only vaguely reticulated. There is only one madreporite.

The length from the ends of two arms = 75 mm. Diameter of the disk = 10 mm.

Indicated in the British Museum as originating on Vancouver Island.

## 30. ASTERIAS HEXACTIS.

1861. *Asterias hexactis*, Stimpson. *Proc. of Boston Society of Natural History*, v. VIII, p. 272.

Four dried examples from Puget Sound, sent to the British Museum with the original label from the *Smithsonian Institution*.

### 31. ASTERIAS CRIBRARIA.

1861. *Asterias cribraria*, Stimpson. *Proc. of Boston Society of Natural History*, v. VIII, p. 270.

An individual from Behring Strait, sent to the British Museum by the *Smithsonian Institution* with original label.

### 32. ASTERIAS TENERA.

1861. *Asterias tenera*, Stimpson. *Proc. of Boston Society of Natural History*, v. VIII, p. 269.

An individual from Massachusetts Bay, sent to the British Museum with original label by the *Smithsonian Institution*.

### 33. ASTERIAS BRACHIATA. Sp. nov.

Species with five very elongated, rounded arms, gradually decreasing to end in a very sharp point.  $R = 180$  mm,  $r = 27$  mm,  $R = 6.5r$ . Greatest width of the arms at the base, 32 mm. The arms are thus nearly six times longer than wide.

Each adambulacral plate has two elongated, cylindrical spines, placed transversely, one before the other. But the spines of consecutive plates do not have exactly the same position, so that the two rows of spines are slightly irregular and seem from place to place to be three. All spines have slightly below their free end a mixed bouquet of straight and crossed pedicellariae, the latter in considerable number. Immediately outside the external row of adambulacral spines, without an appreciable interval, begins the first row of ventral spines that are not separated from the marginal spines. The number of rows of ventral spines is difficult to give in a precise manner because they are irregular and very close together, a very large number of intercalary spines are there and interposed between the principal rows, and a very large number of these spines are double. We can say there are approximately five or six of these rows, leaving out the double spines that are more numerous at the base of the arms. As a result, the entire ventral surface of the arms is covered with cylindrical, obtuse spines, with slightly regular spaces, and each with a bunch of small crossed pedicellariae on the external side. The bunch is transformed into a crown for the two external rows of spines. These continue, especially at the end of the arms, with small, short, obtuse spines, nearly in the form of tubercles of the dorsal region. These spines are found at all points of the ossicles that form the dorsal skeletal frame, so that they sensibly reproduce, sometimes in an incomplete manner, an areolar arrangement. The areoles are 4 or 5 mm in length and two or three in width and arranged transversely in relation to the arms. They have a large number of papular pores and some very small straight pedicellariae, longer than wide, on their surface. There are some small crossed pedicellariae around the small dorsal spines.

The madreporite plate, circular and very large, is located near the center than the edge of the disk.

A single dried specimen in good condition, sent in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts) with a label thus conceived: *Stichaster long armed species*.

*Note.* —The number and arrangement of the spines, short and truncated, and the rounded form of the arms of this species resemble a little *Stichaster*. But the arrangement of the skeleton is areolar exactly as in *Asterias*, the mesh of the network being only tighter than in most other cases, while in *Stichaster*, or at least in the *Stellerides* to which we believe this name should be reserved, the calcareous skeleton is, as we have seen, constituted completely differently.

#### 34. ASTERIRAS EPICHLORA.

1835. *Asterias epichlora*, Brandt. *Prodromus descriptionis animalium a mertensio, etc.*

1857. *Asterias epichlora*, Stimpson. *Journal of Boston Society*, v. VI, p. 528. (inexact synonymy).

A specimen of this species, with label of *Smithsonian Institution* is in the British Museum.

#### 35. ASTERIAS KATHERINÆ.

1846. *Asterias Katherinæ*, Gray. *Ann. Nat. Hist.*, v. VI, p. 179.

1842. *Asteracanthion Katherinæ*, Müller and Troschel. *System der Asteriden*, p. 19.

1857. (?) *Asterias gigantean*, Stimpson. *Boston Journal of Natural History*, v. VI, p. 528.

1862. *Asteracanthion Katherinæ*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 339.

1863. *Asterias Katherinæ*, Gray. *Synopsis*, p. 2.

It is very difficult to know precisely what Gray designated under the name of *Asterias Katherinæ*. In the collection of the British Museum, we have found several labels of Gray with this name, but these labels being mobile, it is possible they have been moved. Moreover, the individuals with them belong to four distinct species. Some are *Asterias Troschelii* Stimpson and have been placed in the collection only after the true types. The others were all given to the British Museum at the same time, and it is certain that Lady Katherine Douglas gave them to him as is indicated in the catalog. But Gray in his *Synopsis* indicates these individuals came from the mouth of the Columbia River on the west coast of North America, and the catalog gives it as Labrador, the east coast. On the other hand, the description Stimpson gave to his *Asterias gigantea* suits them perfectly and this latter is certainly the American Pacific coast. There is thus doubt, either on the authenticity of the specimens in question, as types of *Asterias Katherinæ*, or their location. The authenticity of the types does not seem contestible: in the common catalog of the collection of asteroids is found, in fact, only the one gift of asteroids of Lady K. Douglas. This occurred before 1840. This lot had a very large number of asteroids with six arms and two with five that correspond well with the description of Gray, as for the other characters of the individuals. These thus are surely the sought types. But their location remains still doubtful and they certainly do not belong to a single and same species. One of the individuals has six arms belonging to the species we are going to describe as *Asterias Douglasi*. One of the individuals with five arms is still another species. We consider the others as constituting the true *Asterias Katherinæ*. None of these asteroids, moreover, can be confused with *Asterias epichlora* Brandt, as Stimpson thought. We were able to make sure of this by comparing an individual of this latter species, collected by the voyagers

ordered by the *Northwest Boundary Survey*, collected in Puget Sound and given to the British Museum by the *Smithsonian Institution*.

Here is the description to which should be reserved, in my opinion, the name *Asterias Katherinae*, Gray's description evidently made with them.

Ordinarily six arms, sometimes five. The upper part of the body is slightly convex. Arms large at the base, pointed at the tip.  $R = 7r$ ,  $D =$  approximately four decimeters. Adambulacral spines in a single row with bunches of numerous small straight pedicellariae on the external side. Immediately after is a band of ventral more robust spines, arranged in transverse rows of two or three spines. A narrow groove separates this band from another simple row of spines representing the lateral spines. Then comes a very large naked band and a very irregular row of shorter spines that indicates the beginning of the dorsal region. This is scattered with numerous short spines with a rounded head and strongly striated, sometimes isolated, sometimes in groups of two or three, but arranged without order. A circle of a few crossed pedicellariae surrounds these spines. But they are particularly numerous on the sides between the back and the line of lateral spines, in the groove that separates this line from the band of ventral spines and between these and the adambulacral spines. These straight pedicellariae have the form of short isosceles triangles with a very large base. The marginal plate is marginal.

Color red in the dry state.

It now remains to describe another type likewise confused with *Asterias Katherinae* at the British Museum and with individuals, unfortunately without locality, coming from the collection Lamarre-Picquot We name it *Asterias Douglasi*.

### 36. ASTERIAS DOUGLASI. Sp. nov.

Six large, pointed arms.  $R = 70$  mm,  $r = 17$  mm,  $R = ca. 4r$ .

Adambulacral spines arranged in two rows, very long, cylindrical, ending in an obtuse point not enlarged at the tip, very finely striated. Around them are some straight pedicellariae with short, large valves. The total height of the organ being however a little larger than the maximum width. There are three longitudinal equal distant rows of spines on the ventral surface that are often, in each row, grouped by transverse rows of two or three. These spines are equally cylindrical, short, approximately two times larger than the adambulacral spines, end in a blunt point that is not swollen at the end. In the grooves that separate these rows of spines are sparse straight pedicellariae, similar to those among the adambulacral spines. In addition, crossed pedicellariae are often found around the base of the spines, arranged in a circle, but less numerous and non-fasciculated. The first row of the ventral spines is very close to the adambulacral spines. The latter begin to go up the sides of the arms. Each side of the dorsal surface of the arms is limited by a row of irregularly spaced spines smaller than those of the ventral surface and truncated at the end.

The dorsal skeleton is formed of a network of irregular skeletal plates and irregularly arranged, except along the median line of the arms, where they form a discontinuous series. Each plate has a group of spines, some of which are globular, very short pedunculated and deeply striated. The others are truncated at the end, as if they had been abraded. This latter appearance is especially shown when the spines are very close together on one plate. The worn surfaces, contiguous with each other, are at the same level and form a kind of irregular delimited plane. This appearance, although frequent, appears however accidental, and one finds in the same specimen all transitions between the groups of rounded spines of variable dimensions and groups of worn spines. The groups of largest spines are located in the median line of the arms but are also found in large

number on the rest of the surface of the arms where they are joined by rows of similar spines, vaguely arranged in alveoli. The spines, moreover, are numerous and the imperfect alveoli they form are not more than 3 or 4 mm in diameter.

Dried specimens in the Jardin des Plantes. One, also dried, in the collection of the British Museum. — Coast of Labrador (?).

In the Museum of Paris, the collection of Lamare-Picquot, without locality, 1865. — One can only affirm that this is a species of North America, perhaps near to *Asterias acervata* Stm.

Four dried species, all with six arms from the collection Lamare-Picquot, bought by the Museum in 1865. — One example also dried in the collection Michelin, without indication of locality.

### 37. ASTERIAS OCHRACEA.

1835. *Asterias ochracea*, Brandt. *Prodromus descriptionis animalium ab. H. Mertensio in orbis terrarium circumnavigatione observatorum*.

1857. *Asterias ochracea*, Stimpson. *Journal of Boston Society*. v. VI, p. 527, pl. XXIII, fig. 2.

Two dried specimens, one from the collection Michelin, bought in 1868 by the Museum and with a label evidently in error *Asteracanthion graniferus*, from the seas of the South. The other given in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts). The latter is from the coasts of California.

### 38. ASTERIAS LÜKENII.

1861. *Asterias lütkenii*, Stimpson. *On New Genera and Species of Family of Pycnogonidæ. Proc. of Boston Society of Nat. History*, v. VIII, p. 265.

Two dried specimens from the coast of California, one given by Lorquin, the other by the Museum of Comparative Zoology of Cambridge (Massachusetts) in 1864.

### 39. ASTERIAS CAPITATA.

1864. *Asterias capitata*. Stimpson. *On New Genera and Species, etc. Proc. of Boston Society of Nat. Hist.*, v. VIII, p. 264.

One dried specimen with six arms from the coasts of California, Lorquin.

### 40. ASTERIAS CONFERTA.

1861. *Asterias conferta*, Stimpson. *On New Genera and Species of Asteridæ, Proceed. of Boston Society*, v. VIII, p. 263.

A dried specimen from the coast of California, given by the Museum of Comparative Zoology of Cambridge (Massachusetts).

*Nota.* I could not confirm in this individual the six rows of papular pores that Stimpson observed at the base of the arms of the individuals he described.

#### 41. ASTERIAS TROSCHELII.

1861. *Asterias troschelii*, Stimpson. *Proc. of Boston Society of Natural History*, v. VIII, p. 207.

There are several individuals in the British Museum that I have referred to this species, while remaining doubtful about this determination. These specimens are dried and were collected at Vancouver Island. One of them has the label *Asterias epichlora* Brandt.

#### 42. ASTERIAS NUDA. Sp. nov.

This species is remarkable, like others of the same provenance, by their few spines and the development of the dermal membrane. Five short, large arms, indented at their base in a way to have a form a little lancelated. Subcutaneous calcareous network formed by robust trabeculae, arranged in a very large mesh. This network is very apparent in dried individuals. On the ventral surface is a double row of perfectly regular ambulacral spines very close to each other, the exterior is greater and thicker than the interior but both are cylindrical and obtuse at the end. Among them, in the ambulacral groove and in the empty band that follows immediately the row of ambulacral spines, are a large number of straight pedicellariae, short, large, in the form of an equilateral triangle. The ventral region is formed by three rows of slightly imbricated hypodermic plates in the form of an ordinary trefoil. The first row does not reach the first third of the arms. The second extends the greater part of the arm length, without reaching however the end. The third may extend to the end of the arm. On most of these plates, but not on all, are short, obtuse, cylindrical isolated spines, actually forming three incomplete rows that correspond to the plates. But because of their lacunae, these rows seem at first to constitute only one irregular row going from the base to the end of the arms and containing in all about twenty spines. On the ventral plates are some crossed pedicellariae that are not more numerous in the immediate area of the spines than on the rest of the plate. The sides of the arms have a row of marginal plates nearly the same as the ventral plates and having like them short and obtuse spines. In this very irregular row of imbricated ossicles in the median line of the arms is a corresponding row of spines. A very irregular of imbricated ossicles in the median line of the arms corresponds to the row of spines. There can be one, two or three spines on each ossicle or be completely missing. Between the median row of spines and the marginal rows are at most one very irregular row of similar spines. Isolated cross pedicellariae are sparse on the entire dorsal surface. Some obtuse spines are spread out on the disk, swollen at the end in the form of a button. The large madreporite is located in the middle of one of the minor radii of the disk. It has a large number of very fine radiating sinuous grooves.

A small individual, probably younger, differs from the preceding by the relatively larger dimensions of its skeletal ossicles and the smaller number of its spines.

These two dried individuals are perfectly white.

The dimensions of the larger are:  $d = 100$  mm;  $l = 32$  mm, maximum arm width = 22 mm.

Locality: Port Lincoln (Torres Strait). From the British Museum.

#### 43. ASTERIAS CAPENSIS. Sp. nov.

Small asteroid with six arms, sometimes only five. Adambulacral spines in two very regular rows, cylindrical, obtuse, without pedicellariae, the spines of the two rows being exactly superimposed on each other. Immediately after is a row of larger spines. The spines forming this band are arranged in transverse rows of two or three, oblique in relation to the axis of the arms. These spines extend nearly to the border of the ventral surface. The rest of the arms form a regularly convex surface on which are seven rows of short, large, obtuse spines corresponding to as many rows of ossicles. The spines of each row are not isolated but arranged in groups of two or three irregularly spaced on each plate. A very large number of crossed pedicellariae are scattered between the spines, but they do not seem to be arranged in groups around them. On the border of the disk are generally three very small madreporites with very few grooves.

Diameter, 28 mm; length of an arm = 10 mm. From South Africa (British Museum).

#### 44. ASTERIAS FUNGIFERA.

18.... *Asteracanthion graniferus*. Collection du Museum, manuscript.

This species is very distinct from the *Asterias granifera* of Lamarck, whose type is preserved in the Museum. It has five large arms that end in an obtuse point and clearly indented at their base to give them a nearly petaloid appearance.

$R = 60$  mm,  $r = 10$  mm,  $R = 6 r$ . The disk is thus relatively small. The greatest width of the arm is 20 mm. It is reached at approximately 6 mm from their point of insertion. The spines of the adambulacral plates are nearly completely absent. They are very short, cylindrical and appear to have been arranged in two rows, each adambulacral plate having two placed one before the other. The spines of the ventral surface are mobile, arranged in three rows, at least at the base of the arms, and in the form of a short, large club, broad and compressed, sometimes transformed into a kind of thick disk attached obliquely to a short stem. Between these spines and the marginal spines is, at least towards the base of the arms, a naked band, where at the end of the arms, are some spines smaller than the others and irregularly arranged in a longitudinal line. The marginal spines have, like all those of the dorsal surface, a thick disk at the end supported by a very short conical stem. Each marginal plate has three or four of the fungiform spines, the median generally a little larger than the others. On the arms, the spines are arranged in irregular groups of two, three, four or even seven, notably in the middle region of the arms. These spines are not all equally large, but they are all at the same level. The enlarged heads of each group touch and form thus a kind of flat surface with an irregular contour that is often tangent to the analogous adjacent groups. These elevated surfaces are nearly one millimeter above the dorsal integument. This gives the dorsal surface of the animal a completely particular aspect. The spines of the disk are very numerous, nearly all contiguous at the center and disposed at the borders in an irregular pentagon containing the madreporites. The points of this pentagon are continuous with the first spines of the median line of the arms. But the sides are isolated in such a way that there seems to be an excavation between each of them and the origin of the arms.

I can give no information on the pedicellariae of this interesting species that approaches slightly in appearance *Asterias ochracea* Brandt and *Asterias Douglasi*.

A single dried example and a little deteriorated; Australia. Jules Verreaux, 1844.

#### 45. ASTERIAS SINUSOIDA. Sp. nov.

Five arms, flat above and below, but very thick, with slightly convex vertical sides. Length of an arm, approximately 57 mm; diameter of disk, 30 mm. Adambulacral spines in two perfectly regular rows, both with the same number of superimposed spines, cylindrical, obtuse at the end. Immediately outside the adambulacral plates are three rows of imbricated plates in the ordinary trefoil form, each with a very large spine in the middle and a circle of a few crossed pedicellariae surrounding the base. These spines form, like the ventral plates that bear them, three regular rows, with the first formed of spines less large and nearly contiguous with the double row of adambulacral spines. The dorsal marginal plates also form a very regular row. Each has three or four obtuse spines, shorter and less large than the spines of the inferior rows. These spines form a row that limits the dorsal surface. On this surface on each side between the median line and the border nearly equidistant from both, is a sinuous row of obtuse spines. The other spines of these two rows in the middle region of the back form a scalloped sinuous line alternatively tangential to the two rows of spines just described. A large loose mesh is formed, recalling those in *Asterias ochracea* Brandt of the boreal hemisphere. These meshes are, in addition, subdivided by ossicles across the dermis but without spines. Around the spines are some small crossed pedicellariae, scattered, not forming a definite circle. These pedicellariae are lacking elsewhere and I have not seen straight pedicellariae. Numerous obtuse spines are on the disk, sparse in the interior in a kind of irregular pentagon. Outside is a large madreporite. The points of the pentagon correspond to the beginning of the sinuous line of spines in the middle region of the arms.

The dried specimens of this species that I studied in the British Museum came from Hobart Town (Tasmania).

#### 46. ASTERIAS CUNNINGHAMI. Sp. nov.

Six short arms, thick at the base, strongly convex. Adambulacral spines in a very regular single row. Then comes a thorny band in which the spines are arranged in two or three obliquely transverse rows. These spines are cylindrical, more robust than the adambulacral spines and nearly as long. These rows alternate with isolated papular pores. The dorsal marginal row is formed of isolated spines, very spaced from each other, but in a regular series. This row is separated from the ventral rows by a naked space mostly filled by a row of poriferous areas, each with twelve pores. The spines on the rest of the body are shorter, irregularly distributed and found generally at the nodes of a very loose calcareous network formed of very short trabeculae. Immediately inside the rows, marginal spines are poriferous areas forming a regular row. Diameter, approximately one decimeter.

Sandy Point (Strait of Magellan), Doctor Cunningham. At the British Museum.

#### 47. ASTERIAS MERIONALIS. Sp. nov.

Greatly resembling *Asterias Cunninghami*, but distinguished easily because the ambulacral spines are arranged in two rows instead of one. Then comes a row of isolated papular pores, then a row of spines flat at the top and grouped in pairs. This band is followed by a naked band contained poriferous areas shorter than those of *Asterias Cunninghami*. Finally, above this naked band is a row of isolated spines limiting the dorsal surface and having spines like those of the first row. The dorsal spines are scattered on the disk and arms. They are a little capitated and striated. Between them are a very large number of scattered cross pedicellariae. The madreporite is triangular and located an equal distance between the center and border of the disk.

From the British Museum. Antarctic Expedition.

#### 48. ASTERIAS GRANIFERA.

1815. *Asterias granifera*. Lamarck. *An. s. vertèbres*. V. III, p. 248.  
1842. *Asteracanthion graniferus*, Müller and Troschel. *Syst. Der Asteriden*, p. 20.  
1862. *Asteracanthion graniferus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 336.  
1865. *Margaraster graniferus*, Gray. *Synopsis*, p. 2.  
1869. *Asteracanthion graniferus*, Edm. Perrier. *Pédicell.*, p. 28.

This curious species has to a high degree the character Gray used for his genus *Uniophora*, i.e., the change of the dorsal spines to true globes supported by skeletal plates whose development is proportional. It would merit the name *globifera*, if Gray had not given this name to another species where this development is much less marked. It is however, of all the nearby species, which are generally very variable, that which is easiest to describe.

The five arms are very short, wide, and thick, but flat above and below. They are slightly indented at their base to have nearly a petaloid base and blunt at the end. The adambulacral spines, cylindrical and obtuse at the end, are very close to each other, overlapping and perfectly regular. All these spines are equal and no pedicellariae occur among them. The ventral plates have the usual short trefoil-shape and overlapping on the immediately following plate. In the middle of each plate is a large, short spine, enlarged at its end but a little flat. Between these spines are a very large number of crossed pedicellariae, others are arranged in a circle around them. These two rows of ventral plates are followed by another row of plates (lateral plates), each with a globular spine still larger than the ventral spines. These spines form a regular row separated from the preceding by an interval in which are numerous isolated crossed pedicellariae. Between these marginal plates and the plates arranged according to the median line and are very developed, there is only an irregular row of plates. All these plates and the dorsal plates are covered with globular spines of different diameters, all contiguous and which cover consequently completely the dorsal surface. I was not able to find straight pedicellariae. The madreporite, hidden by the dorsal spines, some of which are enormous (3 and 4 mm in diameter) is not visible.

A dried specimen from Tasmania at the British Museum. The dried specimen of Lamarck at the Jardin des Plantes is in very bad condition. It has fewer spherules than the specimen at the British Museum which was used for our description. Another individual, the first coming from the southern seas and collected like it in 1803 by Péron and Lesueur, is still more deteriorated and is included in the forms that Gray designated as *Uniophora globifera* that we are going to discuss.

#### 49. ASTERIAS GLOBIFERA.

1849. *Uniophora globifera*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, p. 288.  
1866. *Uniophora globifera*, Gray. *Synopsis*, p. 2.

The *Uniophora globifera* of Gray, whose types I found at the British Museum, are part of a group of asteroids whose characters are quite variable and that appear numerous in the neighboring seas south of Australia and Tasmania. Perhaps it will be necessary to distinguish several species but we presently lack the elements to make a rigorous delimitation of the species. We have been able to examine, either at the British Museum or at the Jardin des Plantes, ten specimens of the

group, including those we have given the names of *Asterias granifera* and *Asterias fungifera*. There are not two of these specimens that are identical. The relative dimensions of the arm, the number, size, arrangement, even the form of the pedunculate globes that represent the spines are quite variable. Perhaps it would not be impossible to connect the extreme forms we describe as species in this work by numerous intermediary types. Likewise, the study of more specimens could allow consideration as specific characters what we must understand at this moment among those whose variability, if not demonstrated, is at least possible.

Characters common to all forms are the arrangement of the adambulacral spines, always cylindrical, obtuse at the tip and arranged in a double row, perfectly regular and very close together. Between these spines are neither crossed pedicellariae nor straight pedicellariae. This constitution of the adambulacral armature is found in another Tasmanian species that we named *Asterias sinusoida*. The spines, or at least the organs that take their place, are more or less globular or pedunculated and the skeletal plates that support them are usually enlarged and more or less in the trefoil form so frequent for the lateral skeletal plates of other species of the genus. On the same individual, these plates can have several spines of small dimensions, arranged in more or less compact groups or, to the contrary, with only one or two that are then much larger. There are numerous intermediaries between these two extremes, so we can say that the size of the globular spines is inverse to their number on the same skeletal plate. The larger seems to result from fusion of some of the small. It is easy to conceive from this how the physiognomy of different individuals varies. According to the number of small spines that are fused, individuals are covered with small globular spines or relatively enormous calcareous spheroides that can reach 3 or 4 mm in diameter. We add that the relative size and arrangement of skeletal plates in the same individual does not appear independent of the more or less large development of the globules. This results, in the characters, new causes of variability that make nearly impossible, in the present state of our knowledge, any boundary of the species.

The typical individual of the *Uniophora globifera* of Gray has longer arms, narrower, and less petaloid than those of the individual that we call the *Asterias granifera* of Lamarck, after comparison with the type of the illustrious French zoologist. This is the first striking difference. Outside the double row of adambulacral spines are three simple, regular rows of ventral spines, smaller than in *Asterias granifera* and supported by rows of trefoil-shaped plates as usual. Then comes an empty band and a row of slightly regular lateral spines. These spines are supported by lateral plates of triangular form, very enlarged and imbricated in the direction of the end of the arms. The dorsal spines are globular, relatively small, but very diverse in size and dispersal.

The specimens nearest these types have slightly elongated arms and do not have regular rows of ventral and lateral spines. They are replaced by a variable number of spines distributed on the ventral plates. The number of ventral rows of plates is always three and very regular. The arrangement of these spines varies from one plate to another. They cease to have an arrangement that could be described in a general way. They are more numerous and are smaller than in the types. The dorsal spines are always globular, numerous, small and arranged very irregularly on the plates. They are sometimes grouped to form small, very irregular alveoli. They become particularly numerous and compact on the median line. Around them, as in the types, are small crossed pedicellariae. Only in a small specimen, the spines in the median row of the arms are a very irregular, very compact band and only very small globules on the intermediary trabeculae. This is an extreme arrangement in relation to the young age of the specimen.

A specimen from New South Wales is very similar to the large individuals we just described, and scarcely differs in its external adambulacral spines, enlarged at the truncated end. The spines of the median line are less numerous and larger. This fits the category we just described.

Perhaps, to the contrary, it is necessary to separate as a species another individual from Tasmania with ventral plates that form only two rows of spines that each has two globular spines. The lateral plates, in addition to several small, rounded spines in their narrower portion, have in their enlarged portion a very large globular spine. The can be replaced by several spines. Likewise, there are three very large globular spines on the dorsal median plates. These spines can also be replaced by a group of small spines. The arms are relatively narrower than in all the preceding forms. The intermediary plates between the lateral plates and the medial dorsals form only a single, very narrow row with only very small globular spines. Crossed pedicellariae are sparse between the spines or grouped around them. We have not seen straight pedicellariae. The madreporite is very distinct and surrounded by a circle of small globular spines.

In summary, there is on the entire coasts of Tasmania a group of forms of asteroids with adambulacral spines arranged in two perfectly regular rows whose extremes are *Asterias granifera* Lamarck and *Asterias sinusoida* E. P., near in its aspect to *Asterias ochracea* Brandt, *Lütkenii* Stimpson and *Troschelii* Stimpson from the west coast of America. Between these two forms that one can, believe me, clearly characterize as species are found numerous intermediaries to which we give the name for the present of *Asterias globifera*. This requires again a careful study done on more abundant material than that I have had. We do not think these forms are ever joined with the two extremes that we just named, but we cannot presently say that it is necessary to consider them as a single species or if it will be necessary to divide them into several. To these forms is still connected, although it remains very distinct specifically, the species from the Torres Strait that we have named *Asterias nuda*. Some characters of *Asterias polyplax* M. T connect it to this group.

## II. GENUS ANASTERIAS (EDMOND PERRIER).

This genus is remarkable for the reduction of its skeleton. It has up to now only the following new species.

### 50. ANASTERIAS MINUTA.

In this species, the dorsal dermal skeleton appears to be lacking, reduced so much that the animal appears completely soft to the touch. There are, however, the madreporites, ventral plates, and the usual system of adambulacral pieces, as well as five reinforcing ossicles that, in the angle of the arms, is elevated interiorly up to the skin of the disk.

Five short, obtuse arms. General form like that of *Asterina gibbosa*.

R = 12 mm, r = 6 mm, R = 2 r. Diameter of the arms at their base, approximately 6 mm. Interbrachial angle not rounded. End of arms obtuse.

On the dorsal surface, spines are only found at the base of the arms where there are one or two short ones, obtuse and half hidden by the skin near the median line. The rest of the dorsal surface is completely soft. On the disk, folds of the flat dermis are limited by a polygonal outline like a kind of pavement. Elsewhere, papular pores are isolated and nearly uniformly distributed, although without a determined order on all the arm surface. Between the pores are a large number of crossed pedicellariae with short, large jaws. These pedicellariae are not fasciculated. They are,

to the contrary, isolated. They are numerous and distributed without order nearly uniformly on all the dorsal surface of the arms, notably near the median line and the borders. Straight pedicellariae seem missing on the dorsal surface. The small, circular madreporite has a very few irregular, short and wide grooves. It is nearly equidistant from the border and the center of disk, and is half hidden under the skin. On the ventral surface, the ambulacral groove has, as usual, four very regular rows of tube feet. Each adambulacral piece has only one spine, half enveloped in the skin. These spines form a single, perfectly regular row. Some isolated, elongated straight pedicellariae are at the base of the adambulacral plates and in the ambulacral groove. Outside the ambulacral groove, each ventral plate has two divergent spines in the transverse plane. These short, obtuse spines are partly hidden in the skin and form a perfect regular double row near the row of adambulacral spines. Each marginal plate has only one very short spine. These very spaced spines form a regular row, relatively separated from the double ventral row. The band that separates these two rows is covered, like the dorsal region, with crossed pedicellariae.

The papulae are located between the ventral and adambulacral plates. They are large, isolated and form a single row. Those located between the ventral and marginal plate are smaller, more numerous, isolated and irregularly arranged as on the back.

A single individual preserved in alcohol, without indication of locality of origin.

### III. GENUS *STICHASTER* (MÜLLER AND TROSCHEL).

1840. *Monatsbericht der Berliner wissenschaftlicher Akademie.*

#### 51. *STICHASTER ALBULUS.*

1853. *Asteracanthion albulus*, Stimpson. *Invert. Grand-Manan.*, pl. XIV, fig. 5.

1857. *Asteracanthion problema*, Steenstrup, published in 1837 by Lütken. *Om de ned Grönlands forekommende de Asteracanthion arter.. Forhandl. Skandin. Naturforsker.*

1866. *Stichaster albulus*, Verrill. *Proceed. of Boston Soc. of Nat. Hist.* v. X,

Two examples donated in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts), directed by L. Agassiz. East Port. Genus *Stephanasterias*, Verrill.

#### 52. *STICHASTER ROSEUS.*

1788. *Asterias rosea*, O.-F. Müller. *Zool. Dan.*, pl. LXVII.

1788. *Asterias rosea*, Gmel. Linnæi. *Syst. Nat.*, p. 3165.

1792. ----, Bruguières. *Encycl. Méthod.*, pl. CXVI, fig. 2 and 3.

1840. *Stichaster roseus* Müller and Troschel. *Monatsbericht der Acad. der Wiss. In Berlin and Wiegmann's Archiv*, vol. VI, 2<sup>e</sup> part, p 323.

1842. *Asteracanthion roseus*, Müller and Troschel. *System der Asteriden*, p. 17.

1862. *Asteracanthion roseus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 332 (inexact synonymy).

1866. *Stichaster roseus*, Norman. *British Assoc. Reports for 1866*, p. 104.

1869. *Asteracanthion roseus*, Edm. Perrier. *Pédicellaires*, p. 37, pl. I, fig. 7.

Two individuals, one dried from Bergen (Norway); the other from the Sea of the North, donated in 1845 by Lovén.

### 53. STICHAETER AURANTIACUS.

1834. *Asterias aurantiaca*, Meyen. *Reise um die Erde*, v. I, p. 222.  
1840. *Stichaster striatus*, Müller and Troschel, *Monatsbericht Wiss. Acad. zu Berlin and Wiegmann's Archiv*, v. VI, 2e part, p. 321.  
1840. *Tonia atlantica*, Gray. *Ann. Nat. Hist.*, v. VI, p. 180.  
1842. *Asteracanthion aurantiacus*, Müller and Troschel. *Syst. Ast.*, p. 21, pl. I, fig. 23.  
1862. *Asteracanthion aurantiacus*, Dujardin and Hupé. *Echinod.*, p. 337.  
1865. *Tonia atlantica*, Gray. *Synopsis*, p. 2.  
1869. *Asteracanthion aurantiacus*, Edm. Perrier. *Pédicell.*, p. 38, pl I, fig. 8, a and b.

Two dried specimens, Gay, 1836 (Valparaiso); two in alcohol, Eydoux, 1832; seven in alcohol, Hombron and Jacquinot, 1842; one in alcohol, Martinez, 1874, all from Chile.

### 54. STICHAETER AUSTRALIS.

1861. *Cælasterias australis*, Verrill. *Trans. of Connecticut Acad. of Arts and Sciences*, vol. I, part II.

I have been able to examine in the British Museum a very large number of this species coming either from New Zealand or from the southern coast of Australia. Except for the number of arms, I see no characters to justify classifying it in a genus other than *Stichaster aurantiacus*, with which it has so many similarities. It seems dangerous to me to use the number of arms to found a genus in a family where some species has such a great variability in this regard. In spite of its nine to eleven arms, we thus consider the *Cælasterias australis* of Verrill as a true *Stichaster*.

### IV. GENUS CALVASTERIAS (E. P.).

### 55. CALVASTERIAS ASTERINOÏDES.

This curious little species that I described under this name has a singular mixture of characters of *Asterina* and of those of *Asterias*. The general form of the body is that of *Asterina gibbosa* and of related species. The arms are well marked, but short, wide and obtuse. On the largest individual:

$R = 22$  mm,  $r = 11$  mm,  $R = 2 r$ . The width of the arm at the base is 11 mm and the straight borders of two adjacent arms are connected without a rounded angle. The end of the arms is to the contrary rounded. The disk is raised, as in *Asterina gibbosa*. The thickness of the animal is nearly 10 mm. The arms are also thick and very convex above.

The skeleton, completely enveloped in a thick skin, is formed of variously indented calcareous plates often in the form of a trefoil or a star with four short, wide branches and slightly indented at the top. These plates are arranged on the dorsal surface of the arms in nine longitudinal rows and make up the marginal plates. In each series, they are imbricated as in *Asterina*. Moreover, each plate is joined by its lateral branches to the plates of the neighboring series. Above and below these branches is a free space filled with a papular area. These areas are arranged on the arms in a

longitudinal series as in *Asterina*. There are eight series. Each area has two to four pores by which the short, very large papulae extend. Outside these papulae on the border of each papular area are one to three straight pedicellariae on a membranous peduncle, identical in all regards to the straight pedicellariae of the true *Asterias*. The madreporite is small and circular, with a few wide, sinuous radiating grooves, separated by thin sides. It is nearly equidistant from the center and edge of the disk. At a variable distance around it, each skeletal plate sometimes has a small, rounded and slightly projecting tubercle, marked with strong striations whose sides are crenulated. These tubercles are often very difficult to see and sometimes completely missing. There are usually two others of them on opposite sides of the median line of each arm and at the same distance from the disk as those that are inside the madreporite. As a result, these tubercles are arranged in a circle to which the madreporite is tangent on the outside. A very small number of analogous tubercles may occur on the disk in the interior of this circle. In an individual that I believe must belong to the same species, and which alone has an indication of locality, each plate of the arms has a similar tubercle, but slightly smaller. There are even two or three of them on the plates that correspond to the median line of the arms. Outside these inconspicuous tubercles, and ordinarily missing for the most part, there is no trace of spines or various ornaments on the dorsal surface. All this surface is covered by a thick, absolutely naked skin. Each marginal plate has two or three mobile, divergent, short and obtuse spines. Each group is arranged obliquely in relation to the marginal border appearing to have been separately enveloped in an extension of the skin.

On the ventral surface, the ambulacral grooves are very wide and the tube feet arranged, as usual, in four regular series. Each adambulacral plate has a single cylindrical, obtuse and slightly elongated spine. Sometimes these spines are uniformly attached in the same way and then form only a single perfectly regular row. Sometimes they incline alternately slightly to the left and right to seem to be a double line. Inside the adambulacral groove, attached at the base of some spines, is a straight pedicellariae, larger than those of the dorsal surface and supported by a very long membranous peduncle. Between the line of adambulacral spines and that of the marginal spines is a band filled with a row of large isolated papulae. Between them are some straight pedicellariae, equally isolated.

I have not been able to find crossed pedicellariae in this species.

Seven individuals, very well preserved in alcohol. Only one has an indication of locality. It was collected in 1841 by Hombron and Jacquinot in the Torres Strait, between Australia and New Guinea.

*Observation.* According to the arrangement of the tube feet, of the spines bordering the ventral grooves, the form and arrangement of the straight pedicellariae, we cannot doubt that *Calvasterias asterinoïdes* does not belong to same family as *Asterias*. Its external form, the arrangement in series of its skeletal plates and the imbricated arrangement, the arrangement of the poriferous areas and their pores recall, to the contrary, a little that seen in *Asterina*. It is interesting to find in the two families of *Asteridæ* and *Asterinidæ* an arrangement of skeletal pieces very rare in other families. We find also in fact in *Stichaster*, notably in *Stichaster aurantiacus*, skeletal pieces very clearly arranged in longitudinal series and also imbricated. Their form alone is different. In addition, in a very large number of *Asterias*, the pieces in the median dorsal line are likewise imbricated. It is the same of those that make up the calcareous network of the dorsal surface. The characters of *Calvasterias asterinoïdes* that are common to it and *Asterina* are more or less developed in undoubted members of the family *Asteridæ*. Our animal has also other characters that are up to the present nearly exclusively those of this family. There thus is no possible doubt on its zoological position. However, the remarkable development of the skin, the nakedness of the dermis, the quite

special arrangement of the pedicellariae and the other traits of organization that I have already emphasized are characters the sufficiently justify the creation of a special genus for this species in the family *Asteridæ*. We unfortunately have not had the opportunity to examine *Pteraster multipes* Sars. But, having the species we are going to describe, the arrangement of the pedicellariae attributed by Verrill of his *Pteraster Danæ* and the multiplicity of the tube feet of *Pteraster multipes*, we are led to ask if the affinities of Pterasteridæ and Asterinidæ with Asteridæ are not greater than one would ordinarily admit.

#### V. GENUS HELIASTER (GRAY).

1840. *Annals and Mag. of Natural History*, v. VI.

#### 56. HELIASTER MICROBRACHIA.

1860. *Heliaster microbrachia*, Xantus. *Proceed. Philad. Acad. Sci. Nat.*, p. 568.

1867. *Heliaster microbrachia*, Verrill. *Trans. of Connecticut Acad. of Arts and Sciences*, vol., I, 2e part., p. 289.

One individual donated by the Museum of Comparative Zoology of Cambridge (Massachusetts); Acapulco, 1864.

#### 57. HELIASTER KUBINJI.

1860. *Heliaster Kubiniji*, Xantus. *Proceed. Philad. Acad. Sc. Nat.*, p. 568.

1867. *Heliaster Kubinji*, Verrill. *Trans. of Connect. Acad. of Arts and Sciences*, vol. I, 2<sup>e</sup> part, p. 289.

A dried specimen donated by the Museum of Comparative Zoology of Cambridge (Massachusetts); Acapulco, 1864.

#### 58. HELIANTHUS HELIANTHUS.

1792. *Asterias*, Bruguières. *Enc. méth.*, pl. CVIII and CIX.

1815. *Asterias helianthus*, Lamarck. *An. s. vert.*, v. III, p. 245, no 20.

1825. *Asterias helianthus*, Say. *Journal of Soc. Sc. Nat. Philadelph.*

1834. *Asterias helianthus*, de Blainville. *Manuel d'actinologie*, p 212 and pl. XXIII, fig. 5.

1835. *Stellonia helianthus*, Agassiz. *Prodrome d'une Descript. Des Echinodermes Soc. Sc. Nat. Neufchâtel*, v. I, p. 25.

1840. *Asterias (Heliaster) helianthus*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 180.

1842. *Asteracanthion helianthus*, Müller and Troschel. *System der Asteriden*. p. 18.

1862. *Heliaster helianthus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 343.

1865. *Heliaster (heliaster) helianthus*, Gray. *Synopsis of the Asteridæ*, p. 2.

1867. *Heliaster helianthus*, Verrill. *Transactions of Connecticut Academy of Arts and Sciences*, vol. I, part 2, p. 289.

1869. *Heliaster helianthus*, Edm. Perrier. *Pédicellaires*, p. 39.

Five dried examples, two from the collection Michelin; eight in alcohol: six given in 1832 by Eydoux, one given in 1870 by Professor Paul Gervais, and one without indication of origin, the same as the dried individuals.

These individuals have numerous variations in the number of arms (29 to 40), the number and arrangement of the spines of the back, which are in general short, obtuse and rounded at the end. They form two very regular lateral lines and one irregular median line, made up of spines very close to each other and can completely cover the dorsal surface of the arms.

We distinguish as a variety one individual whose dorsal spines are more elongated and end in an obtuse point. Those forming the lateral lines are isolated or paired, the two spines being in a plane longitudinal to the arms. Those forming the median line are in transverse rows or a slightly oblique row of two to four spines. These rows are irregularly placed on each side of the median line, spaced from each other by approximately one millimeter. They thus form one very interrupted median line. The space that separates the median line from the laterals is covered with very small pedicellariae. We give this variety the name *longispina*.

A single dried individual from Chili.

## 59. HELIASTER CANOPUS

18... *Asteracanthion canopus*, Valenciennes. Manuscript. Collection of the Museum.

Professor Valenciennes distinguished this species.

Diameter, 70 mm. Twenty-four arms, exceeding by a little more than a third of the ray of the disk. They have on the dorsal part three simple, perfectly regular rows of spines ending in an obtuse point. One of these rows is median, the other two are marginals.

Two individuals preserved in alcohol from Juan Fernandez; Hombron and Jacquinot, 1841.

*Observation.* When one considers the extreme variation in *Heliaster*, their area so restricted between the Galapagos Islands, Juan Fernandez Islands and the west coast of South America, the weak differences that have been used to distinguish several species, we can ask if these distinctions are really valid and if, in reality, these species are not simple varieties. *Heliaster microbrachia* Xanthus, from Cape San Lucas and Acapulco is the best characterized of these forms. I have not been able to find *Heliaster Cumingii* in the British Museum. *Heliaster Kubiniji* is very near *Heliaster helianthus*, of which *Heliaster canopus* Val. is perhaps only a young.

## VI. GENUS PYCNOPODIA (STIMPSON).

### 60. PYCNOPODIA HELIANTHOÏDES.

1835. *Asterias helianthoides*, Brandt. *Prodr. Descr. Anim. Mertens obs.* p. 71.

1861. *Pycnopodia helianthoïdes*, Stimpson. *On New Genera and Species of Starfishes of the Family Pycnopodidæ — Proceed. of Boston Soc. of Nat. Hist.*, v. VIII, p. 261.

One dried specimen with thirteen arms, donated in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts), directed by Agassiz; Gulf of Singio. Another larger with twenty arms coming from the coasts of California and donated in 1866 by Jules Verreaux.

*Remarks regarding some doubtful species of the family Asteroidea.* — Before preceding to the study of another family, I must add here some considerations regarding some species of asteroids about which there still exists some uncertainty.

We have seen, in regard to the asteroids of our coasts, how one of the most common species still has some uncertainty. In 1865, the Reverend Alfred Merle Norman still distinguished as distinct species *Asterias rubens* Linné, *Asterias violacea* O.-F. Müller and *Asterias hispidia* Pennant. He added that there are in our seas several other forms that could not be placed without difficulty in the description of known species. I.e., in *Asterias rubens* there are numerous forms that could be attached to it specifically but that perhaps are also distinct. It is certain it would be difficult to find two identical specimens, either in regard to proportions of the body, or to the number and form of the spines, the number and arrangement of the pedicellariae, the form and dimensions of the skeletal plates or even of color. It is very difficult to give a diagnosis that applies to all the known forms. However, this variability makes even more difficult the specific identity of related forms to which distinct names have been given, that we do not even agree on the characters corresponding to these names. The same fact applies to the species of the American Atlantic coast. From 1825 to 1873, these species in collections and works have been given a very large number of names by Say, Desor, Alexander Agassiz, Stimpson and Verrill. The latter two authors have given at the same time detailed descriptions of the species they have studied. Not all of these names seem to have been preserved. The disputed species are *Asteracanthion Fabricii*, *berylinus* and *pallidus* of Alexander Agassiz, *Asteracanthion Forbesii* of Desor, and *Asterias vulgaris* and *arenicola* of Desor, to which we will add our *Asterias borealis*.

In 1866, in his memoir titled: *On the Polyps and Echinoderms of New England*<sup>11</sup>, Professor Verrill regarded *Asteracanthion Forbesii* of Desor as identical with *Asteracanthion berylinus* of Alexander Agassiz, after direct comparison of the types of Desoro with the individuals in the collection of the Essex Institute labelled by Alexander Agassiz. He accepted, to the contrary, although with doubt *Asterias vulgaris* of Stimpson, *Asteracanthion pallidus* and *Fabricii* of Alexander Agassiz. This same species has been frequently also designated under the name *Asterias rubens*, to which Say united a more southern species, *Asterias arenicola*. Stimpson believed it identical with *Asterias spinosa* Linck.

In 1873, in his Catalogue of the Marine Invertebrata of the Southern Coast of New England Adjacent Waters<sup>12</sup>, Verrill goes back on these determinations: 1°. It is no longer with *Asteracanthion Forbesii* Desor, but with *Asterias arenicola* Stimpson that he identifies *Asteracanthion berylinus* Alex. Agassiz; 2° The doubt that accompanied the identification of *Asteracanthion pallidus* of this same scholar with *Asterias vulgaris* Stimpson has disappeared; 3° There is no longer a question of *Asteracanthion Fabricii* Alex. Agassiz. In addition, the author adds that he is not very certain that one should continue to distinguish *Asterias arenicola* Stimpson and *Forbesii* Desor, the differences that separate these two forms being perhaps mostly sexual differences. He has made, as we see, a complete revolution in the ideas of this American naturalist scholar who has unfortunately given no details about the causes that have determined these modifications in his opinions. The small number of specimens of the species concerned in the collection of the Museum are mostly dried. Consequently, it would be audacious on our part to oppose the opinion of the eminent zoologist of Yale College who frequently has had the opportunity to study living animals. However, some clarification appears necessary.

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<sup>11</sup> *Proc. of Boston Society of Natural History*, 1866.

<sup>12</sup> *Report of Commissioner of Fish and Fisheries*, p. 718.

The only specimen of *Asteracanthion Fabricii* in the Jardin des Plantes was received from the Museum of Comparative Zoology of Cambridge. It cannot be identified with *Asteracanthion vulgaris* that I have confirmed in comparison with a specimen sent to the British Museum by the *Smithsonian Institution* or with *Asteracanthion berylinus* in the Jardin des Plantes from the Museum of Comparative Zoology of Cambridge. Its arms are shorter, more swollen at the base. Its spines are less numerous and its color is completely different. By its form, it is nearer *Asteracanthion berylinus*. But the spines are arranged differently. And the color of the dried individuals is a somber gray, like that of *Asterias arenicola* instead of the pale yellow-orange as in the first species.

It thus seems necessary to preserve the name under which this specimen was sent by Agassiz, while waiting more complete information from the American naturalists.

It was perhaps inadvertent that *Asteracanthion berylinus* Al. Agassiz was considered in 1873 as a synonym of *Asteracanthion arenicola* Stimpson and no longer as *Asteracanthion Forbesii* Desor. The description of the latter specimen given in 1866 by Verrill himself corresponds exactly to authentic specimens of *Asteracanthion berrylinius* in the Museum. I confirm that comparison of these specimens with the equally authentic species of *Asteracanthion arenicola* in the Museum does not permit any suspicion of their relation.

As to the identity of *Asteracanthion pallidus* Alex, Agassiz with *Asteracanthion vulgaris* Stimpson, it would be desirable that Verrill would establish it in giving a description of the different ages of this species. Between authentic specimens of *Asteracanthion pallidus* and *Asteracanthion vulgaris* in the Jardin des Plantes from the Museum of Comparative Zoology in Cambridge and an equally authentic individual from the British Museum, there is one striking difference in the form of the spines. In *Asteracanthion pallidus*, the spines all regularly end in a small swollen head that is spherical and clearly striated. The sides separating the striations are profoundly serrated. To the contrary, the large, short peduncle that supports this head is nearly smooth. Moreover, in dried specimens, no spines are erect. They all lie on the back of animal beside a small, rounded and perforated mamelon to which it was articulated in the living animal. This is a very general condition so that we can think it is not the normal arrangement, and that the spines were all accidentally broken, the part adhering to the ossicles making up the umbilical mamelon that I just mentioned<sup>13</sup>. Now, in large individuals of *Asteracanthion vulgaris*, I see nothing like this arrangement.

The spines are very long, cylindrical or sometimes thin at the top, sometimes slightly bi- or trifurcated, but never swollen into a small sphere. Their appearance is identical their entire length. One cannot distinguish a smooth and a striated part that is so clear in specimens of *Asteracanthion pallidus*. Finally, the straight pedicellariae are more numerous and relatively smaller.

Are these differences related to the age of the specimens? Between the large individuals nearly three decimeters in diameter, only represented by some *Asteracanthion vulgaris* Stimpson, that we have examined, and specimens of *Asteracanthion opallidus* Alex. Agassiz, that are no more than twelve centimeters in diameter, the distance is too great for us to be able to decide. We must consequently limit ourselves to report these differences to the American naturalists and wait their explanations. This is why we have preserved in the Museum the two names that Verrill considers today as identical.

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<sup>13</sup> Moreover, Verrill himself reported an analogous arrangement in *Asteracanthion Stimpsoni*, an arrangement that we ourselves were able to confirm in two specimens of this species that we have been able to observe since the printing of the preceding pages. *Asteracanthion Stimpsoni* and *Asteracanthion pallidus* would not in any way be confused.

We have added another name to the list of species of the north Atlantic American coast. It seems impossible to us that the individual from Labrador that the Museum of Cambridge sent to the Jardin des Plantes with the name *Asteracanthion polaris* M. T., is identical to individuals from Greenland that represent this species in our collection. The identification cannot be doubted because most of them were donated to the Museum by Professor Paul Gervais, who had them himself from Steenstrup. They thus represent well the *Asteracanthion polaris* of the Danish scholars, the *Asteracanthion polaris* of the museum of Copenhagen. The one in question in the works of Doctor Lütken on the echinoderms of Greenland, and the latter would not be identical to the asteroid from Labrador that Verrill and the American naturalists designate under that name. A difference of one or two in the relative length of the arm does not appear to us in fact to exceed the limit of usual variations. The single specimen we have from this location has in consequence received a new name. Its proportions are however those of individuals designated in America with the name *Asteracanthion polaris*. For one of these, Verrill gave in fact the total diameter as ten and a half inches and a diameter of the disk of one and three quarter inches. This gives an R as equal to nearly five times r. This is one point that requires clarification.

It remains for me to discuss two species, likewise American, but probably of the west coast of North America. Our *Asterias brachiata* could be *Asteracanthion epichlora* Brandt. We have seen only a specimen of this species in the British Museum Its spines were long, less obtuse, and have less clear mesh on the arms. This specimen was orange in color, while the individual also dried sent by the museum of Cambridge is a deep gray.

Finally, our *Asterias Douglasi* would have some relation with *Asteracanthion acervata* Stimpson. But we do not see in it any trace of the arrangement of its groups of spines in three regular bands that Stimpson attributed to his species.

## FAMILY II. FAMILY ECHINASTERIDÆ.

### VII. GENUS SOLASTER (FORBES).

1833. Forbes. *Asteriadæ of Irish Sea*. — *Mem. of Wern. Soc.*, v. VIII, p. 121.  
 1834. *Stellonia* (pars), Nardo. *Isis*, p. 715.  
 1835. *Stellonia* (pars), Agassiz. *Prodr. Soc. sc. nat. Neufchâtel*, v. I, p. 191.  
 1840. *Crossaster*, Müller and Troschel. *Wiegmann's Archiv*. 6<sup>o</sup> year, p. 321.  
 1840. *Solaster*, Gray, (*Endeca* and *Polyaster*). *Ann. nat. Hist.*, v. VI, p. 183.  
 1842. *Solaster*, Müller and Troschel. *System der Asteriden*, p. 26.

### 61. SOLASTER PAPPOSUS.

1605. Clusius. *Exoticorum libri X*, p. 144.  
 1616. *Stella marina tredecim radiis*, Besler. *Fasciiculus rariorum et aspect dignoruum*, Norimb.  
 1703. *Stella rubra coriacea 12 radiis*, Luidius. Reprinted in Linck, *De Stellis marinis*, p. 80.  
 1733. *Dodekaktis reticulate in dorso*, Linck. *De Stellis marinis*, p. 41, pl. XVIII, n<sup>o</sup> 28.  
 1777. *Asterias helianthoides*, Pennant. *British Zoology*, v. IV, p. 66, n<sup>o</sup>72.  
 1780. *Asterias papposa*, Fabricius. *Fauna groenlandica*, p. 369.  
 1783. *Asterias papposa*, Retzius. *Anmarkniger, v. d. Asteriæ genus*. (*Kongl. Vetensk. Acad. Handl. Stockholm*, v. IV, p. 237.  
 1788. *Asterias papposa*, Gmelin. In *Linnæi Systema naturæ*, p. 3160.

1792. *Asterias papposa*. *Encyclop. Méthod.*, pl. CVII, fig. 4 and 5.  
 1816. *Asterias papposa*, Lamarck. *An. s. vert.*, 2nd edit., v. III, p. 246.  
 1824. *Asterias papposa*, Sabine. *Capt. Parry's Voyage*, App. X, fig. 44.  
 1828. *Asterias papposa*, Fleming. *British Animals*, p. 487.  
 1834. *Asterias (Solasterias) papposa*, de Blainville. *Manuel d'actinologie*, p. 241.  
 1835. *Stellonia papposa*, Agassiz. *Prodr. Monogr. Rad.*. — *Soc. Sc. nat. Neufchâtel*, v. I, p. 191.  
 1839. *Asterias papposa*, Johnston. *Loudon's Mag.*, v. IX, p. 474, fig. 69.  
 1840. *Solaster (Polyaster) papposus*, Gray. *Ann. Nat. Hist.*, v. I, p. 183.  
 1840. *Crossaster papposus*, Müller and Troschel. *Ueber die Gattungen der Asteriden*.  
*Wiegmann's Archiv*, v. VI, 1<sup>st</sup> part.  
 1841. *Solaster papposa*. Forbes. *British Starfishes*, p. 112.  
 1842. *Solaster papposus*, Müller and Troschel. *System der Asteriden*, p. 26.  
 1862. *Solaster papposus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 353.  
 1865. *Solaster (Polyaster) papposus*, Gray. *Synopsis*, p. 5.  
 1866. *Solaster papposus*, Norman. *British Association Reports*, p. 104.  
 1867. *Crossaster papposus*, Verrill. *Proceed. Boston Society of Nat. Hist.*, v. X, p. 334.

Numerous specimens, dried and in alcohol, from the Channel, the sea of the North and Iceland.

## 62. SOLASTER ENDECA.

1705. Rumphius *Amboiniscihe Rariteitkamer*, p. XV, fig. F.  
 1733. *Octactis dactyloides*, Linck. *De Stellis marinis*, p. 39, pl. XIV, p. 25.  
 1733. *Enneactis coriacea dentata*. *Ibid.*, p. 44, pl. XVII, n° 27.  
 1776. *Asterias aspersa*, O.-F. Müller. *Zool. Dan. Prodr.*, n° 2833.  
 1785. *Asterias endeca*, Linné. *Syst. Nat.*, ed. Gmel., p. 3462.  
 1783. *Asterias endeca*, Retzius. *Anmarknig. V. d. Asteriæ genuos. (Kongl. Akad. Handl. Stockholm*,  
 v. IV, p. 237.  
 1792. *Asterias endeca*, Bruguières. *Enc. method.*, pl. CXIII, fig. 3, pl. CXIV, pl. CXV and pl.  
 CXVI, fig 4.  
 1816. *Asterias endeca*, Lamarck. *An. s. vert.*, v. III, p. 227, n° 23.  
 1828. *Asterias endeca*, Fleming. *British Animals*, p.487.  
 1834. *Asterias (Solasterias) endeca*, de Blainville. *Man. Actinol.*, p. 242.  
 1835. *Asterias endeca*, Johnston. *Mag. of Nat. Hist.*, vol. IX, p. 300, fig. 44.  
 1835. *Stellonia endeca*, Agassiz. *Prodr., Mém. Soc. sc. Neufchâtel*, v. I.  
 1839. *Solaster endeca*, Forbes. *Mem. of Werner. Soc.*, v. VIII, p. 121  
 1840. *Solaster (Endeca) endeca*, Gray. *Ann. Nat. Hist.*, v. VI, p. 183.  
 1841. *Solaster endeca*, Forbes. *British Starfishes*, p. 109.  
 1842. *Solaster endeca*, Müller and Troschel. *System der Asteriden*, p. 26.  
 1848. *Solaster (Endeca) endeca*, Gray. *Brit. Mus.*, p. 19.  
 1862. *Solaster endeca*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 354.  
 1865. *Solaster (Endeca) endeca*, Gray. *Synopsis*, p. 5.

One specimen from Iceland (alcohol), Gaimard, 1835; two from Bergen (Norway), and one of unknown provenance. The latter donated by the Museum of Comparative Zoology of Cambridge

(Massachusetts). A nice specimen from Greenland, in alcohol, donated by Professor Paul Gervais, 1870.

### VIII. GENUS ACANTHASTER (P. GERVAIS).

1835. *Stellonia* (pars), Agassiz. *Prodrom*, p. 25.  
1840. *Echinaster*, Gray. *Ann. Nat; Hist.* v. VI, p. 241.  
1841. *Acanthaster*, Paul Gervais. *Dict. Des Sc. Nat.*, supplement, v. I, p. 474.  
1842. *Echinaster* (pars), Müller and Troschel. *System der Asteriden*, p. 25.  
1844. *Echinites*, Müller and Troschel. *Wiegmann's Arch.*, p. 180.  
1862. *Acanthaster*, Dujardin and Hupé. *Echinodermes. Suites à Buffon*, p. 350.  
1866. *Echinaster*, Sg. *Heliaster*<sup>14</sup>, von Martens. *Ostasiatische Echinodermen. Archiv für Naturgeschichte*, 32<sup>o</sup> year, 1<sup>st</sup> part, p. 60.

### 63. ACANTHASTER ECHINITES.

1705. *Stella marina quindecim radiorum*, Rumphius. *Ambonische Rar.*, p. 39.  
1744. *Stella pentekaidekaktis*, Columna (Fab.), *Phytobasanos*, pl. XXXVIII.  
1786. *Asterias echinites*, Ellis and Solander. *The Natural History of Zoophytes*, pl. IX.  
1792. *Asterias echinites*, Bruguières. *Encyclopedie méthodique*, pl. CVII, a, b and c.  
1793. *Asterias solaris*. *Beschreibung der Seesonne*, Naturforscher Stücke 27, pl. I and II (Schmidel).  
1816. *Asterias echinites*, Lamarck. *An. s. vert.*, 2<sup>nd</sup> edit. v. III, p. 246, n<sup>o</sup> 21.  
1834. *Stellonia echinites*, Agassiz. *Prodrome*, p. 25.  
1840. *Echinaster solaris* and *Echinaster Ellisii*, Gray. *Annals of Nat. Hist.*, v. VI, p. 281.  
1841. *Acanthaster echinus*, P. Gervais. *Dict. Sc. nat.*, suppl, v. I, p. 474.  
1842. *Echinaster solaris*, Müller and Troschel. *System der Asteriden*, p. 25.  
1844. *Echinites solaris*, Müller and Troschel. *Wiegmann's Archiv*, p. 180.  
1862. *Acanthaster solaris*, Dujardin and Hupé. *Suites à Buffon. Echinodermes*, p. 351.  
1865. *Echinaster solaris* and *Echinaster Ellisii*, Gray. *Synopsis*, p. 12.  
1866. *Echinaster* (*Heliaster solaris*, von Martens. *Ostasiatische Echinodermen (Archiv für Naturg.*, 23<sup>rd</sup> year, 1<sup>st</sup> part, p. 60).  
1871. *Acanthaster Ellisii*, *A. solaris*, *A. echinites*, Lütken. *Vidensk. Meddel.*, p. 292 (68).

It is impossible, with the information that we presently have, to know if the names cited represent one or several close species. Doctor Lütken remarked, however, in his critical and descriptive third memoir on sea stars, that there are indications of at least three species of *Acanthaster*. But this is a simple probability based on the different provenance of the specimens that represent these species and on some characters taken from the number of arms and their madreporites. As these numbers are very variable, there is nothing that be concluded. The three species that Doctor Lütken suggests to exist would be the following:

*Acanthaster Ellisii*, Gray. Twelve to thirteen arms. Three madreporites. (La Paz, Verrill.)

*Acanthaster Ellisii*, Gray. Eleven to twelve arms. Fifteen madreporites. (South America, Gray.)

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<sup>14</sup> von Martens gave in his synonymy the name *Heliaster volaris* Dujardin and Hupé. This is, without doubt, a typographical error. These authors have designated this species as *Acanthaster volaris*.

*Acanthaster solaris*, Gray. Twenty-one arms. Ten madreporites. (Strait of Magellan.)  
*Acanthaster echinites*, Ellis. Twenty arms. Sixteen madreporites. (Batavia, Ellis)  
*Acanthaster echinites*. Ellis. Thirteen arms. Five madreporites. (Mindanao, von Martens.)

By the differences present in individuals coming from neighboring locations that one can consequently suppose to be the same species, one sees the uncertainty that exists in determining species defined only by the number of arms or madreporites.

The examination of five more or less complete individuals in the Museum shows that Doctor Lütken has perfectly good reason to suggest that there are several distinct species of *Acanthaster*. Two of them are in the Museum. Unfortunately, we have no information on their provenance and all identification with the species indicated by Lütken becomes consequently impossible. However, the synonymy of these species should not be indefinitely maintained. As two of the specimens in the collection are surely the *Asterias echinites* of Lamarck, we have because of this good reason to make our choice. We will consequently give to these two individuals and another that is identical the name of *Acanthaster echinites*. The other species, represented by two individuals whose arms and madreporites are less numerous will take the name of *Acanthaster Ellisii* that Gray gave to individuals with this same characteristic.

Of the three individuals of *Acanthaster echinites*, two are nearly intact although in poor condition. One is very deteriorated.

In the largest,  $R = 130$  mm,  $r = 80$  mm. There are nineteen arms. There are only five madreporites, but one part of the region on which these plates are located is destroyed. In the second,  $R = 100$  mm,  $r = 60$  mm. There are only fifteen arms, but ten madreporites. Finally, in the third individual, the arms and one part of the disk are broken,  $R$  and  $r$  cannot be measured, but there are nine madreporites and seventeen arms. All of the other characters are the same. We see that these numbers have no value as specific characters.

Each ambulacral plate has three spines in the ambulacral groove that are rarely equally developed. The median spine is always larger than the others. The internal spine is next. The external spine is usually very small, nearly rudimentary. These spines are cylindrical or slightly flattened and truncated at the end. Outside the groove, each of these plates has a large cylindrical spine *covered up to two thirds of its height with very large irregular granules* and close to each other. The outer third of the spine is naked. At its base and in the interval that separates the internal row of spines is ordinarily a longer pincer pedicellaria. Immediately after this row of spines are two others composed of exactly similar spines, except for their length that is much greater. Numerous pincer pedicellariae with a length greater than 2 mm are scattered between these spines. The dorsal surface is uniformly granulated, with five irregular rows of spines. They are longer than on the ventral surface (18 mm), conical, and end in a sharp point and *greatly granulated up to their end*. Between them *are a great number of pincer pedicellariae*, more than four mm length in some specimens. When these pedicellariae are detached, their alveoli are easily found so that it is always easy to be certain of their existence.

The madreporites are nearly hemispherical.

The color of living animals appears to have been violet.

Individuals of this species in the British Museum come from the Red Sea, Mauritius and the Philippines. Other asteroids of the same geographical region occur up to the west coast of America. It thus is not impossible that the *A. Ellisii* of Gray from the coast of California belong to this species, but we could not find the label of Gray in the British Museum.

#### 64. ACANTHASTER ELLISII.

1840. ? *Acanthaster Ellisii*, Gray. *Ann. Nat. Hist.*, v. VI.

1869. *Acanthaster solaris*, Edm. Perrier. *Pédicellaires*, p. 96, pl. II, fig. 14.

1871. ? *Acanthaster Ellisii*, Lütken. *Vidensk. Medd.*, p. 292.

By the number of arms and madreporites, this species, quite distinct from the preceding, is near the *Acanthaster Ellisii* of Gray. But, lacking the precise locality, we do not want to state that it is absolutely identical. It must be named, and it is better to use the names still doubtful that are already in science than to maintain the synonymy indefinitely. There are two specimens in the Museum that we refer to this species.

The largest has nineteen arms and eight madreporites. R = 66 mm, r = 40 mm. The smallest, which is very well preserved in alcohol, has only fifteen arms and seven madreporites.

There are pedicellariae that I have represented in my previous research on these organs. The spines are arranged nearly like in the preceding species, but they are *completely naked* instead of being covered with granules. The *pedicellariae* are likewise numerous, but they are *very short*, as indicated in our figure and the largest does not reach one mm in length. These two characters distinguish this species very clearly from the preceding. The color is likewise violet, the madreporites being yellowish.

All the spines of the small specimen are likewise pointed and from five rows on each arm, not including those that make up the external row of the adambulacral armature. Each plate of the internal row has two or three spines, nearly equal and divergent. The skin is naked and with very separated, sparse granules.

A nice specimen was reported in 1829 by Quoy and Gaimard (expedition of d'Urville). The location of the other dried specimen is unknown.

#### IX. GENUS ECHINASTER (M. AND T.).

1834. *Stellonia*, pars, Nardo. *Isis*, p. 715.

1835. *Stellonia*, pars Agassiz. *Prodr.*, p. 191, S.N.

1840. *Echinaster*, Müller and Troschel. *Wiegmann's Archiv*.

1840. *Othilia* and *Rhopia*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 281 and 282.

#### 65. ECHINASTER ECHINOPHORUS.

1733. *Pentadactyloaster spinosus regularis*, Linck. *De Stellis marinis liber singularis*, p. 35, pl. XVI, n° 16.

1792. Bruguières. *Encyclopédie méthodique*, pl. CXIX, fig. 2 and 3.

1816. *Asterias echinophora*, Lamarck. *Animaux sans vertèbres*. Vol. III, p. 248.

1840. *Othilia spinose*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 281.

1842. *Echinaster spinosus*, Müller and Troschel. *System der Asteriden*, p. 221<sup>15</sup>.

18.... *Echinaster echinophora*, Manuscript. Collection of the Museum.

1859. *Echinaster spinosus*, Lütken. *Vid. Medd. F. Nat. For.*, p. 66.

1862. *Echinaster spinosus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 345.

1865. *Othilia spinosa*, Gray. *Synopsis*, p. 12.

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<sup>15</sup> Probably in part only.

1868. *Othilia crassispina*, Verrill. *Trans. Conn. Acad. of Arts and Science*, v. I, p. 368, pl. IV, fig 1.

1869. *Echinaster spinosus*, Edm. Perrier. *Pédicellaires*, p. 57.

1871. *Echinaster crassispinus*, Lütken. *Vidensk. Meddel. F. Nat. For.*, p. 61.

The synonymy of this species is very confused because, without doubt, the first authors who considered it have not sufficiently distinguished it from the following species that is very close to it, however perfectly characterized. This is the one that Lamarck gave the name *Asterias echinophora*, as is indicated by the original specimens preserved in the museum of Paris. Müller and Troschel, who had seen these specimens of the museum of Paris, cited *Asterias echinophora* of Lamarck among the synonyms of their *Echinaster spinosus*. It is thus incontestable that they wanted to understand under this name the species of Lamarck. However, they confused perhaps<sup>16</sup> with it the following species named in 1825 by Say, *Asterias sentus*, because, on one hand, they write in synonyms of their *Echinaster spinosus* the *Othilia spinosus* and *aculeata* of Gray, that appears to us to be *Asterias echinophora* Lamarck and *sentus* Say, species very distinct from each other. On the other hand, Agassiz, Verrill and Lütken wrote without any doubt the *Echinaster spinosus* of Müller and Troschel among the synonyms of *Asterias sentus* of Say, which is not the *Asterias echinophora* of Lamarck seen by Müller and Troschel at the museum of Paris and named by them *Echinaster spinosus*. The *Asterias sentus* of Say arrived at the museum of Paris only in 1864, sent under the name of *Othilia spinosa* Gray by the Museum of Comparative Zoology of Cambridge (Massachusetts).

There cannot be any doubt on this point that the *Asterias echinophora* of Lamarck is certainly, at least in part, the *Echinaster spinosus* of Müller and Troschel. The comparison with the figure of Linck can leave no doubt either of the identity of the species of Lamarck with the *Pentadactyloaster spinosus regularis* of the *De Stellis marinis liber singularis*. But the name of Linck does not enter into binary nomenclatures. It is evidently the name of Lamarck that should be preserved and Müller and Troschel were wrong to change it.

Comparison of the specimens of *Echinaster sentus*, sent by Agassiz under the name *Othilia spinosa* Gray and *Asterias echinophora* Lamarck, shows, on the other hand, that these two species are perfectly distinct. The numerous specimens from Central America and Bahia in the Museum, in addition to those of Lamarck, and the identification that Verrill made of his *Othilia crassispina* with the figure of Linck, shows that this latter species and *Asterias echinophora* Lamarck are certainly the same animal. It is thus necessary to modify, in the sense we have just indicated, the synonymy given by Lütken in 1871 in his third critical and descriptive memoir on sea stars and suppresses the names *Othilia crassispina* or *Echinaster crassispinus* introduced into science since the description of Verrill in 1868. There are four dried specimens, in good condition, of *Echinaster echinophorus* from North America in the collection of the museum of Paris. Although the manuscript label of Lamarck no longer exists, we cannot doubt these are his correct specimens because, in addition to the recopied label *Echinaster echinophora*, that they have the mode of preservation and mounting used in the collection from the time of Lamarck. These are, in addition, the only ones that existed in the Museum when Müller and Troschel visited, and that were shown to these scholars as being *Asterias echinophora* Lamarck. In addition to these four specimens, historic in a way, the collection has an individual in alcohol from Central America, given in 1849

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<sup>16</sup> However, we cannot affirm this in a positive manner, because Müller and Troschel said expressly that in their *Echinaster spinosus*, there were “no more than ten to twelve spines from the middle of the disk to the end of the arms”, while in the *Asterias sentus* of Say, there are up to twenty or twenty-four.

by Morelet; six dried individuals, of which only three are in good condition, collected at Bahia in 1853 by Castelneau; four individuals, likewise dried, from Balize in Yucatan, by Bocourt, a member of the scientific expedition of Mexico. Finally, a dried individual and two individuals in alcohol labeled in the collection as *Echinaster brasiliensis*. They were collected in 1844 at Rio de Janeiro by Castelneau and Deville.

#### 66. ECHINASTER SENTUS.

1713. ? *Echinaster seu Stella coriacea pentadactyla echinata*, Petiver. *Gazophladium*, pl. XVI.  
1825. *Asterias sentus*, Say. *Journal of the Academy of Natural Sciences of Philadelphia*, v. V, first part, p. 143.  
1840. *Othilia aculeata*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 281.  
1842. *Echinaster spinosus*, Müller and Troschel (pars). *System der Asteriden*, p. 22.  
1869. *Othilia spinosa*, Agassiz. *Bullet. Du Muséum de zool. comp. de Cambr., (Massach.)*, n° 9, p. 308.  
1871. *Echinasater sentus*, Lütken. *Vid. Meddel.*, p. 60.

This species has more elongated arms than the preceding, and the number of spines of each of the seven rows is also very great (eighteen to twenty-four). In this regard, the figure of Petiver represents it much better than it represents *Asterias echinophora* Lamarck, which, to the contrary, is exactly figured by Linck. On the other hand, *Othilia aculeata* Gray differs mostly from the preceding species by the elongation of its arms and the larger number of spines, i.e., exactly by the characters that distinguish *Asterias sentus* Say from *Asterias echinophora* Lamarck. This is what led us to establish the preceding synonymy that seems to us to completely exclude the name *Othilia spinosa* Gray, given by the American naturalists to *Asterias sentus* Say. The adoption of this latter name and of *Echinaster echinophorus* for the preceding species, settles, moreover, all the difficulties, although each applies to a well established species and has priority over those of Müller and Troschel and of Gray.

The Museum has four dried individuals of this species from Florida, sent in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts).

#### 67. ECHINASTER SPINULOSUS.

1869. *Echinaster spinulosus*, Verrill. *Proceed. of Boston Society of Natural History*, v. XII, p. 386.  
1871. *Echinaster spinulosus*, Lütke. *Vidensk. Meddel.*, p. 61.

A single dried individual from Florida, sent in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts).

#### 68. ECHINASTER BRASILIENSIS.

- Seba* — *Thesaurus*, pl. VII, fig. 4.  
1840. *Othilia multispina*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 282.  
1842. *Echinaster brasiliensis*, Müller and Troschel. *System der Asteriden*, p. 22.  
1859. *Echinaster brasiliensis*, Lütken. *Vid. Medd. F. Nat. For.*, p. 67.

1862. *Cribella brasiliensis*, Dujardin and Hupé. Suites à Buffon, *Echinodermes*, p. 830.  
 1865. *Othelia multispina*, Gray. *Synopsis*, p. 12.  
 1869. *Echinaster brasiliensis*, Edm. Perrier. *Pédicellaires*, p. 57.  
 1869. *Othelia brasiliensis*, Agassiz. *Bull. of Mus. of Comp. Zool. of Cambridge (Massachusetts)*.  
 p 308, n° 9.  
 1871. *Echinaster brasiliensis*, Lütken. *Fid. Medd. f. Nat. For.*, p. 60.

Two dried individuals from the collection of Michelin, without indication of origin; three in alcohol (Rio de Janeiro), Freycinet, 1822; two in alcohol (Rio de Janeiro), Gaudichaud, 1839; six in alcohol, only one of large size (Rio de Janeiro, Castelneau and Deville, 1844.

#### 69. ECHINASTER CRASSUS.

1842. *Echinaster crassus*, Müller and Troschel. *System der Asteriden*, p. 23.  
 1862. *Echinaster crassus*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 346.  
 1865. *Echinaster crassus*, cited by Gray among his *Othelia*. *Synopsis*, p. 12.  
 1866. *Echinaster crassus*, von Martens. *Ost. Echinod., Troschel's Arch.*, 32° year, 1<sup>st</sup> part, p. 85.  
 1869. *Echinaster crassus*, Edm. Perrier. *Pédicellaires*, p. 57.

Dujardin and Hupé and, after them, von Martens indicated this species came from the seas of India. The only specimen known, the type of Müller and Troschel, that exists, dried in the museum of Paris, has a label indicating *provenance unknown*. We think the indication of Dujardin and Hupé is simply an editorial error. Müller and Troschel in their work only reproduce the statement of the label in the museum of Paris.

#### 70. ECHINASTER GRACILIS.

1842. *Echinaster gracilis*, Müller and Troschel. *System der Asteriden.*, p. 23.  
 18.... *Echinaster Clouei*, Val. Manuscript, Collection of the Museum.  
 1862. *Echinaster gracilis*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 346.  
 1866. *Echinaster gracilis*, cited by Gray among his *Othelia*. *Synopsis*, p. 12.  
 1869. *Echinaster gracilis*, Edm. Perrier. *Pédicellaires*, p. 57.  
 1869. *Echinaster Clouei*, Edm. Perrier. *Pédicellaires*, p. 57.

I refer to this species, in addition to the type of Müller and Troschel that is dried and a little deformed, three individuals in alcohol that Valenciennes distinguished under the name *Echinaster Clouei* that has all the characters of the type. The number of rows of spines can vary from seven to eleven. We should not take as absolute the number of seven given by Müller and Troschel, a number that is, moreover, too low. In the type, there are seven main rows. But there are four other very evident rows, although incomplete. This would bring the number to eleven, which we have indicated in our description as the maximum number. The identity of the dried individual and those preserved in alcohol is thus complete and the name *Echinaster Clouei* should disappear. The three individuals to which Valenciennes applied it came from Madagascar, where it was collected by Captain Cloué, today an admiral.

Dujardin and Hupé indicate this species as originating from the seas of India. The type of the Museum, as said by Müller and Troschel, gives no indication of locality, and it does not appear

probable that the French authors had particular information in this regard. von Martens, in his work on the echinoderms of the Indian archipelago, does not mention this species. We should thus consider Madagascar as being the true country of *Echinaster gracilis*, while recognizing that the species could be found elsewhere.

#### 71. ECHINASTER ERIDANELLA.

- 18.... *Asterias* (?) *eridanella*, Valenciennes. Manuscript. Collection of the Museum.  
1842. *Echinaster eridanella*, Müller and Troschel, *System der Asteriden*, p. 24.  
1862. *Echinaster eridanella*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 346.  
1865. *Echinaster eridanella*, von Martens. *Ostasiatische Echinodermen*, *Arch. für Naturg.*, Jahrg. 32, Vol. 1.  
1865. *Echinaster eridanella*, cited by Gray among his *Othilia*. *Synopsis*, p. 12.  
1869. *Echinaster eridanella* and *Echinaster affinis*, Edm. Perrier. *Pédicellaires*, p. 57 and 58.

Examination of a very large number of *Echinaster eridanella* determined me to attach to this species the individual that I had distinguished with doubt in 1869 under the name *Echinaster affinis*. The isolation of the ventral and marginal papular pores is found more or less marked in the true *Echinaster eridanella*. There thus is no need to attach to it an importance sufficient to establish a species. Although the types seen by Müller and Troschel, and preserved in the Museum, all have six arms and two madreporites, it is impossible to separate by any other character three individuals with five arms and a single madreporite coming from the collection Michelin that have no indication of locality. The distribution of individuals of this species in the collection of the Museum is:

1° An individual with six arms (six intact, the seventh broken) preserved in alcohol, sent from New Caledonia by Balansa in 1872;

2° An individual with seven arms from the sea of the Indies (*Echinaster affinis* E. P.) without other indication. It is a typographical error that north of India is indicated in my *Recherches sur les Pédicellaires* as the locality of this individual instead of the sea of the Indies;

3° Three individuals with six arms from New Ireland in a state of dessication. They are the types of Müller and Troschel that Gray, in his *Synopsis of the Species of Asteriadae*, p. 12, incorrectly indicates by a copying error as originating from New Zealand.;

4° Three dried individuals with five arms, without indication of locality, coming from the collection Michelin.

Eight specimens in all from the sea of the Indies and islands located to the north and northeast of Australia.

It is wrong, we believe, that in the zoology of the voyage of Baron Claus von der Decken, von Martens united this species with *Echinaster fallax* that has neither the size nor the deep red color.

#### 72. ECHINASTER SERPENTARIUS.

- 18.... *Asterias* (?) *serpentarius*, Valenciennes. Manuscript. Coll. of the Mus.  
1842. *Echinaster serpentarius*, Müller and Troschel. *System der Asteriden*, p. 347.  
1862. *Echinaster serpentarius*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 347.  
1865. *Echinaster serpentarius*, cited by Gray among his *Othilia*. *Synopsis*, p. 12.  
1869. *Echinaster serpentarius*, Edm. Perrier. *Pédicellaires*, p. 57.

Four dried individuals from Vera Cruz. These are the types of Müller and Troschel. One other dried individual without indication of locality in the collection Michelin, acquired by the Museum in 1868.

### 73. ECHINASTER FALLAX.

1809. *Asterias*, sp., Savigny. *Description de l’Egypte*, pl. IV, fig. 3.  
1840. *Othilia purpurea* and *Othilia luzonica*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 282.  
1842. *Echinaster fallax*, Müller and Troschel. *System der Asteriden*, p. 23.  
1862. *Cribella fallax*, Dujardin and Hupé. *Suites à Buffon. Echinodermes*, p. 350.  
1865. *Othelia purpurea* and *Othilia luzonica*, Gray. *Synopsis*, p. 12.  
1866. *Echinaster fallax*, von Martens. *Ostasiastische Echinodermen, Troschel’s Archie*, Jahrg. 32, Vol. I, p. 60.  
1869. *Echinaster fallax*, Edm. Perrier. *Pédicellaires*, p. 57.

Ten dried specimens from the Red Sea, Botta and collection Ch. Bonaparte; one in alcohol. Dried specimens from the Philippine Islands collected by Lagalise. These latter specimens have six arms and two madreporites, while the types of the Red Sea usually have only five arms and a single madreporite. We can thus with rigor preserve the two species that Gray named *Othilia purpurea* and *Othilia luzonica*. But all the other characters of these two forms are identical and neither in one nor the other is the number of arms absolutey fixed. It is thus very probable that it is a matter here of different forms of the same species. In this species can be placed a specimen from Zanzibar collected by Louis Rousseau and designated in the collection by Valenciennes under the name *Ophidiaster tigrinus*. This specimen differs however from the type by its larger size, its color that appears to have been clearer, its spines fewer, larger and shorter. But these latter characters appear to be related to the size of the individuals. If this species is really distinct, the consideration of a single individual does not permit us to decide absolutely if the name *Echinaster tigrinus* can be applied to it. *Echinaster fallax* is found in the Red Sea and in the Indian Ocean up to Timor (von Martens) and to the Philippines. It would not be surprising if it could descend on the African coast to Zanzibar.

*Observation.* — It is perhaps useful to report an error regarding this species made by Dujardin and Hupé. The descriptions of asteroids by these authors are nothing else, in general, than the translation, pure and simple, of those of Müller and Troschel. In the *System der Aseriden*, the description of *Echinaster fallax* follows that of *Echinaster seposita* and begins with these words: “*Dem Vorigen in Form und in der Hautbedeckung ganz ählich, etc.*”. that Dujarden and Hupé have rendered in their description of *Cribella fallax* by this: “species close to the preceding”. But in moving some species of *Echinaster* into their genus *Cribella*, it is *Cribella Eschrichtii* that they have placed immediately before *Cribella fallax*, in a way that we could believe no relation exists between the two species, the phrase of Müller and Troschel applying to *Cribella seposita*. It should be noted, in addition, at the head of their description of *Cribella sanguinolenta* Sars (our *Cribrella oculata*), Dujardin and Hupé have reproduced simply the synonymy given in 1857 in the *Videnskabelige Meddelelser* by Lütken, who united into a single species *Echinaser oculatus* and *Eschrichtii* of Müller and Troschel. In spite of this, Dujardin and Hupé nevertheless gave as for a distinct species the description they had given of *Echinaster Eschrichtii*, which thus makes a duplication.

#### 74. ECHINASTER SEPOSITUS.

1733. *Pentadactyloaster reticulatus*, Linck. *De Stellis marinis*, p. 35, pl. IX, n° t.  
1782. Bonanni. *Rerum naturalium historia exisentium in museo Kircheriano*, v. II, pl. IV, E.  
1783. *Asterias seposita*, Retzius. *Vetensk. Akad. Forhandl.*, v. IV, p. 237.  
1788. *Asterias seposita*, Linné, Gmelin, p. 3162.  
1805. *Asterias sanguinolenta*, Retzius. *Dissert.*, p. 22.  
*Asterias sarena*. ----- *Ibid.*, p. 21.  
1816. *Asterias seposita*, Lamarck. *An. s. vertèbres*, 2<sup>nd</sup> edit., V III, p. 251.  
1826. *Asterias seposita*, Risso. *Prod. de l'Europe mérid.* v. V, p. 270.  
1834. *Asterias (Pentasterias) seposita*, de Blainville. *Manuel d'actinologie*, p. 240.  
1834. *Stellonia seposita*, Nardo. *Oken's Isis*, p. 716.  
1835. *Sellonia seposita*, Agassiz. *Prodrome d'une monogr. De Radiaires*. — *Soc. sc. nagt. De Neufchâtel*, v. I.  
1840. *Rhopia seposita* and *Rhopia mediterranea*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 282.  
1842. *Echinaster sepositus*, Müller and Troschel. *System der Asteriden*, p. 23.  
1857. *Echinaster sepositus*, Sars. *Litt. Fauna in Nyt. Mus. für Natur*, p. 51, n° 25.  
1862. *Cribrella seposita*, Dujardin and Hupé. *Suites à Buffon. Echinodermes*, p. 351.  
1865. *Rhopia mediterranea* and *Rhopia seposita*, Gray. *Synopsis*, p. 12  
1869. *Echinaster sepositus*, Edm. Perrier. *Pédicellaires*, p. 57.

Numerous specimens dried and in alcohol from the Mediterranean; Naples, Savigny, 1818; Palermo, Messina, Constant Prévost, 1832; Calle (Algeria), Guichenot, 1842; various localities on the Algerian coast, Deshayes, 1842 (scientific expedition of Algeria).

#### 75. ECHINASTER VETITUS (EDM. PERRIER).

- 18.... *Ophidiaster*. Coll. Mus. Manuscript.  
1867. *Ophidiaster (?) vestitus*, Edm. Perrier. *Rech. sur les Pédicellaires*, p. 62,

We described, in 1869, this species that we placed with doubt among the *Ophidiaster* of Müller and Troschel, while indicating the affinities that seemed to us to unite it with *Echinaster*. There can be no doubt that this latter opinion, explicitly stated in our thesis, is the correct one.

A single individual preserved in alcohol; Mayotte, Cloué, 1847.

#### X. GENUS CRIBRELLA (AGASSIZ, PARS).

1835. *Cribrella*, Agassiz (pars). *Prodr. Soc. sc. Neufchâtel*. v. I, p. 191, not synonymous with *Linckia*, Nardo.  
1844. *Cribrella*, Forbes. *British Starfishes*.  
1840. *Henricia*, Gray. *Ann. Nat. Hist.*, v. VI, p. 281.  
1842. *Echinaster*, Müller and Troschel (pars). *System der Asteriden*, p. 22.  
1862. *Cribrella* Dujardin and Hupé. *Echinodermes*, p. 345.

#### 78. CRIBRELLA OCULATA.

1733. *Pentadactyloaster oculatus*, Linck. *De Stellis marinis*, p. 61, pl. XXXVI, n°62.
1776. *Asterias sanguinolenta* and *Asterias pertusa*, O.-F. Müller. *Zool. Dan. prodr*, n°234 and 235.
1777. *Asterias oculata*, Pennant. *British Zool.*, v. IV, p. 64, pl. XXX, fig. 56.
1780. *Asterias spongiosa*, Fabricius. *Fauna groënlandica*, n° 363.
1805. *Asterias seposita*, Retzius. *Dissert.*, p. 21.
1823. *Asterias pertusa*, Fabricius. *Kongl. danske Videnskab. selskabs. Skrifter*, II Volume, p. 41, pl. IV, fig. 2.
1828. *Asterias oculata*, Fleming. *British Animals*, p. 487.
1839. *Linckia oculata*, Forbes. *Memoirs of the Werner Soc.*, v. VIII, p. 120.
1840. *Henricia oculata*, Gray. *Ann. of Nat. Hist.*, v. VI, p. 184.
1841. *Asterias spongiosa*, Gould. *Inverteb. of Massachusetts*, p. 345.
1841. *Cribrella oculata*, Forbes. *British Starfishes*, p. 100.
1842. *Echinaster oculatus*, Müller and Troschel. *System der Asteriden*, p.24 and 127.
1842. *Echinaster Eschrichtii*, Müller and Troschel. *System der Asteriden*, p. 25.
1844. *Echinaster sanguinolentus*, Sars. *Wiegmann's Archiv für Naturgeschichte*, v. X, p. 16.
1844. *Echinaster Sarsii*, Müller and Troschel. *Wiegmann's Archiv für Naturg.*, v. X, p. 179.
1846. *Echinaster oculatus*, Düben and Koren. *Vetenshaps Akademiens Handlingar*, p. 241.
1851. *Echinaster Eschrichtii*, Brandt. *Middendorf's Reise in den äussersten Norden und Osten Siberiens*, v. II, p. 32.
1851. *Asterias spongiosa*, Desor. *Echinod. from Nantucket, Proc. Boston Socidetyi*, vol. III, p. 67.
1853. *Linckia oculata*, Stimpson. *Invertebr. of Grand Manan*, p. 14.
1853. *Linckia pertusa*, Stimpson. *Ibid.*
1857. *Cribrella sanguinolenta*, Lütken. *Vidensk. Meddelelser*.
1862. *Cribella sanguinolenta*, Dujardin and Hupé. *Suites à Buffon. Echinodermes*, p. 349.
1862. *Cribella Eschrichtii*, Dujardin and Hupé. *Ibid.*
1865. *Henricia oculata*, Gray. *Synopsis*, p. 5.
1866. *Cribrella sanguinolenta*, Norman. *British Assoc. Reports*. p. 195.
1866. *Cribella sanguinolengta*, Verrill. *Proc. Boston soc.*, v., p. 345.
1866. *Echinaster oculatus*, von Martens. *Ost. Echino. Troschel's Archiv für Naturgeschichte*, 32<sup>nd</sup> year, V. I, p. 84.
1869. *Echinaser oculatus*, Edm. Perrier. *Pédicellaires*, p 57.

Numerous specimens dried and preserved in alcohol coming from the coasts of the Channel<sup>17</sup>. A specimen from Greenland in alcohol donated in 1861 by Steenstrup; two specimens from Greenland, also in alcohol, donated in 1870 by Professor Paul Gervais; two specimens from the sea of the North in alcohol donated in 1845 by Professor Loven; three small dried examples from Nahant (near Boston, Massachusetts) donated by the Museum of Comparative Zoology of Cambridge (Massachusetts).

This species has been reported from Java, Boie and Timor in the Sunda archipelago. von Martens, who cites this fact, doubted that an animal could be so high in the boreal regions and then equally in the Indian Ocean. After examination of the specimens in the Museum, the fact can be explained by a confusion of species. In addition to the European and Greenland individuals, there are, in fact, two individuals in the Museum that are very similar that had been collected in 1858 at the Cape of Good Hope by de Castelleau and that I had described in 1869 as a distinct species

<sup>17</sup> This species is very abundant at Roscoff. But it necessary to use a dredge to obtain it. It is not found at low tide.

under the name of *Echinaster (Cribrella) ornatus*. Specimens of the same provenance are also in the British Museum. At first glance, this species does not appear to differ greatly from our European cribrellids. But a more attentive examination shows the the spines, that form several close rows on the trabeculae of the calcareous network, are here a little shorter and larger. They are rather granules than spines. The madreporite is naked instead of having spines as in *Cribrella oculata*. Finally, the adambulacral spines are arranged quite differently. They are larger, cylindrical, end in an obtuse or slight swollen tip, and each adambulacral plate has three or four placed one before the other. The latter are shorter and ordinarily slanted ourwards. These spines are, in addition, very different in their form of granules of the ventral plates, with which they gradually merge. There is thus a closely related species by its form of the northern species that a first examination perhaps does not permit distinguishing. But it is very possible that this is the case of the reported *Cribrella oculata* of the Sunda archipelago, whose presence, as *Cribrella*, is made less improbable by the African species. I shall add that Filhol has collected another cribrellid from Campbell Island and New Caledonia. We find, finally, in the duplicates of the collection, three individuals indicated as collected at Madagascar in 1841 by Louis Rousseau. But this indication was added afterwards. Only the name of our regretted colleague can be read on the original label and no trace of the locality. As the collection has other *Cribrella* of Louis Rousseau, collected at Cancale in 1839, I believe that there was simply a copying error and there is no need to take this indication into account, the reported individuals from Madagascar being in all ways identical to those of Cancale.

On the other hand, in comparing individuals of our coast with the Greenland individual donated by Paul Gervais, it is easy to confirm notable differences.

These specimens have arms that are more elongated, more rounded and, at the same time, more pointed than the others. The form of the arms is absolutely conical. But, what is immediately striking, is the much greater development of the integument so that all the spines, without exception, are enveloped by a more or less adherent sheath enveloping the spine of each side. Moreover, instead of being arranged in distinct bunches or forming multiple close rows on the calcareous trabeculae, the arrangement of these trabeculae is perfectly evident. The spines seem uniformly distributed and form a continuous and uniform covering on the surface of the disk and the arms. The isolated papular pores are distributed between them. An analogous arrangement is found on the ventral surface, where each adambulacral plate has a row of four or five divergent spines and placed one behind the other perpendicular to the axis of the ambulacral groove. Moreover, it happens also that two of these consecutive rows, one inclined toward the end of the arms and the other towards the base, form a very open dihedral angle.

All these arrangements are sufficiently particular to state the individuals that have them, two in the collection, a particular designation. If we accept, with the zoologists of the north of Europe, that there are only diverse varieties of *Cribrella oculata* in the seas of these regions, this would be the variety *murina*. If not, this could become a distinct specific name.

## 77. CRIBRELLA ORNATA.

1869. *Echinaster ornatus*, Edm. Perrier. *Pédicellaires*, p. 59.

We apply this name to two individuals collected in 1858 at the Cape of Good Hope by de Castelneau, which has been questioned regarding the preceding species. That which we have said is sufficient to distinguish it (museums of Paris, London and Copenhagen).

## XI. GENUS VALVASTER (NOV. GEN.).

### 78. VALVASTER STRIATUS.

1816. *Asterias striata*, Lamarck. *An. s. vertèbres*, v. III, p. 253.  
1842. *Asteracanthion striatus*, Müller and Troschel. *System der Asteriden*, p. 18.  
1862. *Asteracanthion striatus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 335.  
1865. *Asteracanthion striatum*, Gray (cited under this name after *Asterias Wilkinsonni*). *Synopsis*, p. 2.  
1869. *Asteracanthion striatus*, Edm. Perrier. *Recherches sur les Pédicellaires*, p. 38.

Müller and Troschel were wrong to place this curious species in the genus *Asteracanthion*. Various characters in secondary appearance but that are never found in *Stellerides* of this genus, call attention to this. In the first place, the enormous valvular pedicellariae that form a row along the entire upper border of the arm of the animal belong to a type completely different from those found in true *Asterias*. And this is not without importance if we consider the constancy of the form of these organs in the entire group<sup>18</sup>. In the second place, each plate bordering the ambulacral groove has three or four spines in the groove instead of the single spine in most *Asteracanthion*. This is an important character in the present case, because the width of the plates in question is related to that of the ossicles to form a complex between which pass the tube feet, and of which they are only the crown. Now, in *Asteracanthion*, the four rows of the tube feet are obtained only by a considerable narrowing of the ossicles that overlap to make two alternate rows in each half of the groove. As a result, the plate that overlaps these ossicles and has only the same width, is thus necessarily very narrow and does not have the space for several very large spines, except in the case where these spines are placed one before the other. In most of the other asteroids, to the contrary, the tube feet are arranged in only two rows, the ossicles that separate them are much wider and we see this multiplicity of spines of the adambulacral plates that is the rule everywhere else. This evident connection between two kinds of characters, one of which at first seems of little importance, makes it reflect on the second a part of the importance of the first. And thus our attention has naturally been attracted by the makeup of the ambulacral groove of this singular species. In the intact part of these grooves, which unfortunately are split for some length, we have been able to verify that there is only one row of papular pores on each side of the median line. The ambulacral groove can have only two series of tube feet and not four as in the *Asteracanthion* of Müller and Troschel. Moreover, towards the end of an arm, the tube feet are dried in place and have been perfectly preserved. There really are only two rows. It is thus completely necessary to remove *Asterias striata* Lamarck from the genus *Asterias* as we understand it and bring it closer to its general form. It is in the group of *Echinasteridæ* that this species is placed naturally. But the special characters it has, notably the well-developed valvular pedicellariae, leads to assigning it a separate place in this group. I propose thus to create for *Asterias striata* a new genus, to which I shall give the name *Valvaster*, recalling the most unique character.

I have little to add to the description of Müller and Troschel. However, as in a previous work where I was forbidden to bring any change to the accepted names at the Muséum, I preserved to this species the name of *Asteracanthion striatus* of Müller and Troschel that I had examined in the

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<sup>18</sup> See our *Recherche sur les pédicellaires et les ambulacres des Astéries et des Oursins*, 1<sup>st</sup> part (*Annales des sciences naturelles zool.*, 5<sup>th</sup> series, v. X, 1869),

Museum, one can believe that the pincer pedicellariae are constructed in the type of those of *Asteracanthion*. It is nothing. Having at my disposal only one dried specimen, I had not wanted in 1865 to damage it and did not examine microscopically its pedicellariae. I simply confirmed their existence with a magnifying glass. This examination today is necessary and I have been able to demonstrate that the pincer pedicellariae are sessile, formed only of two pieces, denticulated on their bordered and attached directly to the ossicles. The crossed pedicellariae do not exist as could be seen with the magnifying glass. There are simply calcareous granules of the skin that are very abundant between the spines.

A single dried specimen from Mauritius; Mathieu, 1812.

## XII. GENUS *MITHRODIA* (GRAY).

1840. *Mithrodia*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, p. 288.

1844. *Hereaster*, Michelin. *Revue de Zoologie*, p. 173.

### 79. *MITHRODIA CLAVIGERA*.

1816. *Asterias clavigera*, Lamarck. *An. s. vert.*, v. III.

1840. *Mithrodia spinulosa*, Gray. *Ann. Nat. Hist.*, v. VI, p. 288.

1842. *Ophidiaster echinulatus*, Müller and Troschel. *System der Asteriden*, p. 32.

18 ... *Scytaster subulatus*. Manuscript. Coll. Mus.

1844. *Hereaster papillosus*, Michelin. *Revue zoologique*, p. 173.

1845. *Hereaster papillosus*, Michelin. *Magazin de zoologie*, pl. IX.

1862. *Ophidiaster echinulatus*, Dujardin and Hupé. Suites à Buffon, *Echinodermes*, p. 363.

1865. *Mithrodia spinulosa*, Gray. *Synopsis*, p. 2.

1866. *Echinaster echinulatus*, von Martens. *Ostasiatische Echinodermen, Archiv für naturgeschichte*. Jahrg. XXXII, vol. I, p. 59.

1869. *Ophidiaster echinulatus*, Edm. Perrier. *Pédicellares*, p. 59.

1871. *Mithrodia echinulata*, Lütken. *Vidensk. Meddel.*, p. 266.

This remarkable asteroid was first placed by Müller and Troschel among the *Ophidiaster* because, doubtlessly, from the granular covering over the entire surface of its dermis that extends in the form of small scales up to the end of its long and robust spines. None of the *Echinaster* of the authors of the *System der Asteriden* had in fact a similar character. All have naked skin between the spines. This is especially quite evident if one removes from *Echinaster* animals in the genus *Cribrella* where thin and very numerous spines occur (*Cribrella ornata*, E. P.) to simulate granulation. If we examine however the constitution of the skeleton of *Ophidiaster echinulatus* and the arrangement of its spines, we quickly recognize that the affinities of this curious species are rather towards *Echinaster* M. T. than towards *Ophidiaster* M. T. Also, in his work on the echinoderms of East Asia, von Martens designated this asteroid under the name *Echinaster echinulatus*. This name is more exact than that of Müller and Troschel, but does not appear to me to be absolutely acceptable. The differences that separate *Ophidiaster echinulatus* of Müller and Troschel from the true *Echinaster* (*Othilia* Gray) are more than specific. The ossicles of the skeleton have a regularity of arrangement that is not ordinarily found in the *Echinaster* and that reproduces exactly the arrangement that is found in some *Pentaceros*, such as *Pentaceros reticulatus*. These are the same ossicles arranged in six equal and equidistant rays supporting six

other rays arranged in a regular hexagon and thus forming a network of either equilateral triangles or regular hexagons and whose nodes support ordinarily a long, cylindrical spine and entirely covered with oval scales. This covering of spines, the granular covering of the dermis are other characters that do not exist in the *Echinaster*. In the latter, the spines of the adambulacral plates remain isolated on each plate or, if two of them, one is a little before the other as in the *Asteriadae*. The constancy of this arrangement in these two genera gives them some importance. It was because it struck us in the *Asteridae*, that we were led, as we recall, to examine more attentively the *Asterias striata* of Lamarck and to recognize that Müller and Troschel were wrong to relate it to their genus *Asteracanthion*. Nor does *Ophidiaster echinulatus* have the arrangement of adambulacral spines of *Echinaster*. It also has on each adambulacral plate a whole row of spines. The number of these spines is seven to nine in *Ophidiaster attenuatus* Müller and Troschel. In addition, each adambulacral plates has, outside the groove, a large cylindrical, scaly spine as those of the back.

I do not believe it is possible to keep the asteroid that we are considering among the *Ophidiaster*. If it gets closer to the genus *Echinaster*, as understood by Müller and Troschel, it is not possible either to relate it to this genus, even while preserving the extent attributed to it by these authors. I thus preserve the genus *Mithrodia* that Gray had created for it and that Michelin, not recognizing the genus of Gray, had named four years later *Heresaster*. But Gray and Michelin were wrong to believe in their new species and their new species name should be rejected. The species concerned will thus be designated, in the collection of the Museum, under the name of *Mithrodia clavigera*. The specific name is from Lamarck.

I will add that one of the specimens of the Museum shows in *Mithrodia clavigera* a quality that has never to my knowledge been reported in *Echinaster* but is frequent in *Ophidiaster*,<sup>19</sup> that of producing comet forms. Now this is an important fact, because the existence of these forms in a species implies for the individuals of these species not only the possibility of reproducing missing arms, but more still for each arm the possibility of producing a completely whole individual when it is detached from the disk.

The Museum has two individuals of this species from Mauritius coming from the voyage of Péron and Lesueur in 1803. These are those that have the label *Scytaster subulatus* M. T. A dried specimen from Mauritius, coming from the collection Michelin, with two arms detached and with the original label of Michelin (*Heresaster papillosus* Michelin). Another dried specimen was collected from the Hawaiian Islands (Kanai) by Rémy in 1857. Three others, in alcohol, remarkable for the size, were collected from the same island by Bailleu, consul of France (1874). These individuals from the Hawaiian Islands, more robust than those from Mauritius, and missing the dorsal row of spines, were considered by Horace Mann as a distinct species that he named *Mithrodia clavigera*, leaving to the individuals from Mauritius the name of *Mithrodia spinulosa* Gray. We have the greatest doubts about the value of this specific distinction A third individual, in alcohol and very good condition, was collected in 1857 at Sainte Lucie<sup>20</sup> by Arthur Fleury. Finally, a comet-shaped individual that is in alcohol but without label. This is only one where the arrangement of the skeletal ossicles is perfectly apparent without preparation, which is a rarity greater than the dermal granules.

### FAMILY III. LINCKIADÆ.

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<sup>19</sup> In the sense that Müller and Troschel employed these two generic terms.

<sup>20</sup> This "Sainte-Lucie" whose geographic position is not further specified and is without doubt the Bay of Sainte Lucie in the island of Borneo, at least that Sainte Lucie has not been mistaken for the Cape San Lucas in California, where is found in a strict sense *Mithrodia Broadleyi* of Verrill, perhaps identical with the species of Mauritius.

The respective limits of the genera *Ophidiaster* and *Scytaster* as established by Müller and Troschel have been the subject of recent discussion.

While one part of Gray<sup>21</sup> still persisted in 1866 in dividing the species of this group into a large number of genera (*Dactyloaster*, *Tamaria*, *Cistina* (?), *Ophidiaster*, *Linckia*, *Fromia*, *Gomophia*, *Nardoa*, *Narcissia*), von Martens<sup>22</sup> thought most of these forms should be united into a single genus to which he preserved the name *Linckia*, under which Nardo and Agassiz had generically designated most among of them. Without absolutely rejecting this point of view, Lütken, first in 1864<sup>23</sup>, then in 1871<sup>24</sup> in presenting another that he even opposed intentionally to that of von Martens. He divided the *Ophidiaster* and *Scytaster* of Müller and Troschel into three principal groups that are:

1° *Scytaster* with two or more series of uniform adambulacral spines (the *Scytaster* of Müller and Troschel and some *Ophidiaster* such as *Ophidiaster tuberculatus* M., T.);

2° *Ophidiaster* with two series of adambulacral spines, of which the external ones are much larger than the internal ones but in smaller number (*Ophidiaster ophidianus* M., T.);

3° *Linckia* with two series of granular adambulacral spines that merge almost completely with the granulation of the ventral surface (*Ophidiaster miliaris* M., T.).

To these principal groups are added other secondaries, as *Leiaster* of Peters, perhaps identical to *Lepidaster* of Verrill, and *Mithrodia* or *Hereaster*. But for these latter, we believe it necessary to accept the opinion of von Martens, who considers them as nearer *Echinaster* than *Ophidiaster*. The number of genera that Lütken accepts in this group thus is reduced for us to four: *Ophidiaster*, *Scytaster*, *Linckia*, *Leiaster* or *Lepidaster*. Actually, the characters Lütken used to distinguish these genera, the three first especially, seem very artificial at first glance. Nevertheless, in a group so homogeneous, they allow establishment of very clear groups and it is not inconvenient to keep them, at least provisionally. We have not been able to include the genera *Leiaster* and *Lepidaster*, which are perhaps synonyms. But study of the material we have examined concerning the genera *Ophidiaster*, *Scytaster* and *Linckia* can be based on characters more important than those used by Doctor Lütken, in that they are taken not only from the armature, in itself of little importance for the adambulacral plates, but the arrangement of the skeletal pieces combined with the characters of the armature we just mentioned.

If we examine the ventral surface of a typical *Ophidiaster* (*Ophidiaster ophidianus*, *Ophidiaster cylindricus*, *Ophidiaster porosissimus* Lütken, for example), we can see that it says nearly nothing, that the poriferous areas advance almost continuously up to the second row of adambulacral spines, from which they are separated by a thin granulose band corresponding to a single longitudinal row of small skeletal plates that continues to the end of the arms. Actually, *Ophidiaster attenuatus* appears to make an exception to this rule and combines with the armature of the adambulacral plates of *Ophidiaster* an arrangement different from the ventral surface. But in this species the second row of spines is already very close to the first. These spines are not very large and the arrangement relative to the two rows is already very close to that which we observe in some *Linckia* of Doctor Lütken, *Linckia miliaris* and *multifora* for example. It thus does not seem to me that

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<sup>21</sup> *Synopsis of the Asteriadæ of the British Museum*, p. 13-15.

<sup>22</sup> *Ueber ostasiatische Echinodermen (Troschel's Archiv für Naturgeschichte, 1865, Jahrg.. XXXI, Vol. I, p. 351.*

<sup>23</sup> *Kritiske Bemærkinger om forskjellige Söstjerner (Asterider) mit Beskrivelse af nogle nye Arter (Vidensk. Meddelelser, 1864, p. 163).*

<sup>24</sup> *Fortsatte Kritiske og beskrivende Bidrag til Kundskab om Sestjernerne (Asteriderne) (Vidensk. Meddelelser, 1871, p. 265.*

there can be any serious inconvenience in placing this species in *Linckia*, for which it would not be necessary to change the characteristic of our scholarly colleague from the museum of Copenhagen. It is sufficient to support this by adding that *Linckia* has a very large ventral surface lacking pores and wide at the base of the arms of at least four rows of continuous plates whose wider exterior can be seen in the marginal plates, as in *Linckia multifora* and *ornithopus* for example. It remains to characterize the genus *Scytaster*. The armature of the adambulacral plates in some of these stellerides is very similar in their general aspect to that of some *Linckia*, *Linckia Nicobarica* and *ornithopus*. However, the adambulacral plates are longer, even though they have only two rows of spines as in *Scytaster milleporellus*, they have, in the middle region of the arms, at least three spines in the internal row and two in the external row. In *Linckia*, each plate usually has only two spines (one large and one small) forming the internal row and another forming the external row. This is a difference. But we can add here that in *Scytaster*, as in *Ophidiaster*, there are no, strictly speaking, papular pores, isolated or in groups, on the ventral surface as on the dorsal region, so that the series of adambulacral plates is separated from the first row of pores only by one or at most two rows of plates. These observations apply to all the species I have examined and consequently can be considered a generality. It seems to me in any case that they can be applied to the divisions that Doctor Lütken has proposed to keep in the group of asteroids that von Martens proposed to combine into a single genus, *Linckia*. Consequently, I believe it necessary to adopt these divisions, slightly modified in the sense we have said, for the species of the Museum.

### XIII. GENUS OPHIDIASTER.

1834. Agassiz. *Prodrome d'une monographie des Radiaires. Mémoires de la Société des sciences de Neufchâtel.*  
 1834. *Linckia* (pars). Nardo, *Isis.*  
 1840. *Dactyloaster, Tamaria, Cistina, Ophidiaster*, Gray, *Synopsis of the Asteriadae of British Museum*, p. 13.  
 1842. *Ophidiaster* (pars). Müller and Troschel. *System der Asterioden*, p. 28.  
 1865. *Linckia* (pars). von Martens, *Ostasiatische Echinodermen Archiv für Naturgeschichte*, Jahrg. XXXI, Vol. I, p. 351.  
 1864. *Ophidiaster*, Lütken. *Vidensk. Meddel.*, p. 163, and 1871. *Ibid.*, p. 265.

#### 80. OPHIDIASTER OPHIDIANUS.

1816. *Asterias ophidiana*, Lamarck. *An. s. vertèbres*, v. III, p. 255. n° 43.  
 1834. *Asterias (pentasterias) ophidiana*, de Blainville. *Manuel d'actinologie*, p. 240.  
 1836. *Ophidiaster ophidianus*, Agassiz. *Prodrome*, p. 24.  
 1840. *Ophidiaster aurantius*, Gray. *Ann. and Mag. of Nat. Hist.* v. VI, p. 284.  
 1842. *Ophidiaster ophidianus*, Müller and Troschel. *System der Asteriden*, p. 28.  
 1857. *Ophidiaster ophidianus*, Sars. *Middelh. littoral Fauna. Nyt. Mag. f. Natur*, p. 50, n° 23.  
 1862. *Ophidiaster ophidianus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 358.

Seven individuals in alcohol coming from the Mediterranean without more precise indication. All were collected in 1842 by Deshayes during his scientific expedition in Algeria. Another individual collected in 1849 at Madeira by Castelneau and Deville does not differ sensibly from those collected by Deshayes. The plates are only a little more projecting, united by trabeculae a

little longer and thinner, but these individual differences could be the result of preservation. This is the *Ophidiaster aurantius* of Gray.

Three dried individuals, collected in 1873 from the Cape Verde Islands by Aimé Bouovier.

Webb and Berthelot (*Voyage aux Canaries, Zoologie*, p. 148, pl. II, fig. 1 to 7) reported this species at the Canary Islands. Hupé (*Voyage of M. Castelneau, Zoologie*, v. III, p. 100) indicated it as a common inhabitant also at Madeira.

Three dried individuals from the Mediterranean without more precise information. One dried individual from the collection Michelin.

*Observations.* — One individual mixed with the same label with the types of *Asterias cylindrica* Lamarck differs from *Ophidiaster ophidianus* by its armature of the adambulacral groove, whose plates have three spines instead of two. One of these spines, sometimes the internal, sometimes the middle is much smaller than the others and does not reach their top. While in *Ophidianus ophidianus*, all these spines usually have the same height. The poriferous areas also appear more projecting than the plates. But the individual is dried and deformed, and it is impossible to be completely sure if these characters are sufficient to distinguish it from *Ophidiaster ophidianus*. We attach it provisionally with doubt to this species. We consider also as doubtful its provenance, Mauritius (Péron and Lesueur, 1803). This specimen was not part of the collection at the time of Lamarck. There was certainly a transposition.

#### 81. OPHIDIASTER LEACHII.

1840. *Ophidiaster Leachii*, Gray. *Ann. and Mag. of Nat. History*, v. VI, p. 284.

1852. *Leiaster coriaceus*, Peters. *Uebersicht der Seesterne von Mossambique (Bericht über der Verhandl. K. Preuss. Akad. Wiss., p. 177).*

1866. *Ophidiaster Leachii*, Gray. *Synopsis*, p. 13.

1867. *Leiaster coriaceus*, von Martens. *Echinoderm von Ost-Africa. (Arch. für Naturg. Jahrg. XXXII, Vol. 1.)*

1869. *Leiaster coriaceus*, von Martens. *Claus von der Decken's Reise in Ost-Africa*, p. 130.

We find in the collection Michelin, without indication of location, under the name of *Asteracanthion Linckii* M. and T., an *Ophidiaster* that we would be tempted to confuse at first glance with *Ophidiaster ophidianus*, but that is distinguished actually by several important characters and that we have identified at the British Museum with the type of *Ophidiaster Leachii* of Gray. It belongs to the group of *Leiaster* of Peters and is, very probably, identical with the *Leiaster coriaceus* of this author.

The arms are very long and thin: R = 171 mm, r = 16 mm; R > 10 r; d = 15 mm.

The skin, instead of being covered with dense granules as in *Ophidiaster ophidianus*, is completely naked. The skeletal plates alone are rough and the skin is molded onto them. The skeletal plates are elliptical. The long axis is arranged transversely. They are very regularly arranged and from seven longitudinal rows, not counting the nearest to the adambulacral groove. In the same longitudinal row, the plates can be seen by the top of their small axis. The plates of adjacent longitudinal rows correspond, but are connected by another circular, smaller plate. The tops of the long axis do not touch directly. The interval between the rows of large skeletal plates is filled with elliptical poriferous areas separated from each other by small plates, each containing approximately twenty-five or thirty pores. There are eight rows of poriferous areas, the last are contiguous with the plates adjacent to the ambulacral groove and are twice the number of the large

skeletal plates which are forty-eight from the base to the end of the arms. The adambulacral plates have two or three cylindrical, thin spines, obtuse at the end and perfectly equal and juxtaposed but not overlapping. These spines appear to have been united in life by a fold of skin. Outside and immediately contiguous with them are the large spines of the external row that are a little flattened, enveloped by the skin, at least at their base, without any trace of granulation, while the base of these spines is always granulose as the rest of the body surface in *Ophidiaster ophidianus*. Between two consecutive spines are approximately six spines of the internal row while there usually are only four in *Ophidiaster ophidianus*, where these spines are unequal and so pressed against each other that they overlap in general those of adjacent plates.

The madreporite is large, flat, located near the border of the disk and with a very large number of very fine radiating grooves.

The end of the arm, a little thin, has only one small terminal plate.

No pedicellariae.

The type of Gray is from Mauritius. *Leiaster coriaceus* of Peters is from Quierimba in the Strait of Mozambique.

## 82. OPHIDIASTER CHINENSIS (ED. P.).

Five cylindrical arms, a little thinner towards the end and ending in an obtuse point.  $R = 48$  mm;  $r = 9$  mm;  $R = 54 r$ ;  $d = 10$  mm.

The arms are completely rounded. The spines of the adambulacral plates are in a single row, alternatively large and small. Then is a finely granulose band and the row of nearly contiguous large spines that are cylindrical with a rounded tip. There are two or three of them for three internal spines. The pores are arranged in eight perfectly regular rows. The areas in each band are very distinct and elliptical with the long axis arranged transversely. Each has twelve to fifteen pores. The bands of plates that separate the poriferous bands are formed of slightly imbricated plates. The part turned towards the end of the arm is larger than that turned towards the base. All the plates are granular and the granules are a little larger than those of the poriferous areas. The terminal plate of the arms is very large and only granular.

The madreporite, located equidistant from the center and border of the disk, is round and 2 mm in diameter.

No pedicellariae.

Two individuals in alcohol, from Canton (China). Dabry, 1872.

## 83. OPHIDIASTER GUILDINGII.

1840. *Ophidiaster Guildingii*, Gray. *Annals of Nat. Hist.*, v. VI, p. 13.

1850. *Scytaster Müllerii*, Duchassaing. *Anim. Rad. Antilles*.

1858. *Ophidiaster flaccidus*, Lütke. *Vidensk. Meddel.*, p. 62.

The three dried individuals we have examined come from Saint Thoms (Antilles). They are the same types of Duchassaing and Michelin. They are part of the collection Michelin. After comparison with the types of *Ophidiaster guildingii* of Gray and with the excellent description that Lütken gave to his *Ophidiaster flaccidus*, there is no doubt that the two species are identical. Doctor Lütken had already some suspicion of it. Like those of Michelin, the individuals described by Lütken came from Saint Thomas.

#### 84. OPHIDIASTER PYRAMIDATUS.

1840. *Ophidiaster (Pharia) pyramidatus*, Gray. *Ann. and Mag. Nat. Hist.*, v. VI, p. 284.  
1842. *Ophidiaster pyramidatus*, Müller and Troschel. *System der Asteriden.*, p. 33.  
1859. *Ophidiaster porosissimus*, Lütken. *Vidensk. Meddel.*, p. 63.  
1862. *Ophidiaster pyramidatus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 363.  
1865. *Ophidiaster (Pharia) pyramidatus*, Gray. *Synopsis*, p. 13.  
1867. *Ophidiaster (Pharia) pyramidatus*, Verrill. *Trans. of Connecticut Academy of Arts and Sciences*, vol. I, part. II, p. 287, 328, 330 and 393, March 1867 to March 1871.

A dried individual from Acapulco, donated in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts), but without other designation on the label than this: *Ophidiaster, Acapulco*.

The individual described by Dr. Lütken was, as our specimen, donated by the Museum of Comparative Zoology of Cambridge (Massachusetts). Outside the ordinary characters of *Ophidiaster*, this species is still remarkable by the large poriferous areas containing a large number of pores, confluent laterally and arranged in eight longitudinal series, perfectly regular and symmetrical pairs. The madreporite is unusually large that in a specimen where  $R = 137$  mm,  $r = 15$  mm, is 19 mm in length and a maximum width of 6 mm. The largest part of this plate is turned towards the top of the test. The border is irregular. Outside the small grooves, the plate has others that break it up into very small areoles at least 1 mm in diameter as if this plate was formed by the agglomeration of several others.

The other characteristic that Lütken did not indicate is the presence among the granules of small very numerous organs that could be compared to pedicellariae. These organs are made of small elliptical ossicles, hollowed with small alveoli separated from each other by a thin calcareous trabecula directed towards the small axis. Each of these alveoli has a small calcareous piece that is nothing other than the jaws of pedicellariae. These pieces are hollow and on a dried specimen we have examined, most of them have fallen. We no longer find the oblong basal piece embedded in the ossicles of the test.

In 1867, von Martens described analogous organs in his *Linckia pustulata* (Wiegmann's *Archiv*, Jg. XXXII, Vol. I, p. 62). This is the first true *Ophidiaster* in which we can confirm the presence of pedicellariae or organs that evidently represent them. We shall see that actually these organs are more frequent than we would have believed up to now in *Ophidiaster*. One can give them the name *excavate pedicellariae*.

#### 85. OPHIDIASTER CYLINDRICUS.

1816. *Asterias cylindricus*, Lamarck. *An. sans vertèbres*, v. III, p. 253 (pars).  
1842. *Ophidiaster cylindricus*, Müller and Troschl. *System der Asteriden*, p. 29.  
1845. *Ophidiaster cylindricus*, *Dactylosaster cylindricus*, Michelin. *Essai d'une faune d l'île Maurice*. (*Mag. zool.* p. 20).  
1862. *Ophidiaster cylindricus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 359.  
1866. *Dactyloaster cylindricus*, Gray. *Synopsis*, p. 13.  
1866. *Linckia cylindrical*, von Martens. *Ost. Echinod.* (*Troschel's Archiv für Naturgeschichte*, Jahrg. XXXII, Vol. I, p. 85).

1869. *Ophidiaster cylindricus*, Edm. Perrier. *Pédicellaires*, p. 59.

1871. *Ophidiaster asperulus*, Lütken. *Vidensk. Meddel.*, p. 274.

Of the three dried individuals in the collection of the Museum that were labeled under this name, one is of large size, pale gray in color and whose poriferous areas have at least fifteen pores. This individual is indicated, as well as two others, as having been collected in 1803 by Péron and Lesuer. It seems that, according to the wording of the common label, that it was seen by Lamarck and that it was understood by the illustrious author of the *Histoire des animaux sans vertèbres* under the name *Asterias cylindrica*. It is, however, specifically very distinct from the other individuals with which is included, and the regularly rounded form of its arms, the uniformity of the granules that cover its skin, characters that agree with *Ophidiaster ophidianus*, prevent applying to it the description of Lamarck: *Asterias radiis quinis cylindricis, longitudinaliter costatis; costis verrucosis; papillis externis canalium conicis, longiusculis*. This individual, moreover, surely was not part of the collection at the time of Lamarck. It lacks, consequently any kind of absolute authenticity. We thus cannot apply the name *Ophidiaster cylindricus* to the two other individuals of Péron and Lesueur whose color is, even after drying, deep red or orange, whose skeletal plates form seven longitudinal rows, projecting, nearly riblike, and have among the small granules some large irregular granules that are irregularly arranged and often truncated at the top, and whose poriferous areas located in the deep intervals of the projecting rows of plates have no more than four or five pores each.

These individuals had been brushed and attached by a pin in a box and was done in the collection at the time of Lamarck. It is to them alone that that is reported in an authentic way the label attributed to Péron and Lesueur in their introduction to the collection. These are the true types of Lamarck. They are two only, not three.

But these two individuals differ. One is undoubtedly the *Ophidiaster asperulus*, described in 1871 by Lütken. The other is identical to the individual from the Seychelles preserved in alcohol that I described in 1869 as *Ophidiaster purpureus*.

If one goes back to the description of Lamarck, it is evident that the individual that he considered as the type of the species, that which shows to a high degree the characters, is the individual corresponding to the species that Lütken named *Ophidiaster asperulus*. It is the only one, in fact, whose *sides* are really *warty*. It is thus to it that should return the name *Ophidiaster cylindricus*, particularly because the new name proposed by Lütken is two years after to that I proposed for the species to which belongs the other specimen.

After the excellent description given by Lütken for his *Ophidiaster asperulus*, I have to return to this point. I shall say only that what distinguishes very clearly the species *Ophidiaster purpureus*, is first that the plates do not have slightly larger granules in their center: everywhere else the plates, like the poriferous areas, are naked or like points of extremely fine granulations on the plates or covered by the skin. Moreover, between two consecutive spines of the adambulacral plates, there is only a single small accessory spine reaching neither above nor below the spines on either side. In *Ophidiaster purpureus*, there are always two or three of them and the granules of the ventral surface, which are very numerous, appear sometimes between the spines.

The excavate pedicellariae, narrow and few in number, are only on the ventral surface of this species of which the Museum has, in addition to the type of Lamarck from Mauritius, six specimens without indication of locality in the collection Michelin. However, in his *Essai d'une faune de l'île Maurice*, Michelin reported this species. It is probable the specimens he had came from this island.

## 86. OPHIDIASTER PURPUREUS.

1816. *Asterias cylindrical*. Lamarck. *An. sans vertèbres*, v. III, p. 255 (pars).

1869. *Ophidiaster purpureus*, Edm. Perrier. *Recherches sur les Pédicellaires*, p. 61.

This species, combined by Lamarck with the preceding, of which it has the general aspect, is distinguished by the following characters:

1°  $R = 67$  mm;  $r = 7$  mm;  $R > 9 r$ ; while in the other species:  $R = 50$  mm,  $r = 7$  mm;  $R < 8 r$ . Thus, in *Ophidiaster purpureus*, the arms are relatively a little longer and narrower than in *Ophidiaster cylindrical*.

2° The armature of the adambulacral plates is different. In *Ophidiaster cylindrical*, between two principal spines of the internal row, there is only a very small rudimentary spine; in *Ophidiaster purpureus*, there are two or three spines.

3° In *Ophidiaster purpureus*, the entire ventral surface is uniformly covered with granules, a little flattened in the form of scales that surround even the base of the large spines of the external row of the adambulacral plates and extend between this row and the internal row. In *Ophidiaster cylindrical*, the ventral surface is naked, stippled, and has only some sparse granules.

4° The entire dorsal surface of *Ophidiaster purpureus* is uniformly covered with dense granules that differ only in the middle of the plates by a slightly larger size. In *Ophidiaster cylindrical*, true granules exist only on the central part of the plates where they appear as small spines. Everywhere else, the dorsal surface is naked and simply stippled.

5° The granules surrounding the madreporite of *Ophidiaster purpureus* show nothing in particular. Those that surround the madreporite of *Ophidiaster cylindrical* form a kind of crescent containing a dozen granules like those in the middle of the plate.

The color is probably brown to purple in the two species, perhaps completely purple in small specimens. There are rare pedicellariae similar to those of the preceding species.

The Museum has three specimens of this species: 1° The individual named by Lamarck *Asterias cylindrical*, which was collected at Mauritius by Péron and Leseur; 2° the individual I described as *Ophidiaster purpureus*, which is preserved in alcohol and was collected at Seychelles in 1812 by L. Rousseau; 3° finally a small dried individual donated in 1812 by Mailard, from Reunion Island.

## 87. OPHIDIASTER PUSILLUS.

1844. *Ophidiaster pusillus*, Müller and Troschel. *Wiegmann's Archiv*, Jahrg. X. Vol. 1, p. 180.

1862. *Ophidiaster pusillus*, Dujardin and Hupé. *Suites à Buffon, Echinod.*, p. 360.

1871. *Ophidiaster granifer*. Lütken. *Vidensk. Meddel.*, p. 276.

This species is remarkable in more ways than one. First because the armature of its adambulacral plates is in some ways intermediate between that of *Linckia* and that of *Ophidiaster*.

In the largest of our five specimens:  $R = 32$  mm;  $r = 7$  mm;  $h = 5$  mm;  $R = 4.5 r$ . In the smallest,  $R = 18$  mm;  $r = 4$  mm;  $R = 4.5 r$ ;  $d = 4$  mm;  $h = 4$  mm.

The arms are a little flattened, very concave above and obtuse at their end. The color of individuals preserved in alcohol is earth brown with deeper patches.

On the ventral surface, the spines of the adambulacral plates are in two rows. In the internal row, the contiguous spines are alternatively large and small as usual but the difference is not that of one to two. Behind and contiguous with this row, there is another formed of more separated spines with only one for two internal spines. This spine is in general located opposite the small spine of the internal row. Finally, more outside is a row of large granules, each corresponding to a spine of the external row, similar in the relative size to the spines of the external row in *Ophidiaster*.

Still further outside, in the middle of the irregular granulation of the ventral surface, are the singular pedicellariae that we have already spoken of that form an incomplete row. There is approximately one of them for three spines of the external row. Each pedicellaria has a basal part sunk into the ossicles of the skin and made up of two oval alveoli<sup>25</sup> united by their narrow part to form eight. A very thick calcareous trabecula separates the two alveoli from each other. In each of the latter is one of the jaws of the pedicellaria. But the basal part of each jaw is far from filling the corresponding alveolus, whose length and width are precisely those of the jaw in height and width. As a result, when the jaws are horizontal, they lie in the alveolus that they fill completely and they leave it empty when they are erect. Each pedicellaria thus appears as eight embedded in the dermis, whose intermediate part between the two loops are raised, or as one of these two hollows that one could call commonly the ends of the table and whose two bowls are rounded. It is to this peculiarity that we wanted to make in the name that we gave these organs. The valves of these pedicellariae have the form of short spoons, toothed on their border. There is a very large number of the singular structures spread irregularly on all parts of the body.

The granules of the ventral surface are very large, rounded, projecting and with very irregular size. They completely mask the edges of the skeletal plates so that one cannot count the number of their rows.

The poriferous areas are located on bands relatively sunken to the parts that separate them, formed by skeletal plates with inconspicuous borders, but are apparent because on their median region are granules larger than the others. It is on the sides of these projecting bands that usually are found pedicellariae. All the dorsal surface is covered with rounded granules that become large in the central region of the plate where they are arranged in groups.

The madreporite is very large, rounded, marked with very large radiating grooves. It is located on the edge of the disk.

Five examples in alcohol from New Caledonia and donated in 1872 by Balansa, who sent to the Museum a large number of other species of asteroids from New Caledonia, species still represented by specimens in very good state of preservation. Two dried examples without indication of provenance. One of them appears to have been in the collection at the time of Lamarck has the same label as an *Ophidiaster attenuatus* from Sicily. Specimens of this species in the British Museum are indicated as originating from the Philippines.

#### 88. OPHIDIASTER GERMANI (EDM. PERRIER).

1871.? *Ophidiaster cribrarius*, Lütken. *Vidensk. Meddel.*, p. 277.

We have a second species of *Ophidiaster* from New Caledonia. It is represented by three dried specimens from Germain (sent in 1875), three specimens in alcohol from Balansa (1872), and three specimens, one with seven arms, without indication of locality.

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<sup>25</sup> Sometimes three.

In this species, the armature of the adambulacral plates does not have the mixed characters seen in the armature of the adambulacral plates of *Ophidiaster pusillus*. It is quite frankly an ambulacral groove of *Ophidiaster*. The spines of the adambulacral plates are in a single row, all equal<sup>26</sup>. They are small, nearly like large granules when the ambulacral groove is closed and one sees only their end. Instead of being flat as those of *Ophidiaster pusillus*, they are to the contrary prismatic and clearly truncated at the end. Outside is a row of large ovoid spines, separated from each other so that there are between two consecutive spines three to five internal spines. The space between the spines and that separates the row they form from the furrow spines strictly speaking is filled with round irregular granule that covers also the sole row of plates that makes up the ventral surface, immediately after which is a row of poriferous areas. All the poriferous areas are, moreover, arranged in eight longitudinal rows. All these rows are similar and the areas that compose them are very large, each with twelve pores. These rows are separated by more projecting bands formed of very distinct plates, slightly imbricated, each larger on the distal side than the proximal side.

These plates are granulose. The granules covering their central portion are a little larger than those on their border and poriferous areas. On the poriferous area and on the ventral surface are pedicellariae identical in general form to those of *Ophidiaster pusillus*. But the alveoli forming pits are toothed and not smooth as in this latter species. This character and that of the ambulacral groove distinguishes clearly *Ophidiaster pusillus* and *Germani* from each other. The arms are nearly cylindrical. At their end, they are still 3 mm in diameter.  $R = 50$  mm;  $r = 7$  mm;  $R = 7$  r;  $d = 6$  mm.

The eight species of the Museum each has two madreporic plates located near the border of the disk in two adjacent interradial spaces. The grooves on the plates are very short and sinuous and not radiating and narrow as in *Ophidiaster pusillus*, where there is only one madreporite relatively larger than each madreporite of *Ophidiaster Germani*.

The anus is central.

The relative dimensions of the arms vary. We have already given the measurements taken from one of our specimens. In another,  $R = 27$  mm;  $r = 5$  mm;  $R = 5.2$  r;  $d = 7$  mm.

## 89. OPHIDIASTER FUSCUS.

1840. *Tamaria fusca*, Gray. *Annals and Mag. of Nat. Hist.*, v. VI, p. 283.

1866. *Tamaria fusca*, Gray. *Synopsis*, p. 13.

Gray made a genus of this species, undoubtedly because of the very large ridge made by the rows of skeletal plates. Actually, it is a true *Ophidiaster*, very near to *Ophidiaster cylindricus* Lamarck (*Ophidiaster asperulus*, Ltk.) on one hand and *Ophidiaster pusillus* and *Germani* on the other.

There is only one specimen of *Ophidiaster fuscus*, the type at the British Museum, with five cylindrical-conical arms, very elongated and obtuse at the end. The major radius is a little more than five times the minor radius. The adambulacral spines form two rows with the arrangement typical of the genus. Each adambulacral plate has in the groove, two cylindrical spines extending a little into the groove, and further outside, separated from these first spines by a little granular space, a larger, flat, lance-like isolated spine obtuse at the end. On the external side is a groove from the base of the spine upwards the length of the median line to the middle of its height. Outside

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<sup>26</sup> I see only this character to distinguish this species from *Ophidiaster cribrarius* from the Tonga Islands described in 1871 by Doctor Lütken.

this row of spines is a row of rectangular granulose plates, corresponding nearly to the adambulacral plates and each with a very nice pedicellariae in a pit exactly like those we have described in detail in *Ophidiaster pusillus* and having, like it, a non-crenulated capsule. The ventral surface has a row of granulose plates scarcely reaching the first third of the arms. Then is a continuous row of plates, each corresponding either to two of the plates of the preceding row or to two of the adambulacral plates. These plates are strongly granulated and each has a conical spine in its center, relatively very large, short and lacking granules. The rows of poriferous areas begin also. They alternate with the rows of the plates and the areas themselves alternate with plates. The latter are very convex, very projecting and form, without counting the previously described rows, five projecting rows, nearly riblike, separated by the poriferous grooves. The plates are covered with large granules among which six or seven are distinguished in the central region of the plate that are much larger, rounded and nearly making small hemispherical tubercles. Nearly all the plates have a nice pedicellariae in a pit, distributed variously. The poriferous areas are very small and have four to six pores. The madreporite is located backwards. We see in the center of the disk a tubular ossicle to the left of which is the anus, then five ossicles corresponding to the arms and the same size as the central ossicle, and finally ten ossicles corresponding alternatively to the arms and to their intervals. These ossicles are granular and tubercular like the dorsal plates. The madreporite is outside the circle of ten. It is small and marginal.

The distance between two opposite arm ends = 65 mm. A single dried specimen in the British Museum is the type of Gray.

Location: Migupou.

#### 90. OPHIDIASTER ATTENUATUS.

1840. *Asterias coriacea*, Grube. *Actinien, Echinodermen und Würmer des Adriatischen und Mittelmeeres*, Koenigsberg, p. 22.

1840. *Ophidiaster (Hacelia) attenuatus*, Gray. *Ann. and Mag. of Nat. History*, v. VI, p. 284.

1842. *Ophidiaster attenuatus*, Müller and Troschel. *System der Asteriden*, p. 29.

1862. *Ophidiaster attenuatus*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 359.

1865. *Ophidiaster (Hacelia) attenuatus*, Gray. *Synopsis of the Starfishes*, p. 13.

In the collection of the Museum, two individuals have this name, one of 82 mm maximum radius, the other in which this ray is not greater than 35 mm. This latter specimen is, moreover, in all regards different from the first has been evidently placed by error with the first species. It is an *Ophidiaster pusillus*. There is, moreover, no doubt about the name of this individual. It is certainly *Ophidiaster attenuatus* of Gray and of Müller and Troschel. However, in the only individual of the collection, that is probably the same seen in the Museum of Paris by the authors of *System der Asteriden*, the four dark transverse bands that they report on the arms have today completely disappeared. This is not surprising, this individual having been examined approximately thirty-five years ago by Müller and Troschel and being held since then enclosed in a glass jar and exposed to light.

I must note that it is absolutely impossible to recognize this species after the description given it by Dujardin and Hupé. These authors made some mistranslation that they gave in the diagnosis of the *System der Asteriden*. The description of *Suites à Buffon* is the following: "*Ophidiaster attenuatus*, Müller and Troschel. Species with five conical arms, thin at the end and five and a half times as long as the radius of the disk. The adambulacral spines are very large and form three rows;

those of the internal row are flat, those of the external row are nearly cylindrical, this and *blunt*. The plates, in longitudinal series on the back and sides are equal. *Those of the ventral surface, smaller, form seven rows*. Each papular area has approximately twenty papulae. The granulation is uniform everywhere. — Coloration red passing to orange and marked sometimes with four transverse bands on the arms. Dimension: width, 162 mm.”

Instead of this, it reads:

“*Ophidiaster attenuatus*, Gray. Five conical arms with acute ends. The ratio of the radius of the disk to the arm radius is 1 to 5 ½. The adambulacral spines are very large. The spines of the interior row are equal and flat. Those of the external row are cylindrical, thick, *obtuse*. *There are two internal spines. This is only one external spine*<sup>27</sup>. The plates, arranged in regular rows, are equal on the sides of the arm and on the back. *The smaller plates of the ventral surface form seven rows*<sup>28</sup>. The papular areas have approximately twenty pores. The granulation is uniform everywhere. Color: Usually uniform red or orange. The example of the Museum of Paris is brown with four dark transverse bands on each arm. Size: six inches.”

The synonymy given by Dujardin and Hupé is equally wrong: the name *Ophidiaster attenuatus* is completely Gray’s and not of Müller and Troschel. Gray never designated this species as *Asterias attenuata*. He created for it a section *Hacelia* in his genus *Ophidiaster*, but he continues to designate it under the name *Ophidiastere attenuatus*.

A single individual from Sicily, without other indication.

#### XIV. GENUS LINCKIA.

1834. Nardo. *Isis*.

1864. Lütken. *Vidensk. Meddel.* (sense of the name changed) p. 164.

##### 91. LINCKIA MARMORATA (MICHELIN).

1844. *Ophidiaster marmoratus*, J.-H. Michelin. *Description de quatre espèces d’Echinodermes de l’île Maurice (Revue de zoologie, 1844, p. 173)*.

1845. *Ophidiaster marmoratus*, J.-H. Michelin. *Essai d’une faune de l’île Maurice (Magasin de zoologie, 1843, p. 21, pl. X)*.

1869. *Linckia marmorata*, von Martens. *Claus von der Decken’s Reise, Seesterne und Seeigel*, p. 130.

This species, which seems not to have been reviewed since Michelin, appears actually quite distinct. But the single specimen that serves as the type is without doubt still very young and it is quite probable that the description that could be made would be only partially applicable to an adult.

The five arms are sensibly cylindrical, although diminishing a little toward their end. R = 10 mm; r = 4 mm; d = 4 mm.

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<sup>27</sup> In the German text: *auf zwei innere kommt eine äussere*. It is this phrase that made Dujardin and Hupé believe there were three rows of adambulacral spines. They have evidently translated *outré les deux rangées internal, il y en a une plus exterior*. The sense is however not doubtful in the text.

<sup>28</sup> *Von den kleineren Tafeln der Bauchseite sind sieben Reihen Tafeln*. These are rows of plates of the sides of the arms and the back, and not as Dujardin and Hupé believed, the rows of ventral plates that are only three in number on each side of the ambulacral groove.

The armature of the adambulacral plates and the arrangement of the plates of the ventral surface leave a certain embarrassment that would doubtlessly disappear if it were possible to examine older individuals.

The furrow spines, all equal, are located at the border of the groove. The second row of spines, a little larger, is separated from the furrow spines by a space filled with ordinary ventral granulations that does not penetrate the spines of the grooves. There is only one of these spines, which are not contiguous, for two of the internal row. The difference in the size of the spines of these two rows does not exceed that we see in some *Linckia*, *Linckia multifora* for example. But a second row of spines, behind the first in such a way that the spines of the two rows correspond exactly, has spines larger and recalling the single row of spines of *Ophidiaster*. The general physiognomy of the ventral surface remains none the less that of *Linckia*. These rows of spines are followed by a very wide, granulose surface lacking papulae corresponding to the ventral surface of *Linckia*. The granulations are dense, hemispherical and slightly conical, smaller near them and in the interval of rows of plates that make up the ventral surface. At the exterior limit of the ventral surface, some larger granules form an irregular and incomplete row immediately below the first row of papular areas. These larger granules are especially distinct on the external half of the arms, where there is one per plate. The total number of papular areas is six. These areas are located in deep grooves relatively very close to the rows of plates that separate them. These latter rows, five in number, are formed of square, completely contiguous plates. The papulae, two are three in number, are in the angles of these plates. It is possible the number increases with the age of the animal, as seen in *Linckia ornithopus* Val. The row of plates of the dorsal median line of each arm join on the disk with the adjacent one of each side by an intermediary plate. A pentagonal figure results, outside of which is the madreporite. In the center of the pentagon is a single plate, to the left of which is the anus (in placing the madreporite behind) and some small, rudimentary plates in the angles of the pentagon. Between this central plate and those of the pentagon are groups of two or three papulae.

All the plates are uniformly granulose. The granules near the center are a little larger than the others. No pedicellariae.

The color of the specimen is gray long transverse irregular patches of purple.

A single dried specimen from Mauritius. It is the type of Michelin in the collection of this naturalist.

## 92. LINCKIA MILLARIS.

1705. *Stella marina* I, Rumphius. *Amboinische Rariteitkamer*, I V., p. 39.

1761. -----, Seba. *Thesaurus*, III, 6, 14, 15.

1733. *Pentadactylosaster asper*, var. *miliaris*, Linck. *De stellis marinis*, p. 31, pl. XXVIII, n° 47.

1788. *Asterias laevigata*, Linné, Gmelin. P. 3164.

1816. *Asterias laevigata*, Lamarck, *An. sans vert.*, v. III, p. 254.

1834. *Astérie miliaire* (*Asterias pentasterias*) *laevigata*, de Blainville. *Manuel d'actinologie*, p. 240.

1834. *Linckia typus*, Nardo. *Isis*, p. 717.

1840. *Ophidiaser...* *Asterias laevigata*, Müller and Troschel. *Wiegmann's Archiv für Naturgeschichte*, sixth Jahrg., first volume, p. 323.

1840. *Linckiaa crassa*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, p. 284.

1840. *Linckia Brownii*, Gray. *Ibid.*, p. 284.

1842. *Ophidiaster miliaris*, Müller and Troschel. *Syngtem der Asteriden*, p. 30.
1852. *Ophidiaster miliaris*, Peters. *Seesterne von Mosambique*. — *Bericht. Verhand. K. Preuss. Akad. Der Wiss.*, p. 177.
1862. *Ophidiaster miliaris*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 360.
1866. *Linckia miliaris*, von Martens. *Ostasiat. Echin. Troschel's Arch.*, Vol. I, p. 4.
1886. *Linckia Brownii* and *Luidia crassa*, Gray. *Synopsis*, p. 44.
1869. *Linckia miliaris*, von Martens. *C. v. d. Decken's Reise in Ost-Africa, Seesterne und Seeigel*, p. 130. — *Archiv für Naturgeschichte*, Jahrg. XXXII, Vol. I, p. 64.
1869. *Ophidiaster miliaris*, Edm. Perrier. *Pédicellaires*, p. 59.
1871. *Linckia laevigata*, Lütken. *Videnski. Meddel.*, p. 47, 48, and *Résumé français*, p. 23.

Ten well preserved individuals in alcohol: four collected in Batavia by Reynaud, expedition of *The Chevrette*; one from the seas of India, collected in 1832 by Eydoux: — two collected in 1842 by Leguillon, expedition of Dumonnt d'Urville; — one collected at Seychelles Islands by L. Rousseau in 1811; — finally two coming from Zanzibar and likewise by Louis Rosseau.

Twenty dried individuals: one from the Mollucas and two without indication of origin are part of the collection of Michelin: — one from Zanzibar donated in 1864 by the Museum of Comparative Zoology of Cambridge (Massachusetts); — five from New Caledonia sent in 1872 by Balansa; — one from the sea of the Indies that was probably the type of Lamarck; — one from the voyage of Hombron and Jacquinot in 1829; — four from Midoro Island (Puerto Galera, Philippines) collected by Laglaise, 1875; — and finally five without any indication other than sea of the Indies at the British Museum, from east Australia.

In the collection of the Museum, three individuals in the same box indicated as this species. All three are different species. One is a true *Linckia miliaris*, another is *Linckia paciica*, Gray, and finally the third is *Linckia diplax*. This latter was entered into the collection only recently. The two others, as some details of preservation indicate, were, to the contrary a part of the collection from the time of Lamarck. He should have seen and identified them himself, although no tradition has been preserved in this regard. We can consequently consider as probable that Lamarck confused under the name of *Asterias miliaris* two species, one that has kept this name and the other has become the *Linckia pacifica* of Doctor Gray.

The description of Lamarck does not distinguish between these two types. His description applies equally well to both and, if he distinguished a variety, it is simply to place individuals under the name of *comet*, that are in the process of regeneration and have one arm much longer than the others. The description of Müller and Troschel seems, on the other hand, to be *Linckia pacifica* rather than *Linckia miliaris* in these phrases: *Die Porenfelder des Rückens von der Grosse der Platten. In eiem Porenfelde gegen 12 Poren.* In the individual that since the specific distinction of *Linckia nicobarica* we should consider as the type of *Linckia milaris*, the papular areas are in fact generally much larger than the adjacent plates. These areas are clearly circumscribed, oval, each having a number of pores that vary from thirty to more than one hundred. The entire length of the median line of the dorsal surface has a more or less large, irregular area confined right and left and lacking papular areas. This area is filled with ovoid, slightly convex plates that are irregularly arranged. All are contiguous and often smaller than the plates of the adjacent region. But it can happen, as in one of the specimens of Michelin, that this area is very reduced, not very distinct, that the papular areas do not exceed the size of the ossicles that separate them. Individuals with these characters are very close to *Linckia nicobarica* but are always distinguished by the characters of the adambulacral spines. Finally, the papular areas nearest the

ventral surface are generally smaller than the others and arranged in a very regular series, especially near the base of the arms, and parallel to this are the marginal plates. This arrangement is much less clear for the following, but it is however still indicated and the papular areas of two consecutive series more or less alternate with each other. Generally, one can count in all four series that are less and less regular as they approach the median dorsal line. I find one example, however, that has five, where the areas, although having very numerous pores, are smaller and have very convex skeletal plates that nearly reach their size. This specimen reproduces very well the appearance of *Linckia nicobarica*, but it is distinguished, however, very clearly by the absence of papular areas in the median line of the back and the arms and by the very clear character that Lütken took from the relative arrangement of the adambulacral spines and the ventral granulation that we have been able to confirm perfect constancy in all our specimens. The two rows of adambulacral spines are separated by a band covered with granulations identical to those of the ventral surface. These granulations penetrate between the spines of the internal series so that each spine, located in ambulacral groove, is separated from the adjacent ones by a vertical line of granulations.

In the thirty examples in the collection of the Museum, only one, that of Lamarck, have four arms. All the others have five. The individual from the Moluccas and those from the Philippine Islands have a very characteristic blue tint. All the others are white in alcohol or brownish gray when dried. The area of the ambulacal groove usually keeps its blue tint.

Some individuals are notable for their much shorter arms, corresponding to the *Linckia crassa* of Gray. Unfortunately, they lack all indications of the locality and we can only mention the character that distinguishes them only from typical examples. In these individuals, three in number,  $R = 85$  mm;  $r = 15$  mm;  $R = 6$  r, while in the others, usually  $R = 7$  r.

### 93. LINCKIA PACIFICA.

1815. *Asterias laevigata*, Lamarck. *An. s. vertèbres*, v. III, p.254.

1840. *Linckia pacifica*, Gray. *Annals and Mag.*, p. 285.

18 ... *Ophidiaster tuberculatus*. Collection du Museum.

1866. *Linckia pacifica*, Gray. *Synopsis of the ast.*, p. 14.

1871. *Linckia nicobarica*, Lütken. *Vidensk. Meddelelser*, p. 270.

This species, described well by Doctor Lütken in his third critical and descriptive memoir on the sea stars with the name *Linckia nicobarica* was for a long time distinguished in the collection of the Museum. But we attributed to it the name *Ophidiaster tuberculatus* M., T. The true *Ophidiaster tuberculatus* had then taken the name *Ophidiaster echinulatus* with some doubt and I found the latter labeled one time as *Scytaster subulatus* M., T: the other specimens had not been identified. There remained the true *Scytaster subulatus* to which he restored a name to replace that which had been removed. Although we have said in our *Recherches sur les pédicellaires*, Professor Valenciennes had created for this species a new name, *Ophidiaster linearis*, excluding thus the genus *Scytaster* where Müller and Troschel placed it.

The Museum has five dried individuals of *Linckia pacifica*. Three were collected by Hobron and Jacquinet (voyage of the *Astrolabe*, 1842) and one of the them has still the indication where it was collected at Samoa; the others do not have a precise locality; a fourth individual comes from the collection Michelin where it was labeled *Ophidiaster ophidianus*; finally the fifth is one of the individuals that was part of the collection at the time of Lamarck and that was probably identified

by him as *Asterias laevigata*. Neither the one nor the other have an indication of locality. Other individuals in the collection have the name *Ophidiaster tuberculatus* M., T. But they should be placed with *Linckia diplax* that has, moreover, with these species numerous resemblances and is distinguished especially by the variable number of arms and two madreporites. The individual from the British Museum is from Tahiti.

In the largest individual of the collection,  $R = 200$  mm;  $r = 16$  mm;  $R = 12.5$  r.

The arms are a little more swollen in the middle region than at their base and are 25 mm in this region. All the skeletal plates of the dorsal and lateral regions are equal, convex, projecting and the same size or larger than the papular areas that they separate. These plates on the back are irregularly arranged. Their diameter is approximately 3 mm, the same as those of the papular areas. In *Linckia miliaris* they can, to the contrary, reach 6 mm in their greatest diameter. The plates that separate them are only 3 mm in diameter. As a result, the papular areas in *Linckia pacifica* are much more numerous. They have the same arrangement in the median dorsal line of the arms the same arrangement as elsewhere, contrary to that in *Linckia miliaris* where the median dorsal line has no papular area. On the sides of the arms, the plates form up to four regular rows alternating with the equally regular rows of papular areas. The ventral surface is formed of four contiguous rows of plates smaller than the dorsal plates and covered with a slightly finer granulation. The ambulacral spines are in two contiguous rows. The furrow spines are alternatively larger and smaller. The external spines are all equal, a little larger and less numerous than the furrow spines. In two individuals, among those of Lamarck, a third row of spines, still less numerous, is more outside and separated by some granules of the test of the middle row. The granules of the test do not penetrate between the spines of the two internal rows, contrary to that in *Linckia miliaris*. There is only one madreporite.

One of our individuals keeps on the ventral surface and notably in the area of the ambulacral groove a slightly bluish tint.

#### 94. LINCKIA DIPLAX.

1842. *Ophidiaster diplax*, Müller and Troschel. *System der Asteriden*, p. 40.

1869. *Ophidiaster diplax*, Edm. Perrier. *Péedicellaires*, p. 59.

1871. *Linckia diplax*, Lütken. *Vidensk. Meddel.*, p. 268.

To this species, which is very close to *Linckia pacifica*, I can report forty-two specimens in the Museum, only five in alcohol. Of the latter, three were collected at Madagascar by Grandidier in 1864 and two have only the information that they were collected in 1842 by Hombron and Jacquinot. Thirteen of these individuals have six arms, two have seven and two others have only four. All the others have five arms and make up consequently the great majority. We find among the forty-two individuals of the Museum, a large number in the form called *comet*, which are only detached arms that have reproduced the entire asteroid. It is to these comet forms that belong the individuals with four arms and many of them with six arms. I more than once asked myself if the variability in the number of arms in this species and in several others is not closely connected with the faculty of regeneration possessed by the detached arms. This regeneration rarely occurs with the regularity that we observe in normal development, and it is in the species where it occurs the most easily that we observe the greatest number of aberrant individuals as to the number of their arms. Another fact that struck me, as it struck, I believe, Dr. Lütken, but that requires confirmation, is that the species in which the capacity of regeneration is most developed includes nearly all that

have more than one madreporite. As if the presence of a certain number of these organs that is, moreover, accompanied without doubt by important modifications of the water vascular system, indicating a greater reciprocal independence and at the same time a greater vitality of the different rays that make up the star.

It is the same in *Asterias tenuispina* and *calamaria*, where one finds most often arms in the process of regeneration and where the number of arms is extremely variable, having also ordinarily several madreporites. It is necessary to make exactly the same observations with *Linckia diplax ornithopus*, *multiforis* and without doubt also *Ehrenbergii*.

We have, in this regard, unfortunately no information relative to *Acanthaster*, in which the madreporites are remarkably numerous.

After examination of numerous specimens, the only characters that appear to me to distinguish *Linckia diplax* from *Linckia pacifica* are a slightly smaller size; slightly thinner arms, four to seven in number, and finally two madreporites in individuals with four arms as in those with five, six or seven. One of the two individuals with four arms that I examined has even three madreporites, of which one, larger than the others, is in addition composed of three plates slightly smaller than the single plates and perfectly distinct. In general, individuals in the form of a comet have madreporites on each side of the large arms. In six individuals, this fact is present in five, but the rule is not absolute.

The character taken from the presence of two madreporites seems to me basically the most important that one can invoke to distinguish the two species. When it concerns individuals with five or four arms, the resemblance is such in fact that Lütken, after having considered for a long time an individual as *Linckia diplax* because of its two madreporites, placed it among the *Linckia nicobarica* because of its provenance. But, if certain specimens of *Linckia nicobarica* can have two madreporites, I conclude that it becomes very difficult to state clearly the limits of the two species.

There are, among the individuals that I have examined, some difference in the arrangement of the skeletal plates that form on each side of the body three regular, more or less distinct rows and affect the more or less large size relative to the papular areas, so that there is a more or less large number to one of the latter. But I do not believe that up until now that one can ascribe to these differences a specific importance.

Outside the numerous individuals of this species that have this vague information: "Sea of the Indies", the Museum has one individual from Reunion Island donated in 1862 by Maillard, three individuals from Madagascar donated in 1864 by Grandidier, one individual from New Caledonia donated in 1872 by Balansa. I found in the British Museum an individual with this information: California.

In some dried individuals, the underside of the body is still bluish.

## 95. LINCKIA GUILDINGII.

1810. *Linckia Guildingii*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, p. 285.

18.... *Ophidiaster ornithopus*, Valenciennes. Coll. Mus., manuscript label.

1842. *Ophidiaster ornithopus*, Müller and Troschel. *System der Asteriden*, p. 31.

1850. *Scytaster stella*, Duchassaing and Michelin. *Anim. Radiaires des Antilles*, p. 4.

1859. *Ophidiaster ornithopus*, Lütken. *Vidensk. Meddel.*, p. 80.

1862. *Ophidiaster ornithopus*, Dujardin and Hupé. *Suites à Buffon. Echinodermes*, p. 364.

1861 ? *Linckia guildingii*, Gray. *Synopsis*, p. 14.

1866. *Linckia ornithopus*, Verrill. *Proceed. of Boston Soc. of Nat. Hist.*, July 1866.
1867. *Linckia ornithopus*, Verrill. *On the geographical distribution of the Echinoderms of the West Coast of America. (Tr. Of Connecticut Acad., vol. I, part 2, p. 330.*
1868. *Linckia ornithopus*, Verrill. *Notice on Corals and Echinod. collect. by Prof. E.-F. Harth at the Abrothos Reefs (Tr. Of Connecticut Academy, vol. I, part 2, p. 367).*
1869. *Ophidiaster ornithopus*, Edm. Perrier. *Pédicellaires*, p. 59.
1869. *Ophidiaster ornithopus*, A. Agassiz. *Bullet. Mus. comp. zool.*, n° 9, March 1869.
1871. *Linckia ornithopus*, Lütken. *Vidensk. Meddel.*, p. 266, 270, 272.

The Museum has a suite of fifty-four individuals of this species. Two of them, from Vera Crua, are the types of Valenciennes; three were collected in 1853 at Bahia by de Castelneau, and all the others, coming from Guadeloupe, are the types of *Scytaster stella* of Duchassaing and Michelin. I must add that it is absolutely impossible for me to distinguish from the types of this species five individuals collected at the Cape Verde islands by Aimé Bouvier and donated by him in 1873 to the Museum of Natural History. There are thus fifty-nine *Linckia ornithopus* at the Museum. The fact that this same species can be encountered at the same time on the American and African coasts of the Atlantic does not appear very extraordinary if one considers that the Antilles and Cape Verde are located at nearly the same latitude and that they are somehow connected by the equatorial current. This fact is not, moreover, isolated.

The number of arms varies greatly in this species. Among the individuals in the collection, there is one with four arms, ten with six arms, among which is one of the two individuals that are types of Valenciennes<sup>29</sup>, and one with seven arms. All the others have five arms. Five is consequently more frequent than all the others. Six is after it. In the individual with seven arms, which comes from Guadeloupe, two contiguous arms are regenerating and the stump of one of the two is still very short. But the base of the arm is as wide as the five others which indicates that the seven arms were first simultaneously developed and that is not a matter here of one monstrosity resulting from one regeneration.

The individuals with a greater or lesser number of regenerating arms or at least whose arms are unequal are notably more numerous than the others. Forty of the fifty-nine individuals at the Museum are these. Among these forty individuals, the comet form is frequent and we find in one of the cartons of Michelin a series that is in this regard very remarkable. It has, in the first place, an isolated arm that is extremely near the disk that has been broken and closed by a scar, then an arm whose scarred part has four small arms beginning to grow and whose total length varies from 1 mm and 1.5 mm, the length of the arm on which it is beginning to grow is 43 mm. These arms have a series of comet forms that lead gradually to normal individuals with equal arms. The first specimens show in an absolutely indisputable way that, in some asteroids, that seemed to us up to here limited to the genera *Linckia* and *Hereaster*, a detached arm without any part of the disk is capable of producing a complete asteroid. Lamarck had already believed in the existence of this capacity, since disputed, and attributed it without distinction to all asteroids<sup>30</sup>. But he attributed

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<sup>29</sup> Müller and Troschel were wrong, consequently, in writing in their diagnosis this simple phrase: "*Funf cylindrisched Arme*", which could make one believe that the number of arms is constant in this species. Also, Lütken notes this too absolute statement as one of the objections that one could be made to his identification of *Ophidiaster ornithopus* of Valenciennes with the *Scytaster stella* of Duchassaing and Michelin. The objection is not valid because one of the two types has five arms and the other, six.

<sup>30</sup> *Histoire naturelle des animaux sans vertèbres*, 2<sup>nd</sup> edition, Deshayes and Milne Edwards, v. III, p. 232.

this capacity only to a whole arm and he added<sup>31</sup>: “A portion of a detached arm would not have this capacity.” We can note that an arm of *Linckia* detached from the disk can never be considered like a whole arm. It leaves a more or less short portion from the disk but that belongs to it. The proposition of Lamarck consequently loses all its apparent exactness. It is impossible, without experiments, to know to what relative extent a portion of the arm of an asteroid is necessary to be able to reproduce a complete asteroid. All that I have been able to observe in this regard is that I have never encountered the trunk of the arms lacking its tip that was in the process of reproducing, although it reproduces the rest of the asteroid by its other end. In the largest individual from *Linckia Guildingii* from Guadeloupe in the Museum, R = 85 mm. In the smallest, R = 19 mm. This individual has the comet form and we measured the longest arm. For the other arms, R = 13 mm. The individuals from Vera Cruz, named by Valenciennes, approach the size of the largest individual from Guadeloupe. It is the same for one of the individuals collected by Bouvier from the Cape Verde Islands. So this species seems to reach the same size in these different localities. Another remark to make is that dried individuals of large size are in general a lighter color than the small one. The large individual from Guadeloupe and another with four arms that is nearly the same size and from the same locality are a light sepia slightly washed in red. The two individuals of Valenciennes are white pink, tinted with brown in the individual with six arms. The largest individual from Cape Verde is mostly tinted in pink on the lower surface of the arms. To the contrary, all the small individuals are deep red brown, sometimes marbled on a lighter base. This difference cannot be the result of mode of preservation of the specimens because the arms of an individual in comet form produced by an arm 35 mm long and 6.25 mm wide is yellow-brown washed with pink that is usual in large specimens, while the new regenerated portion is a deep red purple.

Regarding this species and the identification of the specimens he possessed with *Ophidiaster ornithopus* Valenciennes, Lütken noted this phrase of Müller and Troschel: “*Furchenpapillen in drei Reihen*” can be a difficulty and is not without doubt entirely correct. Examination of the two type specimens of Müller and Troschel, the types of *Scytaster stella* of Duchassaing and Michelin, and the specimens collected at Cape Verde by Aimé Bouvier shows that actually the ambulacral groove is usually bordered on each side by three rows of granules clearly distinct from the ventral granulations. The two internal rows belong to the adambulacral plates and they are immediately contiguous. But the external row is formed of granules corresponding one to one with the middle row and separated from each other by granules identical to those of the ventral surface. As Lütken said very well, they are themselves only a modification. This difficulty disappears complete if one accepts, in summary, in an absolute manner, the specific identity of the individuals studied by Lütken with the *Ophidiaster ornithopus* of Valenciennes as with the *Scytaster stella* of Duchassaing and Michelin, whose *Scytaster* are young because of their isolated papular pores— are certainly the true *Linckia*, in the sense where Lütken applied the word to an adult.

I shall add, in ending what regards this species, that in it, as in *Linckia diplax*, there is nearly always on each side of the large arm, the generating arm, two madreporites in the individuals in the form of a comet.

*Observation.* — It is impossible for me to find any distinctive character between *Linckia Guildingii* just discussed and an individual collected at Tahiti in 1829 by Hombron and Jacquinot during the voyage of the *Astrolabe*, commanded by Dumont d’Urville. If this individual, dried and with a light brown gray color and no information of provenance, I would not hesitate to place it with *Linckia ornithopus*. But *Linckia ornithopus* comes from the American Atlantic coasts and

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<sup>31</sup> *Ibid.*, .233.

this individual from one of the archipelagos of the Pacific. This identification is completely doubtful. It becomes even more doubtful if one remembers this phrase of Lütken<sup>32</sup>: ‘Two small specimens of *Linckia nicobarica* can resemble the largest specimens of *Linckia ornithopus*.’ We are then tempted to consider the specimen in question as a young *Linckia pacifica* that lives, according to Doctor Lütken and the species I have examined, at Tahiti, the Archipelago of the Navigators or Samoan Islands, Tonga Islands and perhaps all of tropical Oceania, since it could be found at the Nicobar Islands, as indicated by the name given it by Doctor Lütken. But the same scholar, so accomplished in the knowledge of Stellerildes, adds immediately: ‘However, it will always be easy to distinguish these two species (*Linckia nicobarica* and *Linckia ornithopus*), because in *Linckia nicobarica* there is only one madreporite and the rows of ventral plates are always visible, while in *Linckia ornithopus* there are two madreporites and the rows of ventral plates are scarcely visible, hidden by the general granulation.’ In the example from Tahiti that we are examining, there are two madreporites located, as usual in similar cases, in two consecutive interbrachial angles and the longitudinal rows of the ventral plates are also not distinctive as in the typical examples of *Linckia ornithopus*. The distinctive characters thus disappear completely. However, this example comes from the same localities as *Linckia nicobarica*. It is very probable that it is to this species that it is necessary to place it because of the presence of two madreporites in individuals of a species that usually have only one<sup>33</sup>, *Linckia miliaris*, which has precisely the same area of distribution as *Linckia nicobarica*. If now we consider that we have been able to confirm the presence of the double madreporite to distinguish *Linckia diplax* from the sea of the Indies, from Reunion Island and New Caledonia from *Linckia pacifica* from the islands of the tropical zone of the Pacific and the Indian Ocean, we have this alternative: to extend the zone of geographical distribution of *Linckia diplax* to Tahiti and the range of the specimen in question, or accept that the madreporite is not a sufficient species character and makes *Linckia diplax* and *pacifica* one species. But then what characters distinguish this species from *Linckia Guildingii*? We see only two. One is the smaller size of the latter species is purely relative and not applicable. The other is the color, that in our specimens is bluish in *Linckia pacifica* and *diplax*, as in *Linckia miliaris*, and that is a more or less deep reddish purple to brown in *Linckia guildingii*. This character becomes also unfortunately inapplicable for many dried individuals of our collections or specimens preserved in alcohol and whose original color turns red as long as the alcohol is concentrated. We can see by this example how often it is very difficult to identify asteroids and in particular those of the family *Linckiiadae*. I am not the first to emphasize this and to attest to a very remarkable plasticity.

In summary, regarding the specimen that is the object of these remarks, the wisest seems to me, based on the preceding observations, is to dubiously label it as *Linckia diplax*. New material alone can resolve the question of identification that we just emphasized.

I shall add that concerning this individual, the locality cannot be doubted because it still has glued on its dorsal surface the original label of the voyageurs that collected it, a label that I have attached, as usual, to the specimen in the collection.

## 96. LINCKIA MULTIFLORA.

1816. *Asterias multiflora*, Lamarck. *Animaux sans vertèbres*, v. III, p. 254.

1840. *Linckia typus*, Gray. *Annals and Mag. of Nat. Hist.*, p. 284.

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<sup>32</sup> *Videnski. Meddelelser*, 1871, p. 262.

<sup>33</sup> Lütken, *Vidensk. Meddelelser*, 1871, p. 262

1840. *Linckia Leachii*, Gray. *Annals and Mag. of Nt. Hist.*, p. 285.
1842. *Ophidiaster multiformis*, Müller and Troschel. *System der Asteriden*, p. 34.
1845. *Ophidiaster multiformis*, Michelin. *Faune de l'île Saint-Maurice (Magasin de Zoologie*, p. 20).
1862. *Ophidiaster multiformis*, Dujarden and Hupé. Suites à Buffon, *Echinod.*, p. 362.
1866. *Linckia typus* and *Linckia Leachii*, Gray. *Synopsis*, p. 13 and p. 14.
1866. *Linckia multiformis*, von Martens. *Ost. Echinod. (Wiegmann's Arch.*, Jahrg. XXXXII, Vol. I, p. 65<sup>34</sup>).
1869. *Linckia multiformis*, von Martens. *Cl. v. d. Decken's Reise in Ost-Africa, Seesterne und Seeigel*, p. 130.
1869. *Ophidiaster multiformis*, Edm. Perrier. *Pédicellaire*, p. 59.
1871. *Linckia multiformis*, Lütken. *Vidensk. Meddel.*, p. 267.

It is between this species and *Linckia Guildingii* Gray, in regard to the arrangement of the adambulacral spines, exactly the same difference as between *Linckia miliaris* and *pacifica*. So I do not insist on this arrangement, as does Doctor Lütken. Lütken reported this species as corresponding to *Linckia miliaris*.

I have found in the collection of the Museum no less than seventy eight individuals of this species, eight in alcohol and seventy dried. They are from the Red Sea (Botta, 1837; and the collection Michelin), from Nossi-Bé (Cloué, 1842 and Boivin, 1853), from Reunion Island (Maillard, 1862), Seychelles (Louis Rousseau, 1811) and New Caledonia (Balansa, 1872). I cannot separate from them an individual collected at Hogolen during the voyage of the *Astrolabe* in 1820 by Hombron and Jacquinot. Finally, in a remarkable coincidence with the reported facts of geographical distribution, an individual from the Hawaiian Islands has exactly the characters of *Linckia multiformis* from the Red Sea and an analogous habitat and extent and geographical position to that of *Linckia miliaris*, *pacifica* and *diplox*. The usual color of the species appears to be red (von Martens). However, among individuals from Reunion Island with a very pronounced red tint is one with a white background, resulting with doubt from decoloration, and very irregular bluish patches. The same character is found in three individuals from the Red Sea. The number of arms is usually five. But the Museum has five individuals with six arms. I have not seen any with seven arms. *Linckia multiformis* has thus the same reproductive faculties as *Linckia Guildingii* and exactly the same general appearance. We have seen that the principal distinctive character of these two species is the arrangement of the adambulacral spines.

#### 97. LINCKIA BOUVIERI (NOV. SP.).

Bouvier collected an asteroid from the Cape Verde Islands that causes some difficulty in setting the limits of the family of *Linckiadae*. Its ventral surface is completely like that of true *Linckia*, *Linckia miliaris* for example, and the characters that we have defined the genera are perfectly applicable. There thus is no doubt from the systematic point of view on the place of this species. But from the methodical point of view, it is something else. The dorsal surface is completely like that of the some species of *Scytaster*. The resemblance to the dorsal surface of *Scytaster variolatus* is striking. So that the species in question, in spite of the distinct characters that we have related it

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<sup>34</sup> von Martens correctly assigned this species to the *Linckia typus* and *Leachii* of Gray. Müller and Troschel, to the contrary, incorrectly assigned the first of these species to their *Ophidiaster miliaris*, which is the *Linckia miliaris* of von Martens.

to *Linckia*, in some way straddles the two genera. There are three specimens in the Museum. I will first completely describe one that will allow then to easily understand the characters of the others.

The individual I shall consider as typical has the following dimensions.  $R = 50$  mm;  $r = 8$  mm;  $R = 6.2$  r;  $d = 9$  mm.

The arms are flat below but convex above. They taper gradually to a point, but only by a small amount so that it is still very obtuse. Very near it, the arm is still 5 mm in diameter.

On the ventral surface, the adambulacral spines are in two rows. The furrow spines are formed of alternating large and small spines. The large spines are flat, truncate and a little larger at the top than at the base. The small spines are cylindrical. The spines of the second row are immediately contiguous with those of the first and nearly the same size. They are opposite the small spines and separated by a small granule that is consequently opposite the large internal spine. Outside are three longitudinal rows of small irregular plates. The external one gradually decreases in width and stops at the beginning of the last third of the arms. These plates are covered with round, slightly unequal granulations that hide their exact limit. There is no papular pore between them. On the border of the arms, they are followed by a row of larger, slightly elliptical plates, slightly wider than long. There are thirty-three of these plates for each arm. The first three, near the interbrachial angle are those in which the width is the greatest over the length. No pore separates these rows of small plates of the ventral surface. Then comes a second row of plates exactly like those of the preceding and superimposed on them. The tops of the small axis of these plates touch the large axis of the lower plates and with the latter limit the papular areas that are small and sunken between the plates. In each area are a dozen pores. The rows of plates can be considered as making up the lateral surfaces of the arms. Those remaining to be discussed make up the dorsal surface. They are larger than the preceding, rounded but irregular, and form three irregular rows. Between them are intercalated a number of more or less large small plates that in large individuals can be larger and completely hide the triserial arrangement. Between these plates that are separated by narrow more or less deep grooves are small, deep papular areas that have four to eight pores. As the plates are a little convex, the dorsal surface has a pustular appearance, completely like that of the dorsal surface of *Scytaster variolatus*.

The disk is formed of a circle of ten circular plates surrounded by a central group of five or six irregularly arranged plates. The madreporite, flat and as large as these plates, is located in the circle of the ten plates and the extension of the upper row of marginal plates. It touches the interbrachial plate of the circle with which it is contiguous and decreases by approximately half its width. The madreporite has very fine sinuous grooves whose borders are frequently united by trabeculae that sometimes make the madreporite appear cribrellated.

In the largest individual,  $R = 91$  mm;  $r = 11$  mm;  $R = 8.3$  r.

There are forty-five marginal plates and the rows of the dorsal plates are distinguished by their irregularity and the number of intercalary plates. The number of these plates in the center of the disk is also larger and the marginal circle of the disk less regular.

The color of dried individuals is violet gray. It is absolutely white in smaller individuals, one of which is very deteriorated. The two others are intact.

#### 98. LINCKIA NODOSA (SP. NOV.).

This species also has some analogy with *Scytaster* in its dorsal surface. It resembles it much however than the preceding:  $R = 91$  mm;  $r = 11$  mm. Near the base, the arms have  $d = 11$  mm. But the animal being flat, this dimension is perhaps a little too large and actually the arms are thinner

than in the preceding species. In one slightly smaller specimen,  $r = 10$  mm and at the corresponding level to the preceding,  $d = 9$  mm. We do not take this diameter at the very base of the arms because the arms are slightly enlarged where they join the disk. It is at the origin of this inconspicuous enlargement 4 or 5 mm from the disk, that we took these measurements.

On the ventral surface, the spines of the adambulacral plates are arranged in two rows. The furrow spines are alternately large and small. The small spines are cylindrical. The large spines are enlarged from the base to the top. The external row has spines contiguous to the furrow spines, each located opposite to one of the small spines and sometimes separated by some granules. Their size is a little larger than those of the larger furrow spines. Outside these is a row of spaced granules, larger than the other granules of the ventral surface and separated from the external row of spines by a space covered with smaller granules. At the base of the arms, the ventral plates form only five rows. But the first row scarcely extends beyond the interbrachial angle. It has only three or four plates on each arm. The second, formed of nine or ten plates, extends a little further. The third is still a little longer, i.e., up to the end of the first sixth of the arm. All these plates are covered with rounded granules, a little larger on the plates of the internal row. There are no pores between these plates. Then comes, as usual, two rows of nearly square marginal plates, with rounded papular areas with a dozen pores between them. There are approximately sixty of these plates. The granules that cover the marginal plates are a little smaller than those of the ventral plates. The arms end in a rounded, very large projecting plate in the form of a tubercle with three to five small unequal tubercles. This plate is naked.

The plates of the dorsal surface form three irregular rows. Some of these plates, larger, more projected and generally rounded, form nodules that are irregularly arranged. Some of these plates are also found on the disk. One of them is always located inside the madreporite towards the center of the disk. It is formed numerous plates that are finely granulated like those of the arms. The papular areas are small, sunken and with six to eight pores. They are rare on the disk. The madreporite is very large, rounded, flat and marked with a large number of fine, very sinuous radiating grooves.

Two dried individuals in the collection Michelin. Locality unknown.

#### 99. LINCKIA UNIFASCIALIS.

1840. *Linckia (Phataria) unifascialis*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, 285.

*Linckia (Phataria) bifascialis*, Gray. *Ibid.*

1842. *Ophidiaster suturalis*, Müller and Troschel. *System der Asteriden*, p. 30.

1862. *Ophidiaster suturalis*, Dujarden and Hupé. *Suites à Buffon. Echinod.*, p. 361.

1864. *Ophidiaster (Linckia) unifascialis*, Lütken. *Vidensk. Meddel.*, p. 165.

1866. *Linckia suturalis*, von Martens. *Ostasiat. Echinod. (Troschel's Arch. für Naturgeschichte, Ann. Rev. XXXII, Vol. I, p. 85).*

1866. *Linckia (Phataria) unifascialis*, Gray. *Synopsis*, p. 14.

1866. *Linckia (Phataria) bifascialis*, Gray. *Synopsis*, p. 14.

1864. *Linckia unifascialis*, Verrill. *Notes on the Echinoderms of Panama, etc. (Transactions of Connecticut Acad. of Arts and Sciences, vol. I, part II, p. 251), and On the geographical distribution of Echinoderms of the West Coast of America (ibid., p. 328, 330, 333).*

1868. *Linckia unifascialis*, Verrill. *Notice of a Collection of Echinoderms from La Paz (ibid., p. 372).*

1871. *Linckia unifascialis*, Lütken. *Vidensk. Meddelelser*, p. 272, and *Résumé français*, p. 23.

This species is represented in the Museum by three specimens perfectly conforming to the description given by Dr. Lütken. Of these three specimens, one, donated by the Museum of Comparative Zoology of Cambridge (Massachusetts), is from Acapulco. The other two, donated by Guillemin in 1865, came from the Gulf of California. According to von Martens, this species is also found at Atuppu (Sunda Islands)

This species has all the characters of *Linckia*. Nevertheless, the very special arrangement of the papular areas in a single band the length of the arms has led several zoologists to consider it as a sub-genus proposed by Gray under the name *Phataria*.

In his memoir of 1864, Doctor Lütken said he did not find the madreporite. In all our specimens, that conform well otherwise with his description, we have seen a perfectly distinct, very large madreporite but whose level is confused completely with the level of the disk. Moreover, the perforations that riddle the plate are often level with it instead of opening at the base of the sinuous grooves as is usual. If these perforations are accidentally filled, it would become very difficult to distinguish the plate. This explains the observation of Lütken. It would be astonishing that such an important organ would be missing in a genus that usually has it and without leading to profound modifications of the organism.

*Observation.* — Gray described two *Linckia* in this group, to which he gave the names *Phataria unifascialis* and *Phataria bifascialis*. Müller and Troschel, and after them Doctor Lütken, thought that these two species were only one. Examination of the types of Gray and other specimens at the British Museum show however the existence of two very distinct forms that are encountered with nearly equal frequency. One of these forms is that described by Doctor Lütken. It is also that in the collection of the Jardin des Plantes and that corresponds to the *Linckia bifascialis* of Gray. It is characterized by the presence at the base of the arms of a short papular band superimposed on the principal band and whose width is both of this band and the non-porous band of the dorsal surface. This short band is represented by a single series of plates in all the region of the supplementary little papular band.

In the second form, *Linckia unifascialis* Gray, this little supplementary band does not exist and the papular band has exactly the same width its entire length. It is obviously formed by the incomplete fusion of the elliptical papular areas with the large vertical axis arranged in series on each side of the arms. It seems to me that individuals with a single papular band have at the same time more robust and a little shorter arms. I made the same observation on a single specimen in the collection of Paris, a dried specimen that is unfortunately deformed. In this individual, the arms are equally shorter, more obtuse and their section is less clearly triangular than in the typical specimen.

The papular band is a little wider and their areas more distinct. The accessory band at the base of the arms is not present. The plates of the dorsal region form four irregular rows instead of three. But we recognize already a tendency to form four rows in some typical specimens. The single row of plates in the median line at the base of the arms is excessively short. The madreporite is large (3 mm) and located as in the preceding species. For all these reasons, I would not be far from accepting the existence of the second species of Gray. But the two forms are too close and the number of specimens that I have been able to see too few for it to be possible to conclude these two types are distinct species and that there are not intermediate forms between them. We should in any case distinguish this second form as a variety.

## XV. GENUS SCYTASTER (LÜTKEN).

1840. *Nardoa*, Gray. *Annals and Mag. of Nat. Hist.*, p. 286.  
*Gomopia*, Gray. *Annals and Mag. of Nat. Hist.*, p. 286.  
*Narcissia*, Gray. *Annals and Mag. of Nat. Hist.*, p. 287.  
1842. *Scytaster* (pars) and *Ophidiaster* (pars), Müller and Troschel. *System der Asteriden*.  
1864. *Scytaster*, Lütken. *Vidensk. Medd.*

This genus is defined as that of Müller and Troschel. We adopt here as characteristic nearly all that was proposed in 1864, then in 1871 by Doctor Lütken.

4<sup>th</sup> SECTION. — NARDOA (*Nardoa*, *Gommophia* Gray).

100. SCYTASTER TUBERCULATUS.

1840. *Nardoa tuberculata*, Gray. *Ann. and Mag.*, v. IV, p. 240.  
1842. *Ophidiaster tuberculatus*, Müller and Troschel. *System der Asteriden*, p. 32.  
18.... *Ophidiaster echinulatus*. Manuscript labels of the Collection of the Museum.  
1862. *Ophidiaster tuberculatus*. Dujardini and Hupé. Suites à Buffon. *Echinod* p. 363.  
1864. *Scytaster tuberculatus*, Lütken. *Vidensk. Meddel.*, p. 163.  
1866. *Linckia tuberculata*, von Martens. *Ostasiatische Echinodermen*, (*Troschel's Archiv für Naturgeschichte*. Annual Review XXXII, Vol. I, p. 64).  
1866. *Nardoa otuberculata*, Gray. *Synopsis*, p. 15.  
1869. *Ophidiaster tuberculatus*, Edm. Perrier. *Pédicellaires*, p. 59.  
1871. *Scytaster tuberculatus*, Lütken. *Vidensk. Meddelelser, Résumé français*, p. 22.

Müller and Troschel placed this species among the *Ophidiaster*. But if we accept the new characteristic proposed for the genera *Scytaster* and *Ophidiaster* by Doctor Lütken, it goes into the genus *Scytaster* and is near *Scytaster variolatus*, with which it has numerous similarities. In this regard, we can remark that if we take the characteristic of Müller and Troschel, *Scytaster variolatus* itself does not fit in the genus *Scytaster*, considering that among its dorsal plates are true papular areas with pores as numerous as in many *Ophidiaster* in the sense that Müller and Troschel used this generic term. Whether we adopt the characteristic of Doctor Lütken or we give more importance, as we have proposed, to different modes of makeup of the ventral surface, already incidentally reported by the Danish scholar, this species cannot fail to be in the genus *Scytaster*. It differs from all points of view from *Ophidiaster* and, by the makeup of the skeleton and the disposition of the papular areas of the dorsal surface, it is as close as possible to *Scytaster variolatus* that Müller and Troschel themselves have not believed to be among the *Ophidiaster*. The composition of the ventral surface is: first adambulacral plates, each with a row of four furrow spines, nearly equal and very slightly flattened; immediately behind is a row of three or four spines the same height or slightly shorter. These two rows of spines make up all the armature of the adambulacral plates. Sometimes they can be followed by a row of polygonal granules of the ventral surface, taller than the others and simulating a third row of spines and making in any case a transition to the general granulation of the ventral surface. Outside the adambulacral plates is a row of rectangular plates, slightly wider than long, slightly convex, all covered with polygonal granules slightly larger towards the most projecting part of the plate. Immediately after them is another row of plates that are not separated by pores and in which the plates, slightly convex, have an obvious elliptical form, the large axis being parallel to the ambulacral groove so that these plates

are longer than wide, the preceding being, to the contrary, wider than long. In general, each plate of the second row corresponds very regularly to two plates of the first, but this is not absolute. A third row of plates follows. It is formed of plates identical to those of the second and corresponds to them exactly. The plates of these two rows touch only at the top of their small axis. They thus have a space between them in the form of a losenge with curved sides that have the first papular areas that thus form a row alternating with the two rows of plates. Immediately outside the third row of plates, the smaller skeletal plates are arranged irregularly as on the entire dorsal surface of the arms and disk. Some of them, taller than the others, form more or less numerous projecting tubercles that simulate sometimes an incomplete row above the last regular row of plates.

This species is represented in the collection of the Museum by fourteen individuals, two in alcohol. But these individuals are placed under three different names: two (one dried and one in alcohol) under the name of *Ophidiaster echinulatus* Müller and Troschel, another under the name *Scytaster variolatus* Müller and Troschel. The other was not identified. Two individuals collected by Laglaise at the Philippine Islands was acquired the same year (August 1875). One of the localities indicated in the collection of the Museum appears doubtful. The individual labeled *Scytaster variolatus* was collected in 1829 from Batavia by Reynaud (expedition of *la Cherrette*). But the individual labeled *Ophidiaster echinulatus* coming from the seas of the North was collected in 1835 by Gaimard (expedition of *la Recherche*). This is obviously an error. Finally, an individual with one bifurcated arm was collected during the voyage of the *Astrolab* by Hombron and Jacquinot in 1820. The other individuals have no information.

#### 101. SCYTASTER VARIOLATUS.

1733. *Pentadactyloaster asper* (var. *variolatus*), Linck. *De Stellis marinis lib. Singularis*, p. 34, and pl. I, n° 1; pl. VIII, n° 10; pl. XIV, n° 24.  
1792. ... Bruguières. *Enc. méth.*, pl. CXII, fig. 4 and 5.  
1805. *Asterias variolata*, Retzius. *Dissertatio*, p. 19.  
1816. *Asterias variolata*, Lamarck. *An. s. vert.*, v. III, p. 253, n° 36.  
1834. *Linckia variolata*, Nardo. *Isis*, 1834, p. 717.  
1836. *Linckia variolata*, Agassiz. *Prodr. Monog. Des Radiaires (Mém. Soc. sc. nat. de Neufchâtel, v. I, p. 24)*.  
1840. *Linckia variolata*, Müller and Troschel. *Wiegmann's Archiv*, Jahrg. VI, Vol. 1, lp. 322.  
1840. *Nardoa variolata*, Gray. *Ann. of Nat. Hist.*, p. 286.  
1840. *Nardoa Agassizii*, Gray. *Ibid.*, p. 287.H  
1842. *Scytaster variolatus*, Müller and Troschel. *System der Asteriden*, p. 34.  
1862. *Scytaster variolatus*, Dujardin and Hupé. *Suites à Buffon. Echinod.*, p. 366.  
1864. *Scytaster variolatus*, Lütken. *Vidensk. Meddel.*, p. 41.  
1866. *Nardoa variolata* and *Agassizii*, Gray. *Synopsis*, p. 15.  
1867. *Linckia variolata*, von Martens. *Ostasiatische Echinodermen (Arch. für Naturg., Jahrg. XXXIII, Vol. 1)*.  
1867. *Linckia variolata*, von Martens. *Cl. v. d. Decken's Reise, Seeserne und Seeigel*, p. 130.  
1869. *Scytaster variolatus*, Edm. Perrier. *Pédicellaires*, p. 62.

We can report for this species eighteen individuals coming from Zanzibar or from Reunion Island and from Mauritius, and ten individuals from New Caledonia. But between these two categories, I find a constant difference in the number and dimensions of the projecting and convex

plates of the dorsal surface that give to this species its pocked characteristic. In comparing two individuals of the same size and form, we find in one individual from the African coast of Mascarene Islands the large diameter of one of the plates from the middle region of the arms is nearly 5 mm while in the individuals from New Caledonia it does not exceed 3 mm. Moreover, in the individuals from the African region, the large axis of the plates is nearly always arranged transversally in relation to the median line of the arms, while there is little orientation in the New Caledonia individuals, except at the arm base. In individuals from New Caledonia, the number of plates in a section perpendicular to the axis of the arms, between the two upper longitudinal rows is about ten. It is up to five in individuals from Reunion Island. These differences are so constant that it is possible to distinguish at first glance an individual from Reunion Island or neighboring regions from an individual from New Caledonia. Lacking intermediate forms at the present, I thus believe it necessary to distinguish specifically these two forms. The first should have the name *Scytaster variolatus*. I designate the second under the name *Scytaster Novæ-Caledoniæ*. As these species are very similar, I shall give here a detailed description.

In *Scytaster variolatus*  $R = 96$  j,  $r = 16$  mm;  $R = 6$  r. The ambulacral groove is bordered by three tight rows of contiguous spines. On each adambulacral plate, the furrow spine has three prismatic spines, nearly equal, slight rounded at the tip. Behind them are three other spines of the same height but that are not arranged always in the form of an exactly parallel row to the preceding, so that the range is oblique in relation to the axis of the arms or that the spines overlap to form a triangle at the top. The third row also has three spines of the same size as the preceding and are sometimes obviously larger than the granules of the ventral granulation, sometimes passing gradually to this granulation so that they are scarcely distinguishable from those that commence immediately after them. This row can be, moreover, less regular than the preceding. Immediately after the adambulacral plates is a row of rectangular plates, wider than long, covered with polygonal granules, each corresponding to an adambulacral plate. In the middle region of the arms of the individual with the dimensions we have just given, these plates are approximately 12.5 mm long and 1.5 mm wide. They are covered with granules that are usually polygonal and larger than the other granules of the ventral surface so that they reach the dimensions of the spines of the adambulacral plates from whom they can ordinarily be distinguished. Sometimes the development of this granulation obscures the edges of the plates they cover. Immediately outside this row is a row of elliptical plates with the grand axis transverse. Each corresponds to two plates of the preceding row. In each interbrachial angle, some plates form a very short row that is interposed between the two principal rows. Moreover, two other plates superimposed on the preceding are intercalated at the base of the interbrachial angle, between them and the contiguous plates of the adambulacral plate. There are no papulae between these interbrachial plates and the elliptical plates of the second row. But papillae develop as soon as the elliptical plates become contiguous with those of the internal row. The papulae alternate regularly with the plates. Each has not just one, but six to ten pores usually arranged in a circle and thus surrounding a space covered with granules smaller than those of the more projecting part of the plates. A second row of plates exactly like those we just described is found outside them. The plates of this third row correspond exactly to those of the second, touching them only by the tip of their grand axis. The space between them is filled by a papular area like the preceding. The number of plates of each of these two rows is forty-five in this individual. In smaller individuals ( $R = 60$  mm;  $r = 12$  mm), the number decreases to thirty. The dorsal plates are irregularly arranged and of several sizes. They are elliptical with the large axis transverse in relation to the arms. The long axis can pass 4 mm, the small axis is 3 mm. These plates, projecting and convex, do not touch, or at least are

surrounded at their base by a continuous granulose groove in which we see popular areas containing twelve pores. The intercalary plates, smaller than the others, project here. They can be entirely missing. The granules that cover the dorsal plates are polygonal and larger than those that cover the grooves separating the plates. From one of the marginal rows of plates to the other are five large dorsal plates in large individuals. These plates remain very large up to the end of the arms where they still measure at least 2 mm in diameter and have about twenty granules. The decrease in size of these plates towards the ends of the arms is thus not great and is gradual.

The madreporite is variable in size, often small, not very visible and located equidistant from the center and edge of the disk.

The number of arms can vary from four to seven. Individuals with six or seven arms and some individuals with five or even four arms have arms a little thinner than usual and nearly cylindrical. It is to them that Gray gave the name *Nardoa Agassizii*. But we can see there only an accidental variety. The Museum has an individual with seven arms, three individuals with six and thirty individuals with five arms. Of these individuals, nine are without indication of provenance and were probably seen by Lamarck. Two come from Zanzibar and were donated in 1864, one by Grandidier, the other by the Museum of Comparative Zoology of Cambridge (Massachusetts); two from Reunion Island were donated in 1862 by Maillard, the other in June 1872 by Sister Albert; four are part of the collection Michelin and were indicated to also having Reunion Island for origin. A fifth individual, identified in this collection as *Scytaster variolatus*, is *Ferdina flavescens* Gray.

#### 102. SCYTASTER NOVÆ CALEDONIÆ (NOV. SP.).

The largest individual of this species in the Museum has the following dimensions:  $R = 94$  mm;  $r = 14$  mm;  $R = 6.5 r$ .

The arms are 15 mm in diameter at their base and 17 mm at a distance of 30 mm from the buccal opening, corresponding to a distance of about 16 mm from the base of the arms. The arms thus begin to swell slowly up end of the first fourth of their length. The width then decreases very rapidly up to the end of the second fourth, where they already are only 10 mm in diameter. From there, they decrease much more slowly until at their end they are only 4 mm in width. As a result, the arms have a form different from most of the individuals of the preceding species, in which the arms are more regularly conical. This difference is however not absolute, because some more or less deformed individuals from Mauritius in the collection Michelin have an appearance that is very similar to this form of arms of New Caledonian individuals.

The arrangement of the plates of the ventral surface reproduces exactly what we saw in the preceding species, but with still more regularity. The spines of the ambulacral plates are in three rows, where the prismatic spines are very close to each other. Each plate has three spines in each row. But it happens that the spines of the external row are displaced to be oblique and it seems then that there are four rows of spines. The polygonal granulation of the ventral plates are very clearly larger than those of the grooves that separate them and those of the popular areas that have five to ten separated pores. In dried individuals at our disposal, they are not clearly marked.

The skeletal plates of the dorsal surface are not as frequently elliptical as in the preceding species. Although it occurs in this form, most are circular. In addition, these plates are smaller and consequently more numerous than in *Scytaster variolatus*. Two cm from the base of the arms, in the individual with the dimension above, the largest is only 3 mm in diameter and there are a dozen between the two regular rows of plates that border the arms to the left and right. The largest

plate of the disk, which is obviously circular, is not greater than 4 mm in diameter. This is just 1 mm less than the largest plate of the disk in an individual of *Scytaster variolatus* of the same size. In the latter third of the arms mostly the plates become remarkably small. Their granulation keeps the same size. As a result, we see plates that have only four polygonal granules. Most of the others have scarcely seven to ten while at this same place in *Scytaster variolatus*, we find few plates that do not have about twenty granules.

The madreporite, located 8 mm from the center of the disk, is very large and covered with numerous, very sinuous grooves.

These characters, that are especially striking when we compare directly individuals from Reunion Island and New Caledonia, are remarkably constant and appear to me to amply justify, until we find intermediate forms, the specific distinction of these two types.

There are eight dried individuals of *Scytaster Novæ-Caledoniæ* in the Museum. Three in excellent state were donated to the Museum in 1872 by Balansa, and five in good state were sent in 1875 by Germain. We found this species, originating from Port Essington (Australia), in the British Museum. I should add that Grandidier collected from Madagascar an individual that appears to me to belong to this species rather than to *Scytaster variolatus*.

### 103. SCYTASTER ÆGYPTIACUS.

1840. *Gomophia ægyptiaca*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI, 286.  
1842. *Scytaster zodiacalis*, Müller and Troschel. *System der Asteriden*, p. 35.  
1844. *Oreaster Desjardinsii*, Michein. *Magazin de zoologie*, p. 23, pl. XI.  
1862. *Scytaster zodiacalis*, Dujardin and Hupé. *Suites à Buffon, Echinod.*, p. 367.  
1862. *Oreaster Desjardinsii*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*. p. 388.  
1864. *Scytaster Desjardinsii*, Lütken. *Kritiske Bemærkninger om forskjellige Søjterner (Asterider)* med Beskrivelse af nogle nye Aster. (*Vidensk. Meddel.*, p. 168).  
1866. *Gomophia ægyptiaca*, Gray. *Synopsis*, p. 15.  
1867. *Linckia ægyptiaca*, von Martens. *Ostasiat. Echinod.*, (*Arch. für Naturg., Jahrg. XXXIII*, Vol. 1).  
1869. *Linckia ægyptiaca*, von Martens. *Cl. von der Decken's Reise in Ost-Africa, Seest. Und Seeigel*, p. 130.  
1871. *Scytaster Desjardinsii*, Lütken. *Fortsatte kritiska og beskrivende Bidrag til Kundskah om Søjstjerneerne (Vidensk. Meddel.*, p. 280.

We have found two specimens under the name *Scytaster zodiacalis* in the collection of the Museum. One is very large (175 mm in diameter). The other is much less (approximately 60 mm). Only one of these was evidently identified by Müller and Troschel, who attributed to their species only 60 mm in maximum diameter (2.5 inches). I consider this small individual as the type. As for the other individual, it was placed afterwards with the latter. We have already said that it is nothing other than *Ophidiaster tuberculatus* M., T., belonging today to the genus *Scytaster*. There is thus in the Museum only one individual of *Scytaster zodiacalis* that corresponds moreover very exactly with the description given by Müller and Troschel. But comparison of this typical individual with the type of *Oreaster Desjardinsii* that we have before us and that is precisely the same size, shows in a very obvious way the possibility the two species are absolutely identical. The name adopted by Michelin should thus disappear because it is more recent by four years than that of Müller and

Troschel. Doctor Lütken, in his third critical and descriptive memoir on sea stars<sup>35</sup> asked if this species were not a small *Scytaster tuberculatus* and was not able to resolve the question lacking species of the two species whose size was between 160 and 200 mm, or more generally lacking individuals that we could connect surely to the forms that have received two specific names and whose sizes were comparable. The Museum of Paris happily has a *Scytaster tuberculatus* exactly the same size as the type specimens of *Scytaster zodiacalis* of Müller and Troschel and of *Oreaster Desjardinsii* of Michelin. The comparison is very easy and we can state the following differences.

1° The projecting tubercles of the dorsal surface are *entirely* covered with polygonal granulations in *Scytaster tuberculatus*; their point is naked in *Scytaster zodiacalis*;

2° The adambulacral spines are followed in *Scytaster tuberculatus* by a row of granules larger than those of the ventral surface, establishing some kind of transition with the latter. Nothing of this type is observed in *Scytaster zodiacalis*, whose adambulacral spines are immediately followed by fine granulation of the ventral surface, which they greatly exceed in height.

These differences were already considered as probable by Dr. Lütken.

I shall add that the arms of *Scytaster zodiacalis* are more pointed at the end and less wide at the base than those of *Scytaster tuberculatus*. This comparison is easy. The specimen of Michelin and our young *Scytaster tuberculatus* were both flattened during drying. In the first, the diameter at the base of the arms:  $d = 8$  mm and in the second,  $d = 10$  mm. R in both was the same, 32 mm.

Another more important difference is the arrangement of the ventral plates. Outside the adambulacral plates are in both a row of small plates that scarcely reach the first third of the arms and represent the row of rectangular plates that are wider than long in adult individuals. Then is a regular row of plates, each corresponding to two of the preceding plates when they exist and elsewhere contiguous with the adambulacral plates. In *Scytaster zodiacalis*, these plates are larger and more square than in *Scytaster tuberculatus*. In the first, they are 2.5 mm wide and in the second, they are 1.5–1.75 mm wide. This row of plates is immediately followed by a second perfectly regular row of non-tubercular plates that identical to the preceding. In *Scytaster zodiacalis* is a row of plates at the base of the arms whose width decreases gradually and do not reach the middle of the arm. These plates are not regular, their dimensions are unequal, and there are sometimes two for one of the lower plates. Then comes another row of plates that at the base of the arms is separated from the regular ventral row by the preceding incomplete row, but then become contiguous with the ventral row. Many of these plates are tubercular and towards the end of the arm they are sometimes alternatively large and small and end by alternating with the plates of the regular ventral row instead of corresponding to them. Finally, nearly all the latter have a central tubercle towards the end of the arms in *Scytaster zodiacalis* while they are absolutely lacking in *Scytaster tuberculatus*.

For these reasons, it is already certain that we can consider *Scytaster zodiacalis* M., T., or *Oreaster Desjardinsii* Michelin, an actually distinct species. But the fact is made absolutely evident by the examination of an individual from the Red Sea in the collection of the British Museum that is nothing other than the type of *Gomophia aegyptiaca* Gray. This individual differs from the typical *Scytaster zodiacalis* only by its greater size, its diameter is 135 mm.

This is the true adult of *Scytaster Desjardinsii* and it scarcely shows any resemblance with *Scytaster tuberculatus*, its arms being infinitely longer and thinner, since R is more than eight times r. So we thus maintain on one side the separation of *Scytaster Desjardinsii* and *Scytaster tuberculatus*, and on the other hand we are led to consider only as one and the same species *Gomophia aegyptiaca* Gray, *Scytaster zodiacalis* Müller and Troschel, and *Oreaster Desjardinsii*

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<sup>35</sup> Vidensk. Meddel., 1871.

Michelin. Doctor Lütken received the latter species from the Samoan Islands. We found at the British Museum a nice specimen in alcohol from the same location that is identical in its dimensions with *Gomophia ægyptiaca* Gray. This goes to confirm the combinations of which we just spoke. It is remarkable that this individual in alcohol is labeled *Scytaster Desjardinsii* at the British Museum that has the much earlier type of *Gomophia ægyptiaca* Gray.

The discussion of synonymy that we just made makes clear the necessity of substituting the names given by Müller and Troschel and Michelin to this species the specific name published by Gray in 1840 that consequently precedes by two years the first and four years the second. *Scytaster zodiacalis* and *Desjardinsii* of the present authors should henceforth take the name *Scytaster ægyptiacus* although the name has the error of leading to believe that this species that is found from the Samoan Islands to the Red Sea by the way of Reunion Island is exclusively restricted to the coasts of Egypt.

#### 104. SCYTASTER GOMOPHIA (SP. NOV.).

There is a nice specimen in the collection of the British Museum of a species of *Scytaster* that is very near in form and general aspect to large individuals of the preceding species. We propose to give it the name *Scytaater gomophia* in memory of the genus created by Gray for it.

There are five arms, thin and pointed, but a little less long than in *Scytaster ægyptiacus*, because R, instead of being a little larger, is to the contrary here a little less than eight times r. The adambulacral spines are here very clearly arranged in at least two rows. Each adambulacral plate has four furrow spines (three towards the end of the arms) and three in the inner subambulacral row. The furrow spines are a little close together, slightly thinner at the end. The spines of the inner subambulacral row are larger, arranged slightly oblique on the plates so that they appear at first to form several rows instead of one. These spines are obtuse and resemble in no way the granules of the ventral surface. Outside the row of adambulacral plates is immediately a row of ventral plates of the same size. Very frequently, two consecutive plates of this row are fused to form one. They decrease as they approach the end of the arm and end before reaching three-fourths the length of the arm. From the interbrachial angle extends a row of small plates wider than the preceding, but there are scarcely four or five for each arm and nearly corresponding to the ten first plates of the preceding row. The plates that follow also form a longitudinal row but is complete. They are larger than all the preceding and, in general, the length of each corresponds to two plates of the first row except when two of the latter are fused into one. In this case, there is a correspondence in the two rows. The plates are elliptical, a little convex and touch at the ends of their large axes. The ends of their small axes are tangent to a new row of plates that are exactly similar and form the lateral surface of the arms. Between the points of contact of the various plates of the two rows are consequently spaces in the form of a lozenge with curved sides. The sunken spaces are the first papular areas. The dorsal surface proper begins then. It is formed by a very regular hexagonal reticulum of calcareous trabeculae whose nodes have conical tubercles that are very projecting, nearly hemispherical and not conical as in *Scytaster ægyptiacus*. The entire skeletal system is entirely covered with very large granules. The tubercles themselves are also entirely covered with granules instead of being naked at the end as in *Scytaster ægyptiacus*. These tubercles can be considered as forming three principal alternating rows. Between the tubercles of the rows are, with little regularity, a large number of secondary tubercles. On the disk — the small madreporite with a half-r of the distance from the center, being as usual placed behind — is a slightly elevated central

tubercle, to the left of which is the anus. Then five similar apical tubercles and finally ten larger tubercles, alternately apical and interradial: d = ca. 135 mm.

Country: New Caledonia (Cuming).

#### 105. SCYTASTER OBTUSUS (NOV. SP.).

Five irregular arms, nearly cylindrical, with a very obtuse end. R is a little greater than four times r. — Each adambulacral plate has three furrow spines that are followed by a row of large granules simulating a new row of spines. Immediately afterwards begins the general granulation that is very uniform on the entire surface of the body of the animal. After the row of adambulacral plates is a row of plates that decrease rapidly in width towards the middle of the arms where they soon disappear. This row of plates is followed by another still shorter and having only four or plates leaving the interbrachial angle. Then is a complete row of elliptical plates, each corresponding to two plates of the preceding rows and decreasing to the end of the arms. Between these plates, in the interval above them from their point of contact, are the first papular areas, bordered outside by a second row of plates similar to those of the row just described and that can be considered as forming a second row of marginal plates. Above this latter row of plates begins the dorsal surface proper, composed of irregularly arranged ossicles. Some are slightly larger, more projecting and spaced than the others. The madreporite is small and located immediately outside the center of the plates that surround the central plate of the disk

This species, from the Philippine Islands, is distinguished from *Scytaster variolatus* by the form of its arms and shallow papular areas that have each only four or five pores.

British Museum.

#### 2<sup>nd</sup> SECTION. *Narcissia* Gray.

#### 106. SCYTASTER CANARIENSIS.

1839. *Asterias canariensis*, d'Orbigny. *Voyage de Webb et Berthelot aux îles Canaries*, p. 148, *Echinod.*, pl. I, fig. 8 to 5.

1840. *Narcissia Teneriffæ*, Gray. *Ann. of Nat. Hist.*, v. .

1862. *Scytaster canariensis*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p 368.

1866. *Narcissia Teneriffæ*, Gray. *Synopsis of the Ast.*

The history of this species is very interesting. It was perfectly figured in 1839, but without sufficient description, by d'Orbigny in the *Voyage aux îles Canaries* by Webb and Berthelot. So it received the name *Asterias canariensis*. One year later Gray briefly described it with the name *Narcissia Teneriffæ*. No one since had any suspicion of the identity of the types of d'Orbigny and of Gray. In 1862, after examining the type of d'Orbigny, Dujardin and Hupé placed this species among the *Scytaster*. But the fact passed unnoticed, so well that in 1864 and again in 1871, Doctor Lütken, without mentioning *Narcissia Teneriffæ*, considered as probable the identity of *Chaetaster longipes* Retz., a species of the Mediterranean, with *Asterias canariensis* of d'Orbigny. Comparison of the type of *Narcissia* Gray with the figure of d'Orbigny leaves no doubt about the identity of the asteroids described separately by the authors. They are a species very different from *Chaetaster longipes* and should be given a particular section of the genus *Scytaster*. What we have said makes evident the necessity of giving a complete description.

The general form of this *Scytaster* is remarkable because of the small expanse of the ventral surface, the height of the triangular form of the arms, that are moreover very elongated and gradually taper from the base to the tip. They recall that of *Linckia (Phataria) unifascialis*. The size is however greater.  $R = 134$  mm;  $r = 15$  mm;  $R = \text{ca. } 9 r$ ; diameter of the arms at the base, 15 mm; height at the same point, 25 mm.

The ambulacral grooves are bordered by three rows of spines. Each ambulacral plate has five or six furrow spines, very close to each other, truncate at the end and flattened obliquely. Then comes a row of six spines exactly like the first; then a third row of prismatic spines a little smaller than the others that make the transition to the granules that cover the skeletal pieces on the entral surface. These spines are so close together that the rows of a plate encroach on the adjacent plates. Those nearest the mouth squeeze those that extend from it so that the different rows are dispersed a little obliquely in relation to the axes of the arms. Immediately outside this last row are three series of slightly irregular plates, approaching the rectangular form, that are very close to each other and decrease in size as they approach the end of the arms. A still shorter row reaches the first seventh of the arm. The external row extends only a little beyond the first basal fourth of the arms. Outside is a row of larger, rectangular plates, 4.5 mm in height, decreasing in height as they go to the end of the arms. There is no papular pore between the plates of these rows. Immediately outside this row of rectangular plates is a second identical row on which is superimposed. Each of these two rows has fifty to fifty-five plates on each arm.

All these plates and those of the ventral surface are covered with large, prismatic granules that become larger and larger as the ambulacral groove is approached, without the diameter of those nearest the groove exceeding twice the diameter of the finest granules that cover the dorsal surface and the dorsal marginal plates. All are the same size.

The dorsal surface of the arms is ridged. Its two flat sides meet in a narrow angle, but the median line is blunt. This keel is less and less in the last fifth of the arm. The plates that form the dorsal surface are irregular unequal polygons and decrease noticeably in size towards the end of the arm. They are larger near the brachial keel. All are uniformly covered with very dense round granules. Between the plates are some isolated papular pores. There are no pores along the median line of the arms and on the last quarter of the arms. The madreporite is small (3 mm in diameter), with fine, dense groove diverging from the center. It is located near the first upper third of the oblique line that goes from the top of the disk and the interbrachial angle. The anus is a little excentric and located to the left in placing the madreporite behind.

A single specimen from the collection Michelin without indication of locality. The type of Gray in the British Museum came from Teneriffe. Another individual from Lancerote Island.

## XVI. GENUS FROMIA (GRAY, 1840).

This genus appears sufficiently distinct from the true *Scytaster* to be separated from it. While the latter are undeniably close to *Linckia*, *Fromia*, whose type for us is *Asterias milleporella* Lamarck, makes, to the contrary, the transition between *Scytaster* to *Pentagonaster*. We can characterize them by their dorsal ossicles in the form of round completely contiguous plates, their very distinct rectangular marginal plates forming a ventral series and a dorsal series, and their isolated papular pores in the intervals of the plates. All these characters connect them to *Pentagonaster*, or at least to some of them from which they separate by the very distinct pointed arms with rectangular sides, a dorsal surface that is sometimes convex so that their physiognomy recalls a little the *Nardoa* of Gray.

1<sup>st</sup> SECTION. SKIN ENTIRELY COVERED WITH DENSE GRANULATION.

*Fromia* Gray

107. FROMIA MILLEPORELLA.

1761. Seba. *Thesaurus*, III, pl. VIII, n° 10, *a*, *b*.  
1816. *Asterias milleporella*, Lamarck. *An. sans vertèbres*, v. III, p. 253, n° 35.  
1840. *Fromia milliporella*, Gray. *An. and Mag.*, v. VI, p. 286<sup>36</sup>.  
1842. *Scytaster Pistorius*, Müller and Troschel. *System der Asteriden*, p. 35.  
1845. *Scytaster milleporellus*, Michelin. *Faune de l'île Maurice. Mag. de zool.*, p. 22.  
1862. *Scytaster Pistorius*, Dujardin and Hupé. *Suites à Buffon, Echinodermes*, p. 367.  
1865. *Fromia milleporella*, Gray. *Synopsis*, p.14.  
1867. *Linckia (Scytaster) milleporella*, von Martens. *Ostasiatische Echinodermen*, Troschel's *Archiv für Nat urgeschichte*, Jahrg. XXXII, Vol. 1, p. 69.  
1869. *Linckia pistoria*, von Martens. *Cl. v. d. Decken's Reise. Seesterne und Seeigel*, p. 130.  
1869. *Scytaster Pistorius*, Edm. Perrier. *Pédicellaires*, p. 62.

The synonymy of *Scytaster milleporellus* has been obviously very confused with that of *Scytaster pistorius* of Müller and Troschel. In his *Synopsis of the Genera and Species of Starfishes* of 1840, Gray gave his *Fromia milleporella* as a synonym of *Asterias milleporella* of Lamarck and cited at the same time figures 10, *a* and *b* of plate VIII of Seba. He accepted the identity of the two species. Müller and Troschel, in 1842, made the *Asterias* figured by Seba a species distinct from the *Asterias milleporella* of Lamarck and called it *Scytaster pistorius*. At the same time they considered, as being identical to it, the *Fromia milleporella* of Gray, who had referred to the figure of Seba, and the *Asterias milleporella* of Lamarck that became for them a separate species that took the name *Scytaster milleporellus*. In 1866 Gray publishing a new *Synopsis*, only adopted the synonymy of Müller and Troschel and indicated his *Fromia milleporella* as a synonym only with *Scytaster pistorius* M., T., while it was previously synonymous at the same time with *Scytaster milleporellus*. But it is quite evident that Gray accepted this new synonymy and we can attach no importance to this modification of the ideas of the English author. The comparison of the two descriptions found in the *System der Asteriden* gives  $R/r = 3$  in *Scytaster Pistorius*  $R/r = 4.5$  in *Scytaster milleporellus*. The arms of the latter species would be thus longer than those of the preceding. The two rows of plates that we see at the base of othe arms, outside the adambulacral plates, do not reach the end of the arms in *Scytaster milleporellus*. The internal seems to reach it in *Scytaster pistorius*. However, Müller and Troschel did not expressly say it. Finally, in *Scytaster milleporellus*, the dorsal marginal plates are unequal so that the border of the arms appears knotty. All the plates are, to the contrary, equal and longer than wide or square in *Scytaster pistorius*. In trying to evaluate the distinctive characters that Müller and Troschel reported, we see very quickly that they have nothing absolute and are of those that have the most variation in the asteroids of this group. The distinction of the two species after their description would thus be difficult in a large number of cases. In fact, I found at the Museum, under the name of *Scytaster pistorius*, M., T., some individuals from the Red Sea that it was impossible for me to distinguish from other individuals from the same location that had been identified as *Scytaster milleporellus*. It is to be noted moreover that the *Fromia milleporella* of Gray came from the Red Sea, Mauritius and the

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<sup>36</sup> Gray incorrectly wrote *Scytaster posterius*.

Indian Ocean, i.e., the same localities of the specimens of the Museum. There is every reason to believe that these, some of which agree well with the figure of Seba, and types of *Fromia* of Gray are identical. I was able to assure myself of that directly at the British Museum. On the other hand, among the thirty-four specimens of the Mesum are two named by Lamarck. These specimens clearly determine the species of Lamarck and show that it is identical to the species of Gray. It is important to describe them in a complete manner.

In the largest of the two individuals,  $R = 29$  mm;  $r = 9$  mm;  $R = 3.2 r$ ;  $d = 10$  mm; flat body above and below; thickness, 24 mm. The spines of the adambulacral plates are in two rows. There are three or four furrow spines on each plate and two or even three on the first subambulacral row. Outside this row of spines at the base of the arms are two rows of wider and longer plates, separating the row of spines of the adambulacral plates from a first row of longer and wider marginal plates. The most internal of these rows extends nearly to the end of the arms. The most external, decreasing gradually in width, disappears towards the end of two thirds of the arms. At the very base of the arms commences a third row of three or four plates for each arm. Between the first and second row of plates are papular pores. These pores are isolated at the corner of each plate. A general granulation, formed of larger polygonal granules in the middle of the plates covers the ventral surface. No plate has projecting tubercles in its middle. The border of the arms has a double row of granulose marginal plates that are square or a little longer than wide. There are fifteen on the ventral side, twelve on the dorsal side in the small specimen; sixteen on the ventral side and thirteen on the dorsal size in the large specimen. All these plates, whose length is a little more than 2 mm, are obviously equal and decrease slightly as they approach the free end of the arms. Between these two rows of plates, there is a pore at most of the angles between them. The dorsal surface is formed of rounded plates, granulose, having an average a little less than 2 mm in diameter. At the base of the arms, these arms that are obviously circular, form about five rows. But the lateral rows stop successively and the median row alone reaches the end of the arms. The madreporite is a little larger than the dorsal plates and located a little closer to the border of the disk than its center.

The result of the comparison of this description with that of *Scytaster pistorius* M., T., that the latter agrees perfectly to the individual types of *Asterias milleporella* Lamarck, individuals whose authenticity is absolute. It agrees equally with one of the individuals labelled *Scytaster pistorius* in the collection and also with ten individuals from the Red Sea that differ in some variation in the number of marginal plates that can be increased to fourteen for the dorsal plates and eighteen for the ventral plates. There is also in some individuals some granules of the latter of these plates so large they look like small tubercles. The dorsal surface of the arms of the animal can moreover become obviously convex. Three individuals from New Caledonia donated in 1872 by Balansa and ten individuals from Madagascar, one with four arms in the collection Michelin, have these characters. Another individual from Reunion Island, donated in 1862 by Maillard, and two individuals from the collection Michelin with arms slightly convex and labeled *Scytaster pistorius* are in this group.

Five individuals from the Red Sea have in common dorsal marginal plates that are unequal in terms of their convexity and their dimensions. As a result, the borders of the arms are irregularly bossed. In one of these individuals, the alternation of relatively granulose, convex plates with smaller, flat plates is nearly perfect. In the median line of the arms, some plates, particularly towards the end, are distinguished from the others by their convexity and dimensions. These plates are not contiguous and are separated by smaller ones. Finally, some smaller and more projecting plates can be irregularly distributed on the surface of the arms. In these different plates, the

granules are larger than elsewhere. In these individuals there are four adambulacral spines near the mouth, then three furrow spines. There are two or three spines in the subambulacral row. But it most often happens that one of them, in the middle, takes preponderance so that the others are only simple granules. In the largest individual,  $R = 31$  mm,  $r = 9$  mm,  $R = 3.5$  r.

These individuals are those that are separated a little from *Asterias millepora* Lamarck and approach *Scytaster milleprellus* Müller and Troschel, while the others are nearer *Scytaster pistorius* than the others. But if we consider that all these individuals have the same provenance, they are distinguished, in all, only because some have some irregularities in their skeleton, we reach the conclusion that this is a matter of simple accidental variations and that the two types just discussed are not specifically distinct. The last one does not correspond exactly to *Scytaster milleprellus* Müller and Troschel, because even in individuals with unequal marginal plates, the ventral surface has three series of plates, of which one extends nearly to the end of the arms, another up to the last third, and the third with only four or five plates that goes up to a sixteenth of the arms. The length of the first two rows corresponds to that indicated by Müller and Troschel for their *Scytaster pistorius* and not to that they indicate for *Scytaster mulliporellus*.

In summary, my conclusion is that the *Asterias milliporella* of Lamarck is identical not to *Scytaster milliporellus* of Müller and Troschel, but to their *Scytaster pistorius*, identical itself with *Fromia milleporella* of Gray, whose specific name should consequently be conserved. The name *Scytaster pistorius* should be suppressed, as having been given to a species already named by Lamarck.

#### 108. FROMIA INDICA.

1869. *Scytaster indicus*, Edm. Perrier. *Recherches sur les Pédicellaires*, p. 63.

Six arms, slightly flattened. Adambulacral spines arranged in three rows, at least near the mouth. There are two or three furrow spines inclined towards the ambulacral groove, flat and a little enlarged at the end. Then come two spines of the same form, but a little shorter and slightly inclined backwards. Finally are two or three spines that make the transition to the granules of the ventral surface, but whose dimensions however are greater. Outside this external row of spines are two rows of nine to thirty circular plates covered with large and projecting granules. Isolated papular pores occur between these plates. The marginal plates, sixteen on each arm, are square and covered with a granulation a little denser and finer than the granulation of the ventral plates.

The dorsal plates are of two kinds. The large ones (3 by 2.5 mm) are elliptical with the large axis transversal in relation to the axis of the arms. There are two or three irregular rows of these plates that are separated from each other by smaller plates, separated by isolated papular pores. The madreporite is small, with few wide sinuous grooves. It is located nearly equidistant from the center to the edge of the disk.  $R = 26$  mm,  $r = 9$  mm,  $R = 3.4$ ; diameter of the arms at their base = 9 mm; anus central.

The only individual in alcohol is indicated as coming from the sea of the Indies.

#### 109. FROMIA BALANSÆ (SP. NOV.).

Five arms, convex above.  $R = 30$  mm,  $r = 10$  mm,  $R = 3$  r. Thickness of the arms at their base = 7 mm. Diameter of the arms at their base = 10 mm. Adambulacral spines arranged in two rows. Each plate has three furrow spines that are close together, truncate at the top and perfectly equal.

Immediately behind and in contact with them are two shorter spines in the form of large granules. Then is a row of granulose plates, square, that decrease in size as they approach the end of the arms and form a row that disappears as it approaches the end. A second row of similar plates diminishes gradually and stops two-thirds of the arms. Finally a third row stops at the end of the first basal fourth. In all these rows, each plate has a papular pore at each of the angles. All the plates are covered with polygonal granules larger in the center of the plate than on the borders. The marginal plates, forming a double row, are much larger than the ventral plates and nearly square, a little irregular. There are twelve to fourteen dorsals and seventeen ventrals.

The dorsal plates, also smaller, more or less convex, irregular and unequal, form five rows from one border to the other. Some are very convex to give the surface of the arm a slightly pocked aspect. The madreporite, scarcely visible, is surrounded on the outside by larger granules.

Color brownish yellow in wine spirits.

A single individual in very good condition from New Caledonia. Balansa. 1872.

#### 110. FROMIA MONILIS.

18.... *Scytaster monilis*, Valenciennes. Manuscript label. Coll. Mus.

1842. *Scytaster milleporellus*, Müller and Troschel. *System der Asteriden*, p. 35.

1862. *Scytaster milleporellus*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 366.

1866. *Nardoa*..... Cited with the suite of the genus *Nardoa* by Gray. *Synopsis*, p. 15.

1866. *Linckia milleporella*, von Martens. *Ostasiatische Echinodermen, Troschel's Arch. für Naturgeschichte*, Jahrg. XXXII, Vol. 1, p. 60.

1869. *Linckia milleporella*, von Martens. *C. von der Decken's Reise. Seesteren und Seeigel*, p. 130.

1869. *Scytaster milleporellus*, Edm. Perrier. *Pédicellaires*, p. 62.

We find in the collection of the Museum an individual that corresponds exactly, not only to the description of *Scytaster milleporellus* of Müller and Troschel of which it is probably the type, but also to the more detailed description that von Martens gave of this species in 1866 in his *Ostasiatische Echinodermen*. The specific identity is thus without doubt, but we have seen that it makes absolutely necessary, according to the rule of priority, to change the name of *Scytaster milleporellus* M., T. As this individual in the collection has the name of *Scytaster monilis*, this is the name we propose to preserve.

*Fromia monilis* is clearly distinguished from *Fromia milleporella* (*Scytaster pistorius* M., T.) by its longer, thinner arms,  $R = 4.5 r$ .  $R = 31$  mm.  $r = 7.5$ . The adambulacral plates have two equal spines and outside a single spine, much larger than the preceding, cylindrical and ending in an obtuse point. These isolated spines on each plate form the second row. The flat arms are bordered by a double row of plates, longer than wide. There are fifteen of these plates in the lower row, nine in the upper row, separated by a very large space, especially towards the end of the arms. The arms have a uniform appearance. Between the row of ventral marginal plates and the adambulacral row of spines, there are only two incomplete rows of plates. The internal row extends to the last third of the arms. The external row does not extend a fifth of the length. On the dorsal surface, rounded plates making up the skeleton no longer form three rows at the base of the arm. Only one of these rows, the median, reaches the end of the arms. All these characters distinguish in a very clear way this species from the preceding. The only specimen in the Museum, which appears to be very old, has no information on locality or date. It appears however, in spite of the indication by Müller and

Troschel, to have been entered into the collection only after Lamarck. The specimen described by von Martens came from Amboine.

2<sup>nd</sup> SECTION. NAKED SKIN COVERING THE SKELETAL PLATES THAT HAVE SMALL ARTICULATED SPINES ON THEIR BORDER. *Metrodira* (Gray).

Müller and Troschel referred to *Metrodira subulata* Gray a specimen in the collection of the Jardin des Plantes. It was after examination of this specimen that they combined *Metrodira* with their *Scytaster*. But the individual they examined in the collection of the Museum of Paris is very poorly preserved and underwent brushing that made it unsuitable for study. I have seen in the British Museum not only the types of Gray but also other perfectly preserved individuals of different provenance of *Metrodira subulata*. I affirm that after this examination, I have no doubt on the subject of the affinities of true *Metrodira*. These asteroids have a skeleton form of thin calcareous plates, circular, disjointed, with a few small spines on the border, conical, similar to those that are developed on the ossicles of some *Echinaster*, e.g., *Echinaster eridanella*. These ossicles are covered with a thin dermal membrane without granules that make it easy to see the ossicles that it covers. In *Fromia*, to the contrary, the ossicles are always more or less massive, the entire body of the animal is covered with a dense granulation and spines are completely lacking. As a consequence, perhaps it would be advantageous to preserve the generic section of Gray.

111. METRODIRA SUBULATA.

1840. *Metrodira subulata*, Gray. *Ann. and Mag. Nat. Hisgoryo*, v. VI, p. 282.

1842. *Scytaster subulatus*, Müller and Troschel. *System der Asteridea*, p. 12.

1862. *Scytaster subulatus*, Dujardin and Hupé. Suites à Buffon. *Echinodermes*, p. 368.

1866. *Metrodira subulata*, Gray. *Synopsis*, p. 12.

1869. *Scytastere subulatus*, Edm. Perrier *Pédicellaires*, p. 62.

Here is the description of the dried example in the collection of the Museum that has no indication of locality or origin that was studied by Müller and Troschel.

Body flat,  $R = ca. 7 r$ . Arms appear equally flat above and below, elongated, and ending in a point. Each of ambulacral plates, which form a single row between the ambulacral groove and the arms, seems to have a transverse row of three long, thin isolated spines that appear to have been in part covered by the skin. Unfortunately, the specimen having been brushed, it is difficult to resolve this question. The marginal plates form two superimposed rows as in *Fromia*. These are longer than wide and the lower ones are triangular, their end being alternately directed outward and inward. There are no supplementary rows between them and the dorsal plates. There are forty-five to fifty plates in each arm. The dorsal plates, forming at most three irregular rows, are granular. Each has three or four thin, pointed spines on their border. The small, projecting madreporite is equidistant from the center and border of the disk.  $R = 45 \text{ mm}$ ,  $r = 6 \text{ mm}$ ,  $R = 7.5 r$ . Diameter of the base of the arm = 6 mm.

This individual was probably already in the collection at the time of Lamarck and is very reminiscent of *Stytaster subtilis* of the seas of China, described and figured by Doctor Lütken.

The individuals in the British Museum do not correspond completely to this description. The difference that we can point out between them and the individual in the collection of the Jardin des

Plantes do not appear to me to be in the limits of those that can be explained by the state of preservation of the specimens. Nevertheless, we cannot think of creating a specific name for this isolated individual, possibly altered and of unknown provenance in the collection of the Jardin des Plantes. In the case where new specimens show in a more complete manner that it is a distinct species, the individuals of the British Museum that should retain the name *Metrodora subtulata*, that given them by Gray in 1840, the individual of the Museum of Paris having been assimilated only in 1842 by Müller and Troschel. It is thus important to give a complete description of the types of Gray.

There are five arms, *regularly rounded*, thin, pointed, regularly, conical at the base and end. The interbrachial angles are a little blunt. R is slightly greater than eight times r. The dorsal skeletal plates, all rounded, finely granulated, are covered a thin skin. Each has on their border one to three small conical spines arranged variably, but vertical. These plates are contiguous but not imbricated. From the ambulacral groove are first the adambulacral plates, square in form. Each has two divergent small furrow spines that protrude into the ambulacral groove. Behind these are two or even three groups of spines. Then is a slightly larger isolated spine. Finally, at the external border of the plate, another spine, notably larger than all the preceding although still of small dimensions. Together these latter spines form a perfectly regular continuous row. After the adambulacral plates is a row of elliptical plates that extend up to the end of the arms. The large axis of this plates is longitudinal. The first of them do not have spines. The following ones have one on the apical border. Most of the others have two. A row of similar plates and similarly armed limits the upper surface of the arms. These plates are exactly superimposed on the first in most of the length of the arms. But towards the base, *the two rows are separated* in young individuals by a row of smaller plates, a little irregular. Up to three other rows can be added in adults that, moreover, in no case reach the end of the arms. The dorsal plates are rounded, slightly smaller than the marginal, and can be considered as forming three or four alternate rows. Most have a spine directed toward their apical border. On the disk is a central plate, to the left of which is the anus. Next are five plates, arranged in a circle around it, each corresponding to an arm. Those near the anus have, like the central plate, a small spine at the point nearest it. These five plates are surrounded by a concentric circle of ten others, alternatively apical and interbrachial. The lower interbrachial to the left, near the anus, has three or four small spines on its anal border. The posterior interbrachial is the small madreporite, having few grooves and sometimes with small spines. The apical plates of this circle are a little larger than the interbrachials. The disk is completed by two plates located between each interbrachial and the corresponding marginal.

The type specimen comes from Migupon, the others from the Torres Strait, George Sound, and Australia.

## XVII. GENUS *FERDINA* (GRAY 1840).

This genus, very distinct from the preceding, seems to have been forgotten since Gray. It is characterized by its adambuaral armature, composed of a single row of spines, on the base of which is ordinarily extended the ventral granulation. It has only two species, whose general aspect recalls a little that of a *Scytaster variolatus* with short arms. But the characters of the adambulacral armature do not allow them to be confused.

*Scytaster Kuhlii* of Müller and Troschel appears to have an analogous constitution of the ambulacral groove. But we have not examined it and we cannot say if it really appears in the genus *Ferdina*. It seems moreover distinct from the two species of Gray.

## 112. FERDINA FLAVESCENS (GRAY).

A single row of adambulcral spines, more projecting than in *Linckia*, and very distinct granulations on the ventral surfaced. Each adambulcral plate has two of these spines that are flat, truncated at the end and perfectly equal. These plates are small, rectangular, very distinct in spite of the fine granuation that covers them and that extend to the base of the spines of the groove.

After them is an irregular row interrupted in places by small plates of very ordinary rectangular form. Then are two irregular rows of larger plates, but varying greatly in form and size. The external row does not reach the middle of the arms. There is no papular pore between these plates. They make up the ventral and lateral surfaces of the body. All the dorsal surface is formed of very convex, nearly gibbous, rounded plates between which are only completely isolated papular pores. There are, at maximum, five or six pores on the periphery of each plate. All these plates, as well as those of ventral, are covered with a uniform granuation composed of flat, polygonal granules. The anus is central and surrounded by four projecting plates in the only specimen I have seen.

The madreporite has the form of a rectangle, whose median line is oblique in relation to the ray of the disk. It seems to share two of them with one of the convex plates of the test, as the plates next to it are mingled with it.

In summary, this species is remarkable the the irregularity of the convex plates, very granulated, that form the dorsal surface and by the isolation of the papular pores. These characters are similar to the *Fromia* of Gray, but it separated by the simplicity of the adambuacrual armature and the absence of two rows of marginal plates that are observed in this group.

The arms are thick, short and obtuse.  $R = 35$  mm,  $r = 11$  mm,  $R = 3r$ . Diameter of the bae of the arm = 13 mm. Height of the disk = 7 mm.

A single specimen from the collection Michelin, confused with *Scytater variolatus*, and of unknown origin (Mauritius, Gray).

## 112. FERDINA CUMINGII.

1840. *Ferdina Cumingii*, Gray. *Ann. and Mag. of Nat. Hist.*, v. VI.

1866. *Ferdina Cumingii*, Gray. *Synopsis of the Asteridæ in British Museum*.

Five irregular arms, obtuse at the end, with nearly vertical sides.  $R = ca. 3r$ ,  $Dm = 53$  mm. On the ventral surface, each adambulacrual plate has two cylindrical spines up to the base where the ventral granulation occurs that is elevated a little above them, the latter granules being a little larger. Behind the adambulacrual plates is a row of plates two times larger. Then, corresponding to the interbrachial angles, three plates arranged in a triangle. Finally, a row of absolutely marginal plates similar to those that are contiguous with the adambulacrual plates. Above this latter, forming the side of the body, is an identical second row. Finally begins the dorsal surface, formed of irregular ossicles, smaller than those of *Ferdina flavescens*, some strongly convex, nearly tubercular. The most developed are located on the borders of the arms and on the median line. Between the dorsal ossicles are isolated papular pores. The madreporite is small, scarcely visible. All the body is covered with a uniform granulation finer than that of the preceding species.

Dried specimens at the British Museum coming from the wet coast of Colombia.

OBSERVATIONS REGARDING THE PEDICELLARIAE OF THE LINCKIADÆ. —

Among the facts of some importance relative to the family Linckiadæ, there is one to which we believe we must insist here, from the characteristic point of view. This is the existence, in various species of this family of the special form that we have designated *excavate*. Although von Martens had already described these organs in 1867 in a manner sufficiently recognizable in his *Linckia pustulosa*, the fact is isolated, the organs described come from ordinary forms of pedicellariae. von Martens appears to have kept some doubt about their identification. We did not attach great importance to it. The same author had reported pincer pedicellariae on the skin of his *Leiaster speciosus*. Dr. Lütken made the same remark, in 1871<sup>37</sup>, that he did not know, no more than I, of pedicellariae in the genera *Linckia*, *Scytaster* and *Ophidiaster*. It is thus necessary to confirm here the very real existence of organs of this type in the family *Linckiadæ* where they are shown with characters that distinguish them easily from other known forms of pedicellariae. At most we could cite in *Paulia horrida* Gray and in *Pentagonaster pulchellus* by the same author something that vaguely recall them. These observations confirm our opinion relative to the systematic value of characters furnished by these organs, a value that is not limited, as might have been thought by Stimpson, for example, to the distinction of close species but that can be raised to that of families. It is however necessary to state this proposition in the following way: "Pedicellariae can be missing in a family but, when they exist, they are always certain determined types that are constant for the entire family, but different from one family to the other." This does not exclude the coexistence in the same individual of several types of pedicellariae. This is how the Asteriadæ have, in general, have only — until now at least — *straight pedicellariae* and *crossed pedicellariae*, *Goniasteridæ* have only *pincer pedicellariae* and *valvular pedicellariae* with branches implanted in special alveoli, etc. It is to note the *excavate pedicellariae* characteristic of *Linckiadæ* have still been found only in the genus *Ophidiaster* as understood by Gray, Lütken and myself. It would be useful to know what are the *pincer pedicellariae* of *Leiaster speciosus* of von Martens, the true *Leiaster* of Peters appearing to us to form a single section of the genus *Ophidiaster*.

I shall add that, since the printing of the preceding pages, I have been able to confirm directly, thanks to the extreme kindness of Doctor Lütken, that there really exists *excavate pedicellariae* in types of his *Ophidiaster granifer* and *cribarius*, only these organs easily escape observation in individuals preserved in alcohol. The latter is very decidedly different from our *Ophidiaster Germanii* and is distinguished precisely by its pedicellariae with very narrow and edentate cupules.

*Scytaster Galathæ* Lütken resembles greatly our *Scytaster Novæ Caledoniæ*. Nevertheless its arms are thinner, its marginal plates relatively larger and its ambulacral groove slightly differently constructed. These differences, the absence of intermediate forms and the distance of the localities of origin (Nicobar Islands and New Caledonia) decided me to preserve until now a new order of these two species.

Finally, *Scytaster subtilis* Lütken is a form extremely close to *Metrodira subulata* Gray. This section of *Metrodira*, that perhaps merits forming a distinct genus, thus includes at least two species.

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<sup>37</sup> Videnskabilige Meddelelser, p 266.