

STUDY ON THE GEOGRAPHICAL DISTRIBUTION OF ASTEROIDS

By

EDMOND PERRIER

Translated by

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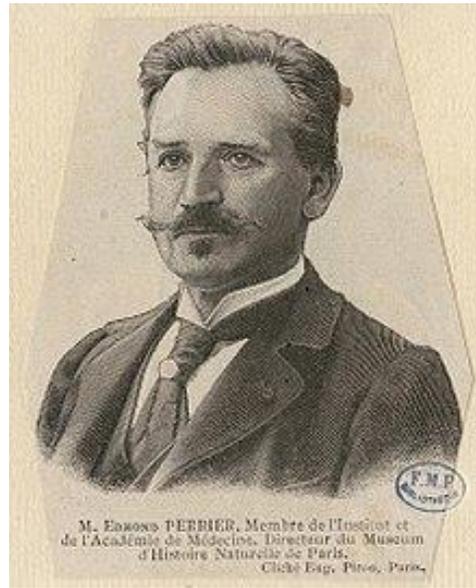
Translation of E. Perrier. 1878. Étude sur la repartition géographique des astérides. Nouvelles Archives du Muséum d'Histoire Naturelle. Paris. Second Series, Volume 1. 1–108.

Translator's Note

Perrier's work is based on the taxonomic designation of families, genera and species at that period. That taxonomy now obsolete. Perrier frequently noted misidentifications, duplications, and inadequate descriptions of species and lack of collections in many regions. He stated that future work would result in many changes. The work is of historical interest because it indicates the state of asteroid taxonomy and knowledge of asteroid distribution in the latter half of the nineteenth century.

I have retained Perrier's spelling of taxonomic names. Family name endings are sometimes inconsistent. The manuscript appears not to have been carefully proofed. There are some obvious errors. I have not attempted to correct these, but in several instances I have indicated "sic".

Edmond Perrier



Jean Octave Edmond Perrier (9 May 1844–31 July 1921) was a student at the *École Normale Supérieure*, where he had classes under Henri de Lacaze-Duthiers. He earned his doctorate in 1869. He was appointed to the chair of Natural History (mollusks, worms and zoophytes) at the *Muséum National d'Histoire Naturelle* in 1876. He was director of the *Muséum* from 1900–1919.

Perrier was interested in the evolutionary theories of Lamarck and Darwin. In his study of the geographical distribution of asteroids, he stated he hoped it would contribute to arguments for or against the “doctrine of transformation”.

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In the present state of science, we are especially interested in research on zoological geography regarding animals whose limited means of location force them to live in limited areas. We could suppose in fact that the effects of the environment then act on the organisms with their maximum intensity because the environment is especially all the more homogeneous as the area is itself more restricted. We investigate with care the variations in specific analogous forms that occur from one locality to another and we hope to highlight the degree of plasticity of these forms, to find incontrovertible arguments for or against the doctrine of transformation.

Terrestrial animals lend themselves in general much better than marine animals to this type of research. Among these latter, those that most abandon the benthos, those whose existence is at least temporarily pelagic are certainly the least appropriate for attempts to determine the influence of the environment. We have known for a long time that their area of distribution is in general enormous and the influence of marine currents is nearly always preponderant in their type of distribution. But why, in the same group, do we not see all the forms specific to one locality extended over the same area, why some of them remain absolutely restricted while others have a marked tendency to become cosmopolitan. What forces, what influences, what correlations between the physical world and the organism impose on some species impassible barriers and not on closely related species? These are questions whose answer is far from being reached. This is why all naturalists who seek to assemble facts to answer this question can be assured to make some service to science. On the other hand, species with a wide distribution only rarely occur, wherever they are, in identical conditions. Do they remain absolutely invariable or can we discover in them some modifications in relation to the differences in relation to the environment? This remains a question of great importance for the theory of speciation.

From these various points of view, the history of geographical distribution of asteroids shows us some interesting facts. However, this story needs to be completed. The number of new species with each voyage adds to the catalog shows that we perhaps are far from having the final number. A very large number are still doubtful, either because the descriptions leave much to be desired or because their range is still uncertain. The origin of many others is unknown, and we cannot say, on the other hand, that our documents are sufficiently complete to fix in a definitive manner the area of distribution of some of the best known forms. Finally, we have only very few exact facts on the bathymetric distribution of these very interesting echinoderms.

Regarding the causes of the mode of dissemination of the species, care is naturally needed. In the adult state, starfish are animals with very slow locomotion: they move on the bottom of the seas but are incapable of swimming. Most of the larvae known until now are, to the contrary, pelagic. Of small size with very strong swimming structures, they can be transported great distances by currents that, in their continuous development, they sooner or later encounter. But not all are the same. The larvae of *Asterina gibbosa*, to which Lacaze-Duthiers has recently called attention, appears much more sedentary. It is evident *a priori* that the organization of the larva should have their counter effect on the area of distribution of the corresponding species. Unfortunately, the larvae of only a very few species is known. The larvae of *Asterias*, *Cribrella*, *Echinaster* and *Asterina* are known, but no one has yet reported the larval of either *Linckiadae*, *Astropectinidae*, or *Goniasteridae* that make up however groups of great importance. We are, moreover, ignorant of the variation that can occur in the same genus.

In spite of all these gaps, in spite of all these *desiderata*, it is no less useful to try to synthesize the information accumulated up to now. This is the goal of this work, a natural complement to the Révision du Stellérides du Muséum that I have previously published.

HISTORICAL REVIEW

There is no comprehensive work yet published on the subject that I undertake. But eminent naturalists have carefully considered diverse local faunas. From 1780, Fabricius reported some species from Greenland in his *Fauna Groënlandica*. O.-F. Müller described those of the Danish coast. Since this period, the asteroids of the northern and boreal seas have been the subject of the numerous works of Düben, Koren, Michael and Ossian Sars, Steenstrup and especially Doctor Lütken, who has brought out the distinguishing characteristics of the echinoderms of Greenland, Finland, and Scandinavia and has, moreover, assembled numerous records relative to their bathymetric distribution. On the other hand, we recognize the investigations of Pennant, Fleming, Forbes, Normond on the species of Britanic seas. Unfortunately, the other published documents on the European coast of the Atlantic consist only in a work of Desmoulins, dating from 1832 and in a catalog of echinoderms of the Bay of Biscay, published in 1872 by Doctor Paul Fischer in the Actes de la Société linnéenne de Bordeaux. For the Mediterranean, the bibliography is much richer: Grube, Philippi, Michael Sars, Lorenz, Helller, and quite recently von Morenzeller, have published special studies on the echinoderm fauna of the Mediterranean and especially of the Adriatic. It is the rest of the Mediterranean that we can consider as known in this respect. We know nothing about the echinoderm fauna of the Greek archipelago, nor of the Black Sea, nor of the coasts of Asia Minor. There are probably, in this region, numerous discoveries to be made.

Returning now to the Atlantic region situated outside the Mediterranean, we find another work reporting the voyage of Webb and Berthelot to the Canaries, in which are described some interesting new species of starfish. Nothing is known of the west coast of Africa. The east coast of this vast continent has been more studied. Peters has studied the coast of Mozambique; Michelin, those of Reunion Island; Savigny, those of the Red Sea; while von Martens has made a critical study of species of the eastern coast of Africa and those of the Sunda archipelago, the Philippines, the Celebes and the nearest Asiatic coasts.

Several years ago, Captain Hutton reported the very interesting fauna of New Zealand. He has published a very interesting catalog of the echinoderms that live on the coast of this island.

Finally, a very large number of investigators have been occupied with the asteroids of the American coasts.

Say, Gould, Desor, Stimpson, Verrill, Alexander Agassiz have successively made known the species of the coasts of the United States. Stimpson has been concerned with those of the American Pacific coast. Hupé, the great work of Claude Gay, Xantus and Philippi have described the asteroids of Chile and neighboring regions. But among all these works, we must report before all as relating in a more specific way to zoological geography the series of memoirs published by Verrill in the second volume of the Memoirs of the Society of Sciences and Arts of Connecticut.

One finds there, in addition to the numerous local lists, on which we shall have occasion to return, a careful comparison of the species of the two coasts of American, a comparison whose interest will escape no one.

Such are the most important publications that pertain to my subject. My attention in this historical review is listing all the authors who have described the asteroids in indicating their habitat. We have wanted only to recall the names of zoologist who had been concerned with the local fauna. We have, moreover, published elsewhere a bibliographic index, as complete as we have been able, of all works related to asteroids.

In the present memoir, we shall study successively the distribution of families of starfish, of genera and species. Finally, we will try to reconstitute the principal faunas characteristic of the various geographical regions.

GEOGRAPHICAL DISTRIBUTION OF FAMILIES

Starfish are found in nearly all the seas. Some species, *Asterias rubens* and *Asterina gibbosa* of our coasts, for example, extend up to the highest seas. Others to the contrary live on in deep water, as most of the species of *Pteraster*, for example.

I divide the class of asteroids into eight families that are the Asteriadæ, Echinasteridæ, Linckiadæ, Goniasteridæ, Asterinidæ, Astropectinidæ, Pterasteridæ, and Brisingidæ. Each of these families has an extended geographical distribution. It is easy to see most of them have real centers around which species and genera are grouped, while genera and species become rare in other regions. We shall study the distribution of these species in the order just listed.

FAMILY ASTERIADÆ

Asteriadæ are found in the coldest regions. *Asterias stellionura* has been collected at Spitzberg. One finds *A. polaris* and *Groënlandica*, and *Stichaster albulus* that extend down the American coast to East Port (Maine). Between Iceland and Norway are *Stichaster roseus*, then *A. hispida*, *A. rubens* that extend to the Strait of Gibraltar but does not seem to penetrate into the Mediterranean.

Asterias glacialis, to the contrary, is very abundant in this sea and has many varieties there. *Asterias tenuispina* is found in the Mediterranean like *A. glacialis* and extends to the Cape Verde Islands. It has also been reported at Reunion Island, but it very probable that this was a small *A. calamaria* Gray. At the Canary Islands, d'Orbigny has reported *A. Webbiana*, reported by Webb and Berthelot, and very close to *A. glacialis*, as *A. Madeirensis*, of Stimpson. But in the tropics, no species has been reported and the same fact is found on the west coast of America and the Caribbean. However, Dr. Lütken has described an *Asterias Mexicana* from Vera Cruz in the Gulf of Mexico. To the contrary, from Labrador to Florida, there are no less than ten species of Asteriadæ, all distinct from those on the opposite coast of the Atlantic. It is a remarkable fact that no species of this group passes from one side to the other of this ocean. These ten species are *A. borealis* and *A. Fabricii* of Labrador; *S. albulis*, *A. vulgaris*, *liittoralis*, *Forbesii*, *tenera* from the coast of Maine and from the coast of Massachusetts, *A. compta*, *pallida* and *arennicola*. Asteriadæ are found below the tropics. Three species are found at the Cape of Good Hope, two at Reunion, one at Madagascar. South of Australia, Tasmania and New Zealand together have ten species. Finally, I have described two of them from the Torres Strait between the most northern point of Australia and New Guinea. Only one species, *A. calamaria*, has been reported in the Indian Ocean. I must say, however, that I have found in the collection of the Museum, indicated as coming from Bombay, an *Asterias* that without this indication I would report as *A. rubens*. Is it an error on the label? I would not dare to say in an absolute fashion, von Martens himself having reported *A. rubens* at Japan (Yokohama and Nagasaki). It is very astonishing, if it is necessary to consider this identification as correct, because we have the right to affirm without more information that our specimen from Bombay is apocryphal. von Martens also indicated *A. tenuispina* as occurring at Java and the Moluccas, Hong Kong, and coast of Australia. I have already said that I believe there is confusion with small *A. calamaria* that reaches a much greater size than the Mediterranean species. As for *Asterias striata* of Lamarck, given as *Asteracanthion* by Müller and Troschel, it does not belong to the genus *Asteracanthion*, nor even to the family Asteriadæ. It is very close to *Echinaster* and should be a separate genus that we have named *Valvaster*. I know of no *Asterias* from the Red Sea and that means very little, we will agree, in favor of the identity of our European species with *A. tenuispina* reported from Reunion Island and elsewhere by Michelin and von Martins.

In summary, there is no doubt that the tropical Atlantic region, likewise the tropical region of the Indian Ocean are not well suited to the development of Asteriadæ that are infinitely more numerous in cold and temperate regions. On the west coast of America, one genus, *Heliaster*, is perhaps exempted from this rule. *Heliaster microbrachia* and *H. Kubiniji* are found at Acapulco on the coast of Mexico. Now, these species and other analogues are found again at Payta, on the coast of Peru, Chile and Juan Fernandez Island. It is very probable they are found on the entire American coast from Mexico to southern Chile. Verrill reported, in fact, *Heliaster microbrachia* is found at Panama. It is curious to see the genus *Heliaster* replaced on the California coast by an apparently analogous genus, *Pycnopodia* of Stimpson, remarkable like the first by the multiplicity of the number of arms. *Heliaster* has, moreover, a very distinct physiognomy from other Asteriadæ. They are restricted to the region that we just indicated and are the only asteroids known from Central America. But at the two extremes of the tropical zone and outside, we find the same phenomenon as on the east coast. The number of species rapidly increases.

In the Behring Strait and Sea:

Asterias acervata Stimpson
---- *cribraria* Stimpson
---- *Kamtschatica* Brandt
--- *pectinata* Brandt

Around Sitka Island:

Asterias janthina Brandt
---- *epichlora* Brandt
---- *ochracea* Brandt

Around Vancouver and in Puget Strait:

Asterias Troschelii Stimpson
---- *paucispina* Stimpson
---- *hexactis* Stimpson
---- *conferta* Stimpson
Vancouveri E.P.

On the Oregon coast:

Asterias fissispina Stimpson
---- *gigantea* Stimpson
---- *Katherinæ* Gray
---- *Lütkenii* Stimpson

On the California coast:

Asterias brevispina Stimpson
---- *æqualis* Stimpson
---- *capitata* Stimpson

Finally at Cape San Lucas at the southern end of Baja California

Asterias sertulifera Xanthus

Pycnopodia helianthoides seems to span more or less all these faunas. It is found from Sitka Island to the coast of Baja California.

This is a region of remarkable richness, comparatively the same as the opposite coast. Furthermore, it is among the Asteriadæ that are found species with large capitate tubercles, whose physiognomy is so characteristic and seems reproduced in a region equally very rich but located nearly at the antipodes of the preceding. I want to speak of southern Australia, Tasmania and New

Zealand. There are no less than ten species there and among them species with very large spherical tubercles, for which Gray created the genera *Margaraster* and *Uniophora*. These are:

<i>Asterias</i>	<i>fungifera</i> E.P
----	<i>globifera</i> Gray
----	<i>granifera</i> Lamarck
----	<i>sinusoïda</i> E.P.
----	<i>polyplax</i> Müller and Troschel

and for New Zealand:

<i>Asterias</i>	<i>Mollis</i> Hutton
----	<i>scaber</i> Hutton
<i>Stichaster</i>	<i>australis</i> Verrill

Asterias calamaria Gray, found from Reunion Island to the western coast of Australia is replaced in this region by *Asterias murciata* Verrill, which is perhaps identical.

The south of America is also well represented. At Tierra del Fuego and in the Strait of Magellan are found:

<i>Asterias</i>	<i>antarctica</i> Lütken
----	<i>rugispina</i> Stimpson
----	<i>meridionalis</i> E.P.
----	<i>sulcifer</i> Valenciennes
----	<i>Cunninghami</i> E.P.

The curious *Labididaster radiosus* Lovén on the Patagonian coast seems to be the counterpart of *Pycnopodia helianthoides* of California. We do not know how far up these species extend, but on the coast of Chile they are replaced by:

<i>Asterias</i>	<i>gelatinosa</i> Meyen
----	<i>gemmifer</i> Valenciennes
----	<i>Germamii</i> Philippi
----	<i>lurida</i> Philippi
----	<i>spectabile</i> Philippi
----	<i>varia</i> Philippi
----	<i>clavata</i> Philippi
----	<i>fulva</i> Philippi
----	<i>mitis</i> Philippi
----	<i>echinata</i> Philippi

to which can be added the beautiful *Stichaster aurantiacus* Meyen and *Heliaster helianthus* Lamarck, twelve species in all.

But this is the region of the maximum number of species. Higher up, the number of species decreases rapidly. On the coast of Peru, Verrill reports only *Heliaster helianthus*, *Heliaster*

Cumingii Gray and *Stichaster aurantiacus*. Two *Heliaster* species are found also at the Galapagos Islands. But no asteride has been reported on the coast of Ecuador or Colombia. A single *Heliaster*, *Heliaster microbrachia* Xanthus, has been found in the Bay of Panama. So in all latitudes, the same phenomenon occurs. Species of the family Asteriadæ, more or less numerous in temperate regions, become much rarer as the warm region is approached. They belong essentially to the median zones. We will have to see by looking at the genera and species how their distribution is brought about.

FAMILY ECHINASTERIDÆ

We recognize in this family the genera *Solaster*, *Acanthaster*, *Echinaster*, *Valvaster*, *Cribrella* and *Mithrodia*. The first is perhaps more separate from the others than they are themselves from one another.

The phenomenon we just reported relative to the preceding family disappears completely. Echinasteridæ are found in the coldest seas, as well as in hot and temperate seas. The only region with no mention of any species is the west coast of Africa, from the Sahara to the Cape. von Martens does not mention any species from the coast of China, but Herklots mentions one species from Japan. This leads us to make the observation that the two regions that show this gap are precisely all the regions of the globe of which the echinoderm fauna is least known.

Indeed, the genera of the Echinasteridæ are in general more restricted than those of the Asteriadæ. *Cribrella* and *Solaster*, for example, are from cold and temperate regions. *Echinaster* coexists on the coast of the Channel with one or the other, but they only reach their full development in the warmest regions where *Acanthaster* takes the place of *Solaster*, from which they differ only in the spines of their skeleton. *Valvaster* and *Mithrodia* are also from warm regions.

If now we consider the species in detail, we will see that they are replaced mutually in the various seas without their number changing much. Thus in all the northern part of the Atlantic, in Europe as in America, and perhaps even in the corresponding part of the Pacific, we find the following species:

<i>Solaster</i>	<i>endeca</i> Linck
-----	<i>papposus</i> Linck
<i>Cribrella</i>	<i>oculata</i> Linck

Cribrella Eschrichtii is added to this list between Greenland and Labrador, while *Cribrella Sarsii* Müller and Troschel and *Solaster furcifer* M. and T. occur in the waters of the islands off the coast of Norway.

In the Behring Strait, these species of *Solaster* are represented by little known species that Brandt names *S. affinis* and *S. alboverrucosus* and at the lower latitude of Sitka Island by *Solaster endeca* var. *decemradiatus*. Below Sitka Island, no one any longer mentions *Solaster*. But Stimpson has described *Cribrella læviuscula* from the coasts of Oregon. Then Echinasteridæ disappears until the coasts of Panama. We remember, however, that this region cannot be considered as perfectly explored.

In the Atlantic, things are a little different. The fauna continues to have a northern character right up to the North Sea. But in the Channel, *Solaster endeca* and *Solaster furcifer* (the latter is, moreover, from deep water) seems to have disappeared. In compensation, *Echinaster sepositus*

Retzius makes its appearance. At least, it is found on the coast of Britany. Doctor P. Fischer has encountered it in the Bay of Biscay and one can conclude it inhabits the entire French Atlantic coast. But our learned colleague does not mention in his list *Cribrella oculata*, which also inhabits the coasts of the Channel, and seems to not to go further down in the Atlantic, nor *Solaster*, of which a single species, *Solaster papposus*, inhabits the Channel. *Echinaster sepositus* penetrates into the Mediterranean where it is found nearly everywhere. It is replaced in the Red Sea, in all the Indian Ocean and off the coasts all the Asiatic archipelago by a species that has a great affinity to it, *E. fallax* Müller and Troschel. At the same time, *Acanthaster echinites* takes the place of *Solaster*. *Echinaster gracilis* M. T. and a curious species, *E. vestitus* E.P., is added to this one at Zanzibar, while to the north-east of Australia *Echinaster eridanella* Val. is found along with *E. fallax* in several localities. According to von Martens, the first of these two species extends up into the Red Sea. All these localities are inhabited at the same time by *Mithrodia clavigera* Lamarck. So that we find here again four species of Echinasteridæ as in cold waters. It is up to here the Mediterranean that represents the minimum of a single species. The warm and temperate regions of the east coast of America has the same conditions as our oceanic coasts.

One species, *Echinaster echinophora* Lamarck, occurs along the entire coast of Brazil, in the entire Caribbean Sea and the Gulf of Mexico. Higher up, below Florida, these two species are replaced by *E. sentus* Say and *E. spinulosus* Verrill.

On the west side of the Americas, there are no species of the east coast. Moreover, the true *Echinaster* is represented by only two species: *E. tenuispinus* Verrill of La Paz and *E. cribrella* Lütken of Chile. Indeed, Verrill lists in the fauna of Panama *E. aculeatus* Gray, but I have found no proof that this species really comes from this region. Other than *Echinaster* we find an *Acanthaster* (*A. Ellisii* Gray) at La Paz and a *Mithrodia* (*M. Bradleyi* Verrill) at Panama. It is curious to see *Acanthaster* reappear at the Strait of Magellan (*A. solaris* Ellis) while the cribrellids appear at the Cape of Good Hope (*C. ornata* E.P.) and at Campbell Island where Filhol reported a pretty species, perhaps identical to that of the Cape. Müller and Troschel have likewise described a *Solaster* from the south-west of Australia, *S. decanus*. It seems thus that there has reappeared in the southern hemisphere some of the types of the corresponding regions of the boreal hemisphere.

The preceding justifies and makes specific what we said at the beginning of this paragraph. Most seas have one to three species of Echinasteridæ. This family thus does not seem to adopt, like the preceding, some zones more than others. But the genera, on the other hand, are more restricted, as we will specify later.

We do not know the provenance of three species of *Echinaster*: *E. crassus* M. T., *E. deplanatus* Grube, and *E. lacunosus* Grube.

FAMILY LINCKIADÆ

More numerous than the preceding, to which it is related by *Mithrodia*, this family has seven genera: *Ophidiaster*, *Lepidaster*, *Linckia*, *Scytaster*, *Fromia*, *Metrodira*, and *Ferdina*. It has a distribution completely different from that we just studied and appears to reach its maximum development in the warm regions. In our seas of Europe, the Mediterranean is the only one in which the Linckiadæ is found. This family is represented there by two species:

<i>Ophidiaster</i>	<i>ophidianus</i> Lamk.
----	<i>attenuatus</i> Gray

The latter is found only in the Mediterranean, but *O. ophidianus* has been collected at Madeira and the Canary Islands by Webb and Berthelot and at the Cape Verde Islands by Bouvier. It also belongs to the warm regions of the Atlantic. In each of the regions that we indicated. It is found associated with other species: *Scytaster canariensis* d'Orb. at the Canaries, *Linckia Bouvieri* E. P. and *L. Guildingii* Gray at Cape Verde.

Without going much higher to the north, the species of the American coast are more numerous. In the Caribbean Sea and Gulf of Mexico are found:

<i>Ophidiaster</i>	<i>Guildingii</i> Gray
<i>Linckia</i>	<i>Guildingii</i> Gray
<i>Ophidiaster</i>	<i>Floridæ</i> E. P.

The latter is further to the north. Further to the south are cited only *O. pyramidatus* Gray of Caracas. It is evident that we are not in a special region because the Atlantic and its dependencies, including the Mediterranean, have in all a total of eight species of the approximately fifty six in the family.

On the west coast of the Americas, the species are still not numerous although distributed over very vast expanse. There are six from California to the Juan Fernandez Islands. These are:

<i>Linckia</i>	<i>diplox</i> ¹ M. T. (California)
----	<i>unifascialis</i> Gray (Panama)
<i>Lepidaster</i>	<i>teres</i> Verrill (Panama)
<i>Ferdina</i>	<i>Cumingii</i> Gray (Colombia)
<i>Ophidiaster</i>	<i>fuscus</i> Gray (Migupou)
----	<i>Agassizii</i> E. P. (Juan Fernandez)

However, we find no more than two species in the same location. In the other parts of the Pacific, to the contrary, notably in the Indian Ocean and into the Red Sea, things change. The Red Sea alone has the following species:

<i>Ophidiaster</i>	<i>Hemprichii</i> M. T.
<i>Linckia</i>	<i>Linckia multifora</i> Lamk.
----	<i>Ehrenbergii</i> M. T.
----	<i>erythrea</i> Gray
----	<i>milleporellal</i> Lamarck
<i>Scytaster</i>	<i>Ægyptiacus</i> Gray

Nearly all the genera of the family are found from the first representing:

At Zanzibar and in the Strait of Mozambique are the curious

<i>Leiaster</i>	<i>glaber</i> Peters
-----	<i>coriaceus</i> Gray

¹ *Linckia læviuscula* Stimpson is a *Cribelle* according to Verrill.

associated with *Linckia diplax* M. T., *L. miliaris* Lamk. *L. multifora* Lam. and *Ehrenbergii* M. T. that we have already encountered in the Red Sea and *Scytaster variolatus* Linck that we will find associated with all the species from the Indian Ocean.

Reunion Island and Mauritius are still richer. Around these islands are:

<i>Leiaster</i>	<i>Leachii</i> Gray
<i>Ophidiaster</i>	<i>cylindricus</i> Lamk.
----	<i>purpureus</i> E. P.
<i>Linckia</i>	<i>marmorata</i> Michelin
----	<i>miliaris</i> Linck
----	<i>diplax</i> M. T.
----	<i>multifora</i> Lamk.
<i>Scytaster</i>	<i>variolatus</i> Linck
----	<i>Novæ Caledoniæ</i> E. P.
----	<i>Ægyptiacus</i> Gray
<i>Fromia</i>	<i>milleporella</i> Lamarck
----	<i>pistoria</i> M. T.
<i>Ferdina</i>	<i>flasvescens</i> Gray

There is thus a total of thirteen species and this number is perhaps only a minimum.

In the Indian archipelago, more species are found. Here is the list given by von Martens in 1866:

<i>Linckia</i>	<i>miliaris</i> Linck
----	<i>multifora</i> Lam.
----	<i>pauciforis</i> v. M.
----	<i>Rosennbergi</i> v. M.
<i>Ophidiaster</i>	<i>pustulatus</i> v. M.
<i>Scytaster</i>	<i>tuberculatus</i> v. M.
<i>Fromia</i> .	<i>monilis</i> Val.
<i>Leiaster</i>	<i>speciosus</i> v. M.

to which it is necessary to add:

<i>Ophidiaster</i>	<i>cribrarius</i> Ltk.
----	<i>Germani</i> E. P. (New Caledonia)
<i>Linckia</i>	<i>pacifica</i> Gray
<i>Scytaster</i>	<i>Ægyptiacus</i> Gray
-----	<i>gomophia</i> E. P. (New Caledonia)
-----	<i>Kuhlii</i> M. T. (Java)
-----	<i>obtusus</i> E. P. (Philippines)
-----	<i>semiregularis</i> M. T. (Java)
-----	<i>Novæ Caledoniæ</i> E. P.
-----	<i>Galatheæ</i> Ltk. (Nicobar)
<i>Fromia</i>	<i>indica</i> E. P.
<i>Metrodira</i>	<i>subulata</i> Lam.

It is difficult to see at present in an absolute fashion if these twenty species are distinct to the coasts of certain islands or extend to nearly all the archipelago. But considering the vast extent in which they are met in several of them, there is a presumption restriction is the exception. We will give, moreover, further on the exact location where most have been found.

In going up the coasts of China and Japan, the species become rare. We have to cite only:

<i>Scyaster</i>	<i>semiseriatus</i> v.M.
<i>Metrodira</i>	<i>subtilis</i> Ltk.

from China and

<i>Fromia</i>	<i>Japonica</i> E. P.
---------------	-----------------------

from Japan.

We do not know the provenance of the following species, doubtful for the most part:

<i>Ophidiaster</i>	<i>bicolor</i> Lam.
----	<i>arenatus</i> Lam.
<i>Linckia</i>	<i>intermedia</i> Gray
-----	<i>Francisca</i> Nardo
<i>Scytaster</i>	<i>cancellatus</i> Grube

These unknowns change nothing to the result. It is quite certain that no other region of the globe has such a great variety of species of *Linckiadae* than the Indian Ocean.

FAMILY GONIASTERIDÆ

The family Goniasteridæ is the most numerous of those we have considered up to here. It is also that which contains the largest number of variable types. We can add that it is one of the most difficult to study well because of the large number of species that have been based on basically unimportant variations of described types, variations that often come from the size of the individuals. We are far from agreeing on the boundaries of the genera that make up this family. We accept the following fifteen:

Nectria Gray
Pentagonaster Linck
Goniodiscus M. T., restricted
Nidorellia Gray
Choriaster Ltk.
Asterodiscus Gray
Culcita Agass.
Goniaster, Agan. S.
Hippasteria Gray
Anthenea Gray
Porania Gray
Asteropsis M. T.

Dermasterias E. P.
Gymnasteria Gray

We must remark that the names *Goniodiscus* and *Goniaster* have here a sense much more restricted than given by the authors who first employed them. On the other hand, the genus *Pentagonaster* can contain some subdivisions that have been considered as genera by Müller and Troschel, Gray, and others such as *Astrogonium*, *Stellaster*, *Hosea*, *Tosia*, *Calliaster*, *Calliderma* or *Dorigona*, etc.

In a general fashion, one can say that the geographical distribution of the Goniasteridæ is superimposed almost exactly on that of the *Linckiadæ* to which they are related in a very manifest fashion by *Fromia* and *Nectria*. However, the area of distribution of *Goniasteridæ* is greater, because they are found up to the cold regions of the Atlantic.

If we accept the authors' reports, seven species inhabit the northern Atlantic and the North Sea:

<i>Hippasteria</i>	<i>plana</i> Linck
----	<i>abbensis</i> Forbes
<i>Pentagonaster</i>	<i>granularis</i> Retzius
----	<i>aculeatus</i> Barrett
----	<i>borealis</i> Barrett
----	<i>hispidus</i> Sars
<i>Porania</i>	<i>pulvillus</i> O.-F. Müller

Of these seven species, the second appears to me only an unimportant variety of *H. plana*. I have not been able to see the types of Barrett, but they appear very close to *P. granularis*. I cannot confirm their identification. In any case, that makes a maximum of six species in the Atlantic. Up to now, none of them have been reported from Channel, nor on any point on the oceanic coasts of France. They are not found in the Mediterranean where they are replaced by two new species:

<i>Pentagonaster</i>	<i>placenta</i> M. T.
----	<i>acutus</i> Heller

Müller and Troschel also reported a *Pentaceros carinatus* from the Adriatic. But the later investigations of Heller, de Lorenz, and von Marenzeller did not find this interesting asteroid. To the contrary, I have found in the collection of the British Museum a very beautiful *Pentagonaster*, *P. mirabilis* E. P., which comes from Scala Nova in the Gulf of Smyrna. The Mediterranean contains thus at least three species of *Pentagonaster*. It is less certain that it includes *Pentaceros*. This genus appears to have a lower latitude in the Atlantic. *Pentaceros dorsatus* (Lin.) has been collected by Bouvier at the Cape Verde islands and another species, *Pentaceros reticulatus*, is abundant in the Antilles and on the coasts of Brazil. There is also at the same locality, the Cape Verde islands, a species of *Pentagonaster*, *P. semilunatus* Linck.

The Red Sea is a little richer. It has two *Pentaceros*:

<i>Pentaceros</i>	<i>mammillatus</i> Audouin
----	<i>tuberculatus</i> M. T.

a culcitid

Culcita coriacea M. T.

a gymnasterid

Gymnasteria carinifera Lamarck

only four species but three genera. A new culcitid appears at the latitude of Zanzibar. It is *Culcita Schmideliana* Retzius. Another is added at Mauritius, *C. Novæ Guineæ*. But at the same time three culcitids occur in this region:

<i>Pentaceros</i>	<i>hiulcus</i> Linck
----	<i>turritus</i> Linck
----	<i>muricatus</i> Linck
<i>Goniaster</i>	<i>obtusangulus</i> Lamarck

The latter is close to *Pentaceros*. It is necessary to add to this list *Gymnasteria carinifera* Lamk. that occurs in the Red Sea. This increases to eight the number of Goniasteridæ from the Mascarene Islands, and probably from the east coast of Africa. It should be noted that the genus *Pentagonaster*, so typical and so numerous, is not up to now, represented in this fauna. It is only further to the east that we find it in a region whose climate is more temperate. However, according to a label in the museum of Cambridge (Massachusetts), *Pentagonaster semilunatus* Linck, has been found at Zanzibar and *P. (Astrogonium) tuberculatus* from Port Natal.

The Seychelles has a fauna very analogous to that of the Mascarenes. We find there however, a new form: *Anthenea articulata* Val. (s. r.) and perhaps also *Goniodiscus capella* M. T. But it is around the Australian continent that the family Goniasteridæ acquires its maximum development. Here are the forms represented there:

<i>Pentagonaster</i>	<i>astrologoru</i> , M. T.
(<i>Tosia</i>)	
----	<i>auratus</i> Gray
----	<i>australis</i> Gray
----	<i>grandis</i> Gray
----	<i>magnificus</i> Gray (Tasmania)
----	<i>nobilis</i> M. T.
----	<i>ruber</i> Gray
----	<i>tubercularis</i> Gray
<i>Pentagonaster</i>	<i>abnormalis</i> (?) Gray
----	<i>Dubeni</i> Gray
----	<i>pulchellus</i> Gray
----	<i>Gunnii</i> E. P.
<i>Pentagonaster</i>	<i>paxillosus</i> Gray
(<i>Astrogonium</i>)	

<i>Pentagonaster</i> (<i>Stellaster</i>)	<i>Incei</i> Gray
<i>Anthenea</i>	<i>acuta</i> E. P.
<i>Culcita</i>	<i>Novæ Guineæ</i> M. T.
<i>Pentaceros</i>	<i>granulosus</i> Gray
<i>Pentaceros</i>	<i>australis</i> Lütken
----	<i>nodulosus</i> Gray
----	<i>Franklinii</i> Gray
----	<i>gracilis</i> Lütken
----	<i>valvulatus</i> E. P.

It is a total of twenty four species to which it will be necessary, without doubt, to add still some of those living in the Malaysian archipelago and the nearby regions of New Guinea.

New Zealand has a fauna that can be considered as a reduction of the preceding. We still find there *Pentagonaster pulchellus* Gray associated with other forms of *Pentagonaster*:

<i>Pentagonaster</i> (<i>Tosia</i>)	<i>magnificus</i> M. T.
<i>Pentagonaster</i> (<i>Astrogonium</i>)	<i>dilatatus</i> E. P.
----	<i>miliaris</i> Gray

But *Pentaceros* and *Anthenea* have disappeared and, to find them again, it is necessary to leave Australia to approach, to the contrary, the equator. The Indian archipelago is not richer, moreover, than the Australian coast. Here is the list of species that have been reported there:

<i>Pentagonaster</i>	<i>clavatus</i> v. Mortens (Flores, Lesser Sunda Islands)
----	<i>semilunatus</i> Linck (Celebes)
<i>Pentagonaster</i> (<i>Astrogonium</i>)	<i>inaequalis</i> Gray (Amboine, New Guinea)
----	<i>spinulosus</i> Gray (Philippines)
<i>Pentagonaster</i> (<i>Dorigona</i>)	<i>longimanus</i> Möbius (Sumatra)
<i>Pentagonaster</i> (<i>Stellaster</i>)	<i>equestris</i> Retzius (Sumatra)
----	<i>gracilis</i> Gray (Moluccas) (Philippines)
<i>Pentagonaster</i> (<i>Stellaster</i>)	<i>Belcheri</i> Gray (Amboine)
<i>Goniodiscus</i>	<i>cuspidatus</i> Lam.
----	<i>pleyadella</i> Lam (Moluccas)
----	<i>Sebæ</i> M. T. (Amboine)
<i>Pentaceros</i>	<i>obtusatus</i> Bory de Saint-Vincent
<i>Culcita</i>	<i>grex</i> M. T.
-----	<i>pentagularis</i> Gray
-----	<i>Novæ Guineæ</i> M. T.
<i>Gymnasteria</i>	<i>carinifera</i> Lam.

This makes sixteen species. But is probable that it is necessary to add to this list some species from the Mascarene Islands whose analogues are found at New Caledonia, *Pentaceros turritus* Linck, for example.

What is most striking about this fauna is the predominance of forms with long arms like *Pentagonaster* and *Goniodiscus* over the nearly pentagonal forms that are, to the contrary, more numerous in Australia. *Pentaceros* are also less numerous but there is, I think, a gap to fill. The Indian Ocean proper has only seven of them.

<i>Pentaceros</i>	<i>superbus</i> Möbius
----	<i>Westermanni</i> Lütken (Bengale)
----	<i>Hedemanni</i> Lütken (Billeton)
----	<i>Reinhardti</i> Lütken (Nicobar)
----	<i>affinis</i> M. T.
----	<i>regulus</i> Val. (Pondichery)
----	<i>verrucosus</i> M. T.

We must recognize in the list three species that have very uncertain information. India or the Indian Ocean does not guarantee their provenance. It is curious that no *Pentagonaster* has yet been reported in this poorly known region.

On the coasts of China and Japan, the fauna keeps the character that we have seen in the Indian archipelago but with some modifications in the species and a notable reduction in their number.

<i>Pentagonaster</i>	<i>semilunatus</i> Linck
<i>Pentagonaster (Calliaster)</i>	<i>Childreni</i> Gray
<i>Pentagonaster (Calliderma)</i>	<i>Emma</i> Gray
<i>Pentagonaster (Stellaster)</i>	<i>equestris</i> Retzius
----	<i>tuberculosis</i> v. Martens
<i>Pentagonaster (Dorigona) 1</i>	<i>Mülleri</i> v. Martens
<i>Goniodiscus</i>	<i>granuliferus</i> Gray
----	<i>capella</i> M. T.
<i>Pentaceros</i>	<i>orientalis</i> M. T.
----	<i>Chinensis</i> M. T.
<i>Asterodiscus</i>	<i>elegans</i> Gray
<i>Anthenea</i>	<i>pentagonula</i> Lam. (Hong Kong)

These twelve forms are all very remarkable. Among them, *Asterodiscus* replaces culcitids of which it can be considered a variety. It is unfortunate that for none of them do we have a precise indication of locality.

If we refer to the east and to the south, towards New Caledonia, the Fiji Islands, etc., we continue to find *Pentaceros*. New Caledonia has the following:

<i>Pentaceros</i>	<i>turritus</i> Linck
----	<i>alveolatus</i> E. P.
----	<i>Caledonicus</i> E. P.

But we still have not received any *Pentagonaster* nor any culcitid. However, this can only be accidental, because Filhol has reported *Culcita pentagularis* Gray from the Fiji Islands and the Torres Strait and culcitids are found also at Hawaii (*Culcita arenosa* Val.) and Saint Paul Island (*C. Veneris* E. P.). Fiji is again notable by the beautiful *Choriaster granulatus* Ltk, near *Pentaceros*. We add finally *Gymnasteria carinifera* Lam. that we have so often encountered living in these islands, Hawaii and very probably also in New Caledonia.

There remains to examine the distribution of the Goniasteridæ on the west coast of the Americas. There, the species are not numerous. We are evidently far from the center of distribution or, more exactly, the principal accumulation.

On the California coast are found:

Mediaster æqualis Stimpson
Amphiaster insignis Verrill (La Paz, Mexico)
Nidorellia Michelini E. P. (Mazatlan, Mexico)

further down

Nidorellia armata Gray (Acapulco, Panama)

It is associated in this last locality with *Gymnasteria carinifera* Lam. and with related species such as our *Dermasterias inermis* (*Asteropsis imbricata* Grube) and *Asteropsis vernicina* Lam.

We find again an interesting species of *Gymnasteria* (*G. valvulata* E. P.) from the Galapagos Islands and on the coast of Ecuador the curious *Nidorellia horrida* (Gray) that replaces the two more northern species.

It is also in this region that occur the only two *Pentaceros* reported on this coast, *P. Cumingii* Gray and *occidentalis* Verrill, which perhaps are identical.

For the coast that follows, we lack information. But at Chile reappear species that recall a little the physiognomy of Australian species:

Pentagonaster Fonki Philippi
Pentagonaster (*Astrogonium*) *verrucosus* Philippi
---- *singularis* M. T.
Goniodiscus penicillatus Philippi

P. singularis goes much further down. It is found in the Strait of Magellan and along with a poranid very near to *P. puvillus* that we propose to name *P. patagonica*.

Of the 113 species that make up this family at the present, only nine still do not have a well-established habitat. These are the following:

Nectria ocellifera Lam.
Pentagonaster (*Tosia*) *ornatus* M. T.
Pentagonaster (*Tosia*) *Lamarckii* M. F.
Pentagonaster (*Tosia*) *regularis* Linck
Pentagonaster (*Astrogonium*) *mammillatus* M. T.
Pentagonaster (*Astrogonium*) *punctatus* Lam.

Anthenea flavescens Gray
Anthenea scaber Möbius

The first of these species comes from Australian seas (expeditions of Péron and Lesueur), probably from the Australian coast itself. *Pentagonaster regularis*, *mammillatus* and *punctatus* are doubtful species whose type cannot be found and it perhaps it is necessary to delete them as duplicates. There are three species for which we do not have geographical information.

We can thus consider as well known the geographical distribution of the Goniasteridæ. Their center is found evidently on the coast of Australia and in the archipelagos of Malaysia and Melanesia. They decrease already on the coast of China and also towards the east. There are only a few species on the Pacific coast of America. Our European seas and the Atlantic all together have only about ten species. I do not give an exact number because some of these species are still doubtful. There remains more than eighty species for the Indian Ocean, China, Australia and the archipelagos of Oceania.

FAMILY ASTERINIDÆ

The Asterinidæ is a small family that has only the five genera *Disasterina*, *Palmipes*, *Asterina*, *Patiria* and *Ganeria* and 31 species. A glance at the map of their geographic distribution shows that these starfish inhabit only warm and temperate seas. They are not found, according to Lütken, on the coasts of Norway. But *Asterina gibbosa* is found on the coasts of England. It is abundant in the Channel, on the entire European coast of the Atlantic and in the Mediterranean. Throughout this region it is associated with *Palmipes membranaceus* Linck that lives only, in general, in deep water, although de Lacaze-Deuthiers found it on the beach of Brest at low tide, in the conditions where one ordinarily finds *Asterina ciliata* in the Mediterranean. So our European seas do not have simultaneously two or three Asterinidæ. This is nearly the same thing everywhere. We know two species on the American Atlantic coast: *A. minuta* Gray and *A. stellifer* Möbius, both from the Antilles. The latter is found on the coast of Brazil and at Senegal. Moreover, Dr. Lüken has communicated to me a new species from Barbados that he names *A. Wesseli*. It should be noted that on the coast of the United States, below our latitude, no one has reported *Asterina* and a single species has been mentioned on the coast of Brazil. On the coast of Patagonia, only *Ganeria Falklandica* represents the family. But there is already a very marked form of transition towards the Astropectinidæ, to which it is connected by *Ctenodiscus*. The Chilean coast is richer. The following five species are there:

Asterina Chilensis Lütken
Asterina calcarata Val.
Asterina Gayi E. P.
Asterina pusilla E. P.
Asterina fimbriata E. P.

But only two species have been mentioned at Panama, *Asterina modesta* Verrill and *obtusa* Gray. Finally, only one species inhabits the coast of California, *A. miniata* Brandt and only three species for the long coast that extends from Chile to the Behring Strait!

We return now to the Atlantic. At Senegal, we can report two species:

Asterina stellifer Möbius
Asterina squamata Val.

Then, nothing until the Cape, where are found:

Asterina exigua Lam.
Asterina coccinea M. T.
Asterina Granifera Gray

Madagascar and Reunion Island have the same fauna as the Red Sea where one can collect:

Asterina cephea Val.
Asterina Wega Val.
Asterina penicillaris Lam.
Asterina Burtonnii Gray
Asterina exigua Lam.

and, they say, *Asterina gibbosa* Pennant. We must however have reservations on the subject of some of these species. *A. burtonnii* and *A. gibbosa* could be only *A. cephea*. This would reduce to four the number of species from the Red Sea. *A. cephea* extends throughout the Indian archipelago where it meets *A. regularis* whose principal station is around Australia up to New Zealand. von Martens reports *A. coronata* from the Mollucas. This makes three species from the Indian archipelago.

Australia shares a little better because on its coast are found:

Asterina regularis Verrill
Asterina Gunii Gray
Asterina calcar Lam.
Asterina exigua Lam.
Patiria crassa Gray (west coast)
Nepanthia brevis (Strait of Prince of Wales)

In all, six species of which the first four are found at the same place.

The first of these species is found abundantly at New Zealand at the same time as another starfish of the same family, the remarkable *Palmipes inflatus*, described by Hutton as a *Pteraster*. It is necessary to add another true *Asterina* that I have named *A. Novæ Zealandiæ*.

The Asterinidæ fauna of New Caledonia is reduced to two species. One, *A. cephea* Val., is in common with the India archipelago, the Mascarenes and the Red Sea. The other is distinct and merits a distinct genus, *Disasterina abnormalis*, E. P.

From the Hawaiian Islands, we recognize again only one species that is unique to them, *A. granulosa* E. P. Finally, at Japan, is *A. pectinifer* M. T. and the superb *Palmipes rosaceus* Lam., which is to two other species, *Acanthaster* and *Solaster*, as *Heliaster* and *Pycnopodia* are to *Echinaster* and *Asterias*.

Except for the very austral or boreal seas, except for the west coast of North America that appears impoverished, we see that nearly all the seas contain two to six species of Asterinidæ. There is a nearly uniform distribution. We cannot indicate here a well-defined region that we have presented for other families, notably the Linckiadæ and the Gonioasteridæ

FAMILY PTERASERIDÆ

This family is made up of a small number of species inhabiting deep waters and recalls a little the general aspect of the Asterinidæ for which they seem to substitute in the northern regions of the Atlantic.

At Greenland, Iceland, on the coasts of Norway, England and the United States and up to Spitzberg are found *Pteraster militaris* M. T. in deep water and *P. multipes* Sars and *P. pulvillus* G. O. Sars in deeper water. Still deeper is *Hymenaster pellucidus* W. Thompson, which is only a true *Pteraster*. But it is not only in cold water where this genus is found. We owe to A. Agassiz the knowledge of a species that we have named *P. caribbæus* that has been collected at Casco Bay (state of Maine) and at Sand Key (Florida) at a depth of 125 feet. *Pteraster danæ* Verrill is also found lower on the Brazilian coast.

Finally, two species of large size are sufficiently different from the preceding perhaps to justify creation of a genus. These species that have, to the contrary, between them the greatest similarity, inhabit the Cape (*P. Capensis* Gray) and Zanzibar, the Philippines and perhaps other locations of the African coast and the Indian archipelago (*P. cribrosus* v. Martens).

This is all that we know at the present on the distribution of the Pterasteridæ, but it is necessary to remember that these delicate animals, living in deep water, are difficult to collect. It is without doubt that submarine explorations, such as the English and the Americans have taken the initiative, will make known a greater number of species.

FAMILY ASTROPECTINIDÆ

Here again is a very numerous family that contains 100 very homogeneous species that includes the genera *Chaetaster*, *Luidia*, *Archaster*, *Astropecten* and *Ctenodiscus*. Two (*Archaster* and *Astropecten*), including alone more than three quarters of the species of the genus, are scarcely distinct from each other. *Chaetaster* has only three species, *Ctenodiscus* has two. The Astropectinidæ are found in all the seas, the coldest as well as the warmest. It is true that *Ctenodiscus crispatus* alone faces the icy seas of Spitzberg and Greenland, although it is found down to the English coasts. But among the Finnish species, we can report two other starfish of the same family, *Archaster arcticus* Sars and *Parelii* Düben and Koren, of which the latter is associated on the coasts of Norway with *Astropecten irregularis* Pennant, *Archaster Christi* Düben and Koren and *tenuispina* Düben and Koren and *Luidia Sarsii* D. and K., all living in deep water. We have reported other species in the North Sea under the names of *Astropecten squamatus* M. T., *A. acicularis* Norman, *A. echinulatus* M. and *A. Lutkeknii* Barrett. But *A. echinulatus*, according to Sars, is identical to *A. irregularis* Pennant. The other species do not appear sufficiently distinguished. More recently, Wyville Thompso has reported two other species from deep water, *Archaster bifrons* W. T. and *A. vexillifer* W. T. It is clear from all this that there are a very large number of Astropectinidæ in the cold deep water of the Atlantic and that one species even extends into polar waters like some Asteriadæ. *Luidia ciliaris* begins, according to Norman, to be found

on the English coast along with *L. Sarsii* D. K. These two species have been confused by Forbes with the name *L. fragillissima*.

Astropectinidæ are rare in the Channel or are found only at great depths. I have seen no specimen from these waters in the collection of the British Museum or that of the Jardin des Plantes. I have never seen them in the fishing nets brought back to Roscoff although they contain *Asterias glacialis*, *Echinaster sepositus* *Cribrellal oculata*, *Solaster papossus* and *Palmipes membranaceus* in abundance. However, at least three species are found on the French Atlantic coast: *Astropecten aurantiacus* and *A. serratus* Val. and *Luidia ciliaris* collected by Fischer at Arcachon.

The species increase in the Mediterranean:

Chaetaster longipes Retzius
Luidia ciliaris Philippi
Archaster subinermis Philippi
Astropecten aurantiacus Linné
Astropecten Johnstoni Delle Chiaje
Astropecten hispinosus Otto
Astropecten pentacanthus Philippi
Astropecten spinulosus Philippi
Astropecten aster Philippi
Astropecten serratus Valenciennes

These eleven species can perhaps be reduced to a smaller number. However, most of them seem very distinct although we have been able to see only a few specimens of some of them. Thus von Marenzeller affirms the identity of *A. spinulosus* Philippi with *A. Johnstoni* Delle Chiaje. More recently, Dr. Lüken has described with extreme care the specimens in the museum of Paris, studied by Troschel, that have always had the name *A. platyacanthus*. Dr. Lüken, to the contrary, considers these two species have no relation to each other. Lacking means of verification, we ourselves are quick to accept his very clear opinion, but we do still do not know which is the true *A. platyacanthus*.

Returning to the Atlantic, we find *A. aurantiacus* Linné up to the Canary Islands. *Astropecten Schænleinlii* M. T. and *Luidia senegalensis* M. T. are found on the coast of Africa. The latter also inhabits the coast of Brazil and the Antilles. But it is the sole asteride of this family common to the two coasts.

On the east coast of the Americas, we can report:

Astropecten articulatus Say (Georgia, Florida, Antilles)
---- *vestitus* Say (?)
---- *duplicatus* Gray (from North Carolina to Saint Vincent)
---- *Antillensis* Lütken (Antilles)
---- *duplicatus* Grube (Antilles)
---- *Richardi* E. P. (Guyana)
---- *Brasiliensis* M. S. (Antilles, Brazil)
---- *Alligator* E. P. (Alligator reef)
Archaster echinulatus E. P. (Barbados)
Luidia clathrata Say (North Carolina, Antilles)

---- *alternata* Say (Florida, Antilles)
 ---- *Senegalensis* M. T. (Antilles, Brazil)
 ---- *variegata* E. P. (mouth of the Mississippi, Strait of Florida)
 ---- *elegans* E. P.
Chaetaster nodosus (Antilles)

Nine species are recorded from the Antilles. Verrill likewise cited nine, but it is necessary to note that several of the names listed are duplicates. Such are *A. articulatus* Say and *A. dubius* Gray, *A. variabilis* Ltk. *Astropecten Valenciennesi* M. T. is identical to *A. duplicatus*. On the other hand, he did not know of the existence of *Chaetaster nodosus*, collected by Duchassaing at Guadeloupe. Finally, it is quite possible that the four other species that live at very great depths will be found elsewhere. We can thus consider the Caribbean as a kind of center that unites all the American *Astropectinidæ*, whose numbers decrease with distance from it. I will add that Müller and Troschel have described, as coming from the Antilles, *Chaetaster Troscheli* named by Valenciennes in the collection of the museum of Paris whose type cannot be found. It does not seem that this species can be confused with *C. nodosus* whose arms are nearly two times longer.

The species of the opposite side of the Americas are nearly as numerous but completely different. We can count there one *Chaetaster*, three *Luidia* and six *Astropecten*.

Chaetaster Californicus Grube
Luidia Californica Ltk.. m. s. (California)
 ---- *tessellata* Ltk. (Colombia)
 ---- *Bellonæ* Ltk. (Guyaquil)
Astropecten erinaceus Ltk. (Panama and Nicaragua)
 ---- *alatus* E. P. (??)
 ---- *latiradiatus* Gray (Tehuantepec)
 ---- *spatuliger* E. P. (Nicaragua)
 ---- *fragilis* Verrill (Panama)
 ---- *Peruvianus*

It is again the equatorial zone that dominates because of ten species it has at least six.

In continuing our route to the west, we find Japan nearly as rich with:

Luidia maculata M. T.
Archaster hesperus M. T.
 ---- *Japonicus* M. T.
 ---- *scoparius* Val.
 ---- *armatus* Gray
 ---- *numbrinus* Grube
 ---- *velitarius* v. Martens
 ---- *Chinensis* Grube

Astropecten armatus, that we recognize here for the first time, will now be associated with all the species of the Indian Ocean and will be found to the base of the Red Sea.

A remarkable species, *A. Samoensis*, is found at the Fiji Islands. On the eastern coasts of Australia are *A. vappa* (*A. armatus*?) M. T., *A. Pressii* M. T. and *A. triseriatus* M. T. Finally,

another species, *A. Edwardsi* Verrill, inhabits the Auckland Islands and New Zealand. At the Sonde Islands are:

Astropecten armatus Gray
---- *Javanicus* M. T.
---- *longispinus* M. T.
---- *scoparius* Val.
Archaster angulatus M. T.
---- *typicus* M. T.
Luidia maculata M. T.
---- *Hardwickii* Gray
Chætaster cylindratus Möbius

Most of the species are found at the Mascarene Islands where *A. Mauritianus* Gray is perhaps only a variety of *A. scoparius* Val. but cannot be confused with *Archaster angulatus* M. T. as von Martens would like. We add finally that the Museum has received from Baillieu, consul at the Hawaiian Islands, a species that appears new and that we name *Astropecten Baillæi*.

From Poulo Condor Islands, located opposite the mouth of the Mekong, the grand river of Cambodia, Dr. Harmand sent us another interesting species that we will name *A. Harmandi*. Finally, in the beautiful collection that we owe to Alexander Agassiz, we find an equally new species from Calcutta, *A. Indicus* E. P. It is necessary to cite in the same waters (Nicobar Islands, *Astropecten euryacanthus* Lütken.

The number of species of the tropical region of the Indian Ocean is thus very considerable. It is approximately fifteen. To what degree are these last species associated into the same fauna? It is still impossible to say. Most have been described only from species collected at a single locality. No study has been made to establish the extent of their distribution or their habitat. What is well known, however, is that one, *A. armatus* Gray, is found in nearly the entire region.

Whatever it is, the information that we have establishes that the warm seas are the preferred habitat of the Astropectinidæ. They are less numerous in temperate seas. But some of them have advanced to just below the polar seas.

We have no indication about the place of origin of the following sixteen species:

Chætaster Hermannii M. T.
Luidia debilis Grube
---- *foliolata* Grube
Astropecten diplacanthus Grube
---- *paleatus* Grube
---- *Olfersii* Grube
---- *Buschii* Philippi
---- *calcitraba* Lamarck
---- *fimbriatus* Linck
---- *regularis* Linck
---- *mesodiscus* Linck
---- *gracilis* Gray
---- *granulatus* Müller and Troschel
---- *hispidus* Müller and Troschel

---- *marginatus* Müller and Troschel
---- *Tiedemanni* Müller and Troschel

FAMILY BRISINGIDÆ

This family of asteroids that is considered, without good cause perhaps², as making a transition to the ophiuroids contains only the single genus *Brisinga* Absjörnsen. This genus itself has only two species from deep regions of the Atlantic. *Brisinga endecacnemos* Absjörn., has been dredged from 100 to 200 fathoms depth in the waters of the Bergen archipelago and in those of the Lofoden Islands. It is also in these regions (Skraaven) that Michael Sars collected *Brisinga coronata* that the dredges of Wyville Thomson had collected from other localities of the Atlantic between Scotland and the Faroe Islands (500 feet) and near the coasts of Ireland (800 feet). *Brisinga endecacnemos* has been collected at 1,000 feet by the *Porcupine* off the coast of Portugal. It extends as high to the north and more to the south than *B. coronata*.

It would be bold to state that the Brisingidæ inhabit only rare localities of the Atlantic where the small number of specimens found in museums were collected, because we are still very far from having explored methodically even our European seas.

We will end the study of the mode of distribution of the families of the class of starfish. All have a very vast area of distribution. But it has been possible to assign for most of them the limits that they do not pass and to show that there exist regions where they seem to develop easily, where the number of their species reaches a maximum, the number decreasing more or less quickly according to the distances in any direction from these areas. It is appropriate now to pose the question more narrowly and to begin for the genera the study that we have made for the families.

GEOGRAPHICAL DISTRIBUTION OF GENERA

The mode of distribution of the groups designated as families we just considered are near those that Müller and Troschel 35 years ago called genera. Our Asteriadæ corresponds to their genus *Asteracanthion* except for the *Pedicellaster* and *Labidiaster* that were yet unknown.

Our Echinasteridæ corresponds to their genera *Solaster* and *Echinaster*. Only we had to transfer *Asterias striata* Lamarck, which the Germans believe to be an *Asteracanthion*, into this family. And another species, *Asterias clavigera*, of the famous French zoologist that the same authors had made an *Ophidiaster*.

The family Linckiadæ that we have adopted corresponds exactly to the genera *Ophidiaster* and *Scytaster* of the *System der Asteriden*. The same is true for the Goniasteridæ that corresponds to the genera *Astrogonium*, *Goniodiscus*, *Culcita* and *Oreaster* in the same work. Finally, the family Asterinidæ is only the genus *Astericus*, less *Pteraster* and Astropectinidæ are only the genera *Astropecten* and *Luidia*, to which we add *Chætaster*.

Thus each family that we have discussed previously can be divided into a very small number of the former genera. The maximum number of divisions is four, in the Goniasteridæ. We must note that in the Linckiadæ, the character used by Müller and Troschel to distinguish

² Since these lines were written, I must recognize, thanks to the kindness of Lacaze-Duthiers, a substantial memoir by G.-O. Sars on the brisingids. It refers to the research of this scholar that these interesting echinoderms are clearly true asteroids near *Asterias*. Their crossed *pedicellariae* are identical to those of all Asteriadæ. We do not hesitate to suppress the family Brisingidæ and place the genus *Brisinga* in the family Asteriadæ next to *Pedicellaster* and especially *Labidiaster*.

Ophidiaster from *Scytaster* does not hold in view of new observations and several authors have proposed to combine the two genera. It is the same for the character they used to distinguish *Astrogonium* from *Goniodiscus* that we propose again to unite under the generic name of *Goniaster*. Thus, according to von Martens, for example, the genera of Müller and Troschel can very well be reduced in the following fashion, using only those species recognized by these scholars.

Asteriadæ: Asterias (Asteracanthion) M. T.
Echinasteridæ: Echinaster, Solaster
Linckiadæ: Linckia
Goniasteridæ: Goniaster, Oreaster, Culcita. Gymasterias
(Asteropsis) M. T.
Asterinidæ: Asterina (Asteriscus) M. T.
Pterasteridæ: Pteraster
Astropectinidæ: Chætaster, Luidia, Astropecten

It is necessary to add the Brisingidae for *Brisinga*. Thus eight families and fourteen genera: five families each have only one genus and consequently do not concern us. Three families have two, another three, and the last four genera. We would have, even for them, very little to add to that we have already said.

Although this view has the support of some eminent naturalists, that Dr. Lütken notably is very close to accepting the genus *Goniaster* as he understood von Martens, we believe it necessary to proceed otherwise. There is no *practical* criterion that allows distinguishing a good genus from a bad one. Each author, when he wants to defend his genera, must give the principles that he used for their defining them. On the other hand, when it is a question of the general way to any category of divisions used in classification, it is necessary to say how they have been used. To systematically investigate the laws of the distribution of genera without saying what the word *genus* means would be nonsense. Here is how the genera I have accepted differ from those of Müller and Troschel and even more from those of von Martens.

When we consider the series of species that make up the genera of these authors it is easy to state the two following facts:

1. Some species in these genera are separated clearly from their congeners, either by an ensemble of a certain number of characters or by very apparent characters.
2. The remaining species, when those of the preceding category are eliminated, although more similar to each other, can be placed into less extended groups when certain characters are used, less apparent without doubt than those on which the large genera are based, but often very precise and evidently related to the organization of the animal. Such are the characters of the skeleton and its relation with the dermis in which it developed.

It seems to me that there is an advantage for the homogeneity of the genera to remove aberrant species in giving them a specific generic name.

On the other hand, it is equally advantageous to indicate all the modifications of a *structure* that individuals of the group can show. If the exterior ornamentation or even the usual relative sizes of the parts are used to define the species, the modifications, either in form or arrangement, have a different importance. We thus are inclined to define our genera according to the form and arrangement of the skeletal pieces, rejecting, to the contrary, all previous genera that were based only on the presence or absence and the arrangement of the dermal granulations, or on

the number of rows of ambulacral spines as are several of Gray's genera. We have not, moreover, had to introduce many new names, Gray having pushed to the last limits the fragmentation of families. We do not pretend, on the other hand, that our divisions have in any way a definitive character. Our knowledge regarding the descriptions of the skeleton and its pieces, our knowledge regarding the comparative anatomy of asteroids are still too incomplete that, in the future, very extensive modifications will be made to our present classification. But we just indicated the principles on which they will be based. We know how we have understood the genera and how the study that we are going to make on their geographical distribution will look. We hope at least to confirm the value of those that we have adopted and that, we repeat, very few are new.

FAMILY ASTERIIDÆ

GENUS ASTERIAS

This genus corresponds completely to the genus *Asteracanthion* Müller and Troschel. We believe it is necessary to separate *Stichaster*, formerly distinguished by Müller and Troschel themselves and whose compact skeleton, formed of pieces arranged in longitudinal series, is truly particular, as well as *Heliaster*, whose large disc, numerous short arms and pedicellariae are truly characteristic. We have already said that *Asteracanthion striatus* must be placed in the family Echinasteridæ as the genus *Valvaster*. On the other hand, we have seen no good reason to include the genera *Margaraster* and *Uniophora* of Gray, based only on the form of skeletal spines. Likewise, the genera *Leptasterias* and *Coscinasterias* of Verrill have modifications too small from the type that we believe it is necessary to keep them. The genus *Asterias* thus understood contains nearly all the Asteriidæ. We thus can apply to it all we have said of the family. It is nearly completely absent from tropical regions, notably in the Indian Archipelago and likewise on the west coast of South America. Temperate zones make up the principal areas of distribution. It goes north to Spitzberg and its species are abundant on the two coasts of North America, the coast of Chile and southern Australia. European seas, with only four confirmed species, are infinitely less well endowed. We will not repeat here the list that has been given before to better indicate that *Asterias* is nearly the entire family, disregarding the aberrant forms.

GENUS HELIASTER

The genus *Heliaster* has a very distinct area of distribution. It is exclusively restricted to the east (sic) coast of the Americas. Its five species, some of which are doubtful, range from the coast of Chile and the Galapagos Islands up to the Gulf of California. All known forms are very close to each other. At first glance, one would take them as unimportant varieties instead of distinct species.

GENUS PYCNOPODIA

The genus has only one species with numerous rays and has an extreme reduction of its dorsal skeleton. *Pycnopodia helianthoides* Brandt sp., inhabits the east (sic) coast of North America, from Sitka Island to Cape Mendocino. The specimens in the Museum are from California.

GENUS STICHAETER

We include *Stephanasterias* and *Cælasterias* of Verrill here. *Stephanasterias albulus* belongs to boreal regions. *Stephanasterias roseus* is from northern regions of the Atlantic. *Stephanasterias*

aurantiacus is from Chile. *Stephanus australis* is from New Zealand. This is a curious distribution and that calls for new work on the real relations that unite these species.

GENUS CALVASTERIAS

A single species from the Torres Strait.

C. asterinoïdes E. P.

GENUS ANASTERIAS

A single species of unknown origin,

A. nuda E. P.

GENUS LABIDIASTER

A single species from Patagonia.

L. radiosus Lovén

GENUS PEDICELLASTER

A single species discovered by Sars from the North Atlantic.

It is not out of context to note here how species with multiple arms are relative numerous on the west coast of the Americas. While in other parts of the world, we can only cite *A. muricata* and *S. australis*, both from New Zealand, and *A. tenuispina* from the Mediterranean and warm regions of the Atlantic that normally have more than five or six arms. We find on the American Pacific coast, going from north to the south, *Pycnopodia helianthoides* (ten to eleven arms), five species of *Heliaster* (fifteen to forty arms) and with them on the coast of Chile, *Aserias gemmifer* (eleven arms) and *A. gelatinosa* (six to eight arms), and finally on the coast of Patagonia, *Labidiaster radiosus* (31 to 35 arms). With these species are found moreover many others that have, as usual, five or six arms.

ECHINASTERIDÆ

If one includes in this family only the two genera *Solaster* and *Echinaster*, like von Martens, it would be necessary to consider *Echinaster* as cosmopolitan. We divide it into the following five genera: *Acanthaster*, *Echinaster*, *Valvaser*, *Criibrella* and *Mithrodia*. The geographic distribution of these genera should then become remarkably clear. The family is completed by the genus *Solaster*, accepted by all authors.

GENERA SOLASTER AND CRIBELLA

Between the distribution of these two genera, we note a remarkable coincidence. We find *Solaster endeca* in all the arctic seas. At Greenland, the Behring Strait, etc. *Solaster papposus* goes down

to the Channel — another species inhabits the southwest coast of Australia. Likewise, the cribrellids go north to Greenland and down to the French coast of the Atlantic. Moreover, one species has been found in the southern hemisphere at the Cape of Good Hope and another, perhaps the same, at New Zealand (Filhol).

GENUS ECHINASTER

Removing the cribrellids, the genus *Echinaster* occurs exclusively in warm and temperate regions. In our European seas, we find only one species, *E. sepositus* that long was thought to be restricted to the Mediterranean. But Fisher has found it in the Bay of Biscay. We have found it in the Channel and at Roscoff (Finistere) where it coexists with *Cribrella oculaa*. The other species, not numerous, inhabit the east coast of Africa and the Indian archipelago. Two species are found on the coast of Panama and four from North Carolina down to and including the Caribbean.

GENUS ACANTHASTER

Except for the Red Sea, the genus *Acanthaster* occupies the entire tropical region of the Pacific, to Panama. Outside this region, I have reported another *Acanthaster* at the Strait of Magellan. But the *Labidiaster* of Lovén that apparently has a very great resemblance to *Acanthaster* is also found in this region. One can ask if there is confusion between these two genera. Moreover, an *Acanthaster* has been reported also from the Galapagos Islands. It is not impossible, consequently, that the genus goes down to the coast of Patagonia. We call for new information.

GENUS VALVASTER

A single species known by a single specimen from Mauritius, *V. striatus* (*Asterias striata* Lam., *Asteracanthion striatus* Müller and Troschel).

GENUS MITHRODIA

Disregarding the aberrant station from the Strait of Magellan, *Mithrodia* seems to be superimposed on *Acanthaster*, like *Cribella* on *Solaster*. We find them in the Red Sea, on the east coast of Africa, at the Mascarenes, at the Philippines, the Hawaiian Islands and, finally, at Panama.

The respective areas of the various genera of Echinasteridæ are thus very clearly circumscribed — we find for the first time in this family two very clear examples of the genera that inhabit the cold or temperate parts of the two hemispheres, austral and boreal, and totally lacking in warm seas of the tropics.

FAMILY LINCKIADIÆ

From what we have seen, the family Linckiadiæ has a much more restricted area of distribution than the families we have just considered. On the other hand, the genera have approximately the same number of species. It is thus nearly a necessity that their particular areas where they are found overlap considerably. These areas are not, however, completely overlapping as we shall see in the following discussion.

GENUS OPHIDIASTER

This is the only genus of the family that is found in European seas. Two species occur in the Mediterranean. One of them, *O. ophidianus* has been found in the Atlantic at Madeira in the Canary Islands (Webb and Berthelot) and at the Cape Verde Islands (Bouvier). *Ophidiaster Floridae* E. P. occurs in the Strait of Florida and the *Ophidiaster Guildingii* Gray) occurs in the Caribbean Sea. These are the only species known for the Atlantic. All the other nineteen species are found in the Red Sea, the Mascarene Islands, the east coast of Africa, the Indian archipelago, China, New Caledonia, and even on the west coast of Africa, but in the warm region only.

It should be noted there is no *Ophidiaster* on the east coast of South America — on the coast of North America, they are not found above Cape San Lucas and Florida. The only species on the west coast of South America comes from Juan Fernandez Islands.

GENUS LINCKIA

The area of distribution of *Linckia* is a little less extensive. It is not found in European seas. They are found in the Atlantic only on the coast of the Cape Verde Islands (two species) and the Caribbean (one species). The Red Sea, the east coast of Africa, Madagascar, the Mascarene Islands, the Asiatic archipelago, various islands of warm regions of the Pacific, and finally the east coast of Central America is their true habitat.

GENUS SCYTASTER

This genus is a little less widespread than the genus *Linckia*. Like it, it is absent from Europe. But, moreover, it is completely absent from the coast of America. One species is found in the Red Sea and spreads from there into nearly all the Pacific (*S. Ægyptiacus* Gray). The other species are at the Mascarene Islands, the Asiatic archipelago, the seas of China and New Caledonia. Finally, we must add one species at the Canary Islands (*S. Canariensis* d'Orbigny), but it necessary to recognize its physiognomy differs very notably from that of the *Scytaster* from the Pacific. Gray formed for it the genus *Narcissia*. Never the less, *Narcissia* differs from *Scytaster* only in that their arms do not have a tubercular appearance like the latter. Basically, they have some analogy with *Fromia*, from which they are separated by the pyramidal form of their arms, the dimension of the arm relative to the disk and, more importantly, by the absence of marginal pates with a particular form and the arrangement of the ambulacral armature.

GENUS FROMIA

Fromia is restricted to the Red Sea, the Mascarenes and the Indian archipelago. One species (*F. Balansæ* E. P.) occurs at New Caledonia, another at Japan. I must say that these species have a very great resemblance to each other. Perhaps the discovery of intermediate forms will result in combining some of them.

GENUS METRODIRA

This interesting little genus has still only two species, one (*M. subulata* Lamarck) that occurs in the Torres Strait and the other (*M. subtilis* Lütken) in the seas of China.

GENUS FERDINA

Two species also, one from Mauritius and the other from the west coast of Colombia. This genus is very close to *Scytaster*.

FAMILY GONIASTERIDÆ

Taken as a whole and without considering of the number of diverse forms that inhabit the same locality, the family of Goniasteridæ could be apparently cosmopolitan. But if one goes down to analyze the genera, nearly all show, to the contrary, a very clear localization, of a kind that the mode of distribution of several of them is superimposed nearly exactly like that of genera we have studied in the previous families. This is an important result in the sense that it allows us to characterize large zoological provinces that study of families alone would not provide evidence.

In what follows, we will study the genera in an arrangement no longer in zoological order but in geographic order, beginning with those that are most northern.

GENUS HIPASTERIA

Four species have been described, but the types that we have seen appear to us to be only unimportant varieties of *Hippasteria plana*, figured by Linck under the generic name of *Pentaceros*. This is the species often designated as *Goniaster Phrygianus*. It has been found in the greatest part of the north region of the Atlantic: Finland, coasts of Norway and England (deep water) in Europe, and Duck Island and the Bay of Fundy in America in the zone of madrepores.

This genus thus characterizes the northern part of the Atlantic.

GENUS PORANIA

We know that two species of this genus that, without going perhaps as far up in European seas as the preceding, coexist however with it to a certain extent in the Atlantic and, in our hemisphere, does not extend further south. These two species are:

1. *Porania pulvillus* O.-F. Müller from the coasts of Norway (Lofoden, Bergen) and England.

2. *Porania Patagonica* from the Bay of Borja (Patagonia) and the Strait of Magellan.

Thus our European species is found represented nearly in the same latitudes of the austral hemisphere at the south end of the American continent, by a congeneric species. We have already had the occasion to note a similar fact for the cribrellids and *Solaster*.

GENUS PENTAGONASTER

This genus is the most numerous of the family. All the efforts to divide it have resulted only with incomplete results. We include a part of *Goniodiscus* of Müller and Troschel and all the *Astrogonium*, except *Astrogonium phrygianum* that remains a *Hippasteria*. Thus constituted, it has species whose marginal plates are smooth, others whose marginal plates are granulose. It can happen that the ventral plates alone are smooth or that the dorsal plates are also. Gray used this character and some others, like the presence or absence of spines either on the plates of the disk or on the marginal plates to establish the genera *Tosia*, *Pentagonaster*, *Astrogonum*, *Calliaster*, *Calliderma*, and *Stellaster*. Genera based on very difficult characters can be questioned. However,

it is very curious that certain established geographical regions correspond to them. As we define it, the genus *Pentagonaster* perhaps can be considered, to the contrary, as cosmopolitan.

We consider first the entirely granulose species to which Gray gave the name *Astrogonium*, which Müller and Troschel understood completely differently. There are four species in the North Atlantic from the coasts of England and Finland and three species in the Mediterranean. They are absent in warm regions but, as in *Poranian*, *Solaster* and the cribellids, we find them along the southern tip of the American continent, from Chile to Tierra del Fuego (four species), then at New Zealand (two species). It is true that another species occurs up to Port Essington in Australia (*P. paxillocus*) and another up to the Fiji Islands. The first, however, has a special physiognomy and approaches that of *Nectria* from the Torres Strait and nearby regions. But we cannot say the same about *P. spinulosus* of the Fiji Islands, although Gray separated it from *Astrogonium* and placed it in his genus *Hosea*. On the other hand, we do not know the provenance of *P. mammilatus* that is attached to this group.

Thus the two principal stations that we just indicated in the northern and southern hemispheres cannot be considered absolute.

The species with smooth marginal and dorsal plates (*Pentagonaster* and *Tosia* of Gray) also have their own special location. This is around the Australian continent where they occur for the most part. One of them, *P. pulchellus*, is found again at New Zealand.

The species from the Chinese seas, Japan and the Asiatic archipelago also have their special physiognomy. They all belong to sections of *Calliderma*, *Calliaster*, *Stellaster* and *Dorigona*, all with more or less distinct arms, sometimes very elongated and a very particular dermal ornamentation.

One species, *P. semilunatus*, which makes up the genus *Goniaster* of Gray, is found in China, at Brazil, Senegal, Cape Verde and the Bissagos Islands. We will return to this remarkable distribution. It is eminently exceptional and does not invalidate what emerges from the study that we just made, to know that each of the principal forms that make up the genus *Pentagonaster* belongs to a particular geographic region, nearly always very clearly circumscribed.

GENUS GONIODISCUS

Goniodiscus, which is so closely attached to *Pentagonaster* by *Stellaster*, obeys this rule in the sense that they inhabit precisely the same geographic region as the latter.

GENUS NECTRIA

The only one whose exact provenance we know (*N. ocellata* E. P.) is from the Bass Strait.

The other genera of Goniasteridæ that remain to be discussed from a geographical point of view, are infinitely easier to circumscribe, as we see it, than the genus *Pentagonaster*. They are, indeed, less numerous in species and less rich in different forms.

GENUS PENTACEROS

The genus *Pentaceros* is, after the genus *Pentagonaster*, that with the greatest extension. One species, according to Müller and Troschel, occurs in the Adriatic, but it has not been found by any authors concerned with the fauna of this sea. However, as a species of this genera has actually been found at the Cape Verde Islands and one very abundantly in the Caribbean, it could very well be that Mediterranean also has some. We know two from the Red Sea. The number of species

increases rapidly to the Mascarene Islands, where there are at least four. The Indian Ocean, the Asiatic archipelago, the northwest coast of Australia, and New Caledonia are among their preferred localities, exactly as we have seen for *Linckia* and *Ophidiaster*. Finally, two species inhabit the west coast of Central America.

Consequently, we can represent *Pentaceros* as inhabiting tropical seas and the warmer seas of temperate regions.

GENUS NIDORELLIA

Nidorellia, which seems to make the connection between *Pentagonaster* and *Pentaceros*, are peculiar to the west coast of Central America.

GENERA CULCITA, RANDASIA, ASTERODISCUS

Less numerous than *Pentaceros*, the culcites, although having an analogous geographic distribution, are however less widespread. We know of no species in the seas of Europe, on the west coast of Africa, or the east and west coasts of the Americas. But in the Red Sea we find *Culcita coriacea* M T., which lives along the entire coast of east Africa where it coexists with *Culcita pentagonalis* Lamarck and perhaps with *C. Schmideliana* Retzius. In any case, we find these two latter species together at Mozambique and probably in the entire Indian archipelago because the first has been collected at the Fiji Islands and the second at the Moluccas and perhaps even, although this is still uncertain, at the Galapagos Islands.

Another culcitid, *C. arenosa* Val., occurs at the Hawaiian Islands, and Vélain, Rochefort and Isle have reported it from the crater itself of Saint Paul Island a curious species we have proposed to name *C. Veneris*.

The Indian archipelago is thus undoubtedly the true center of the culcitids. To the west, they extend to the east coast of Africa and are found to the base of the Red Sea. To the east, they reach the Hawaiian Islands and perhaps the Galapagos archipelago. But it does not appear to have reached the west coast of America. They are thus much more confined than *Pentaceros*.

I believe *Randasia* Gray must be considered a young culcitid. We consequently have nothing to add regarding their origin.

Asterodiscus differs from the culcitids only by the presence of a naked plate on each side of each summit of the disk. The only specimen known is from the north-east of China.

GENERA GYMNASTERIA, DERMASTERIAS AND ASTEROPSIS

The genus *Gymnasteria* includes only a few species, of which only one perhaps can be considered as well known. It is *G. carinifera* Lamarck. It has an area of occurrence nearly exactly superimposable to that of *Mithrodia*. It is encountered in the Red Sea, on the east coast of Africa, at the Mascarenes, New Caledonia, Hawaiian Islands and finally on the east coast of Central America. This is also the where *Gymnasteria inermis* Verrill, perhaps identical to our *Dermasterias*, is found. As for *Gymnasteria inermis* Gray, it is simply a young *G. carinifera*. Our *G. valvulata* from the Galapagos Islands is known only from a young individual. It is not sure that *G. bisserrata* von Martens is distinct from *G. carinifera*. Finally, *G. imbricata* Grube from Sitka is only another of our *Dermasterias inermis*, for which we had first taken it only with doubt.

Asteropsis vernicina Lamarck, which has in common with *G. valvulata* a curious arrangement of pedicellariae, is from Panama and is encountered in consequence in the same region as *G. cafinifera* and in a region very near to *G. valvulata*.

FAMILY ASTERINIDÆ

As in the family Asteriadae, the genera in the family Asterinidae are very different from the point of view of range. *Asterina* contains nearly all the known species and we only repeat about it what we have said of the family.

The genus *Palmipes* has only three very distinct species but whose distribution is very remarkable. One, *P. membranaceus*, inhabits European Seas, from the Channel to the Mediterranean. It has its equivalent at New Zealand in *P. inflatus* Hutton. Finally a magnificent multiarmed species, *P. rosaceus* Lamarck, inhabits Japan.

The genus *Disasterina* has only a single species from New Caledonia. We know two *Patiria*, of which one, the only one whose provenance is known, occurs at western Australia.

Of the three known *Nepanthia*, one comes from the Strait of Prince of Wales, another from Migupou.

Finally, *Ganeria Falklandica* is perhaps *Ctenodiscus* at the Falkland Islands.

We do not know what *Socomia* Gray is or from where it came.

FAMILY PTERASTERIDÆ

Genus *Pteraster*. — Until now, only the genus *Hymenaster* Wyville Thompson has been accepted in the family Pterasteridae, appearing not to differ in characters sufficiently from the true *Pteraster*. We will be disposed, however, to separate the latter, not the *Hymenaster* Wyville Thompson, but the *Pteraster* that have been described under the name *P. Capensis* Gray and *P. cribrosus* von Martens. It is to be noted, in fact, outside of all other results, that in these species the dermal membrane is supported not only by radiating calcareous spicules around a bony support, but by a network of ligaments that unite these spicules and form a more or less large mail that is always closed and perfectly distinct. In addition, these latter species reach an enormous size relatively to that of the true *Pteraster* and live in other geographic regions. These latter particularities cannot be considered as generic characters but they give more support to the zoological character than we reported at first. We can name these asteroids as a new group under the name *Retaster*.

That accepted, the true *Pteraster* are animals from arctic regions or deep water. *Retaster* belongs to warm waters of the Pacific and does not live in very deep zones, if I judge by the number of specimens that have been collected outside methodical research. *Pteraster* goes up to the north to Spitzberg, living along the coast of Greenland, Iceland, England, and Norway. One species inhabits the coasts of Florida, where it has been collected at 125 feet depth. This fact is not isolated. Another form of cold regions, *Solaser fucifer* Düben and Koren, has been collected in the same region at 120 feet depth. Finally, another *Pteraster* is found at Rio de Janeiro (*P. Danae* Verrill).

Retaster comes from the Cape, Zanzibar and the Philippines. This is a region that we have had very often the occasion to refer and of which we will have a little later to indicate the characters from the point of view of the asteroid fauna.

FAMILY ASTROPECTENIDAE

In this numerous family, three genera are very clearly characterized. These are the genera *Chaetaster*, *Luidia* and *Ctenodiscus*. Two, very distinct from these, have, to the contrary, the greatest similarity and differ only by the presence of an anus in *Archaster* and its absence in *Astropecten*. This character, which appears important in other groups, is perhaps much less important in asteroids where the anus is extremely reduced in relation to the development of the digestive system and appears, moreover, to have only a very unimportant physiological role. We are thus not astonished that many species have been assigned to one or the other of these two genera that could have been combined easily and that zoological geography shows us as widespread, both coexisting often in the same waters.

Archaster typicus and *angulatus* seem however to be slightly different from the others. They have pedicellariae lacking in European species of *Archaster*. Their anus is more visible and the pieces of their skeleton scarcely protrude, very notable differences from the special paxillae of the *Astropectinidæ*. These two species inhabit the Indian archipelago. The first goes up to Japan and extends towards the east to New Caledonia and the Tonga Islands. The Mascarene Islands, Java, the Philippines and Australia are the localities where the second has been collected up until now. *Archaster Hesperus* is from Japan. *Archaster subinermis* is from the Mediterranean. All the other six species are from northern regions of deep waters of the Atlantic.

Astropecten does not inhabit such cold waters. They do not appear to ascend into the glacial Arctic Ocean. No species is found from the southern point of the American continent whose extreme southern latitude would be New Zealand, where *A. Edwardsi* has been described. Except for that, all seas have some species of *Astropecten* and the Mediterranean does not seem the least well apportioned.

Luidia ascends perhaps a little less high towards the north than *Astropecten*, — but it is found at some depth in warm and temperate seas. There are usually only one or two species in the same region.

Chaetaster, few in numbers, occupy a zone still more restricted: the Mediterranean, the Antilles and the Philippines. However, Grube has reported a species from California, whose provenance requires verification.

Finally, contrary to the preceding genera, the genus *Ctenodiscus* is restricted to cold waters: Finland, coasts of Norway, Greenland, etc. Another has been collected in Patagonia and described by Doctor Lütken.

Thus four zones can be established corresponding to the four principal genera of the family *Astropectinidæ*. The first is very restricted, wider however than the tropical region where there are the genera *Chaetaster*, *Luidia* and *Astropecten*. The second, exceeding the first, has *Luidia* and *Astropoecen*. Finally a third, still more extensive, is inhabited by *Astropecten*. Outside these three overlapping zones are the polar caps whose limited region is inhabited by *Ctenodiscus* and some *Archaster*.

FAMILY BRISINGIDÆ

The only species in the genus *Brisinga* are from deep regions of the Atlantic (Lofoden Islands at the coast of Portugal).

SUMMARY

If we now look at all the facts on the geographical distribution of the genera of asteroids, here is what is clear. Some genera can be considered cosmopolitan. Others, to the contrary, inhabit more or less restricted areas of the globe. The cosmopolitan genera should be considered as those that best respond to the varied conditions that may be present in the seas. The others, to the contrary, are restricted to more or less limited regions of the globe. The cosmopolitan species should be considered as those that adjust best to the effects to the various conditions of the seas, as those that resist best the effects of the environment, those that, in a word, have the greatest organic *resistance*. But they are also those that have the greatest number of species, those consequently that have the maximum *plasticity*. The coincidence of these two facts is not without interest, because we can ask if they are not connected by a cause and effect, if the reason for the great extension of these genera is not found precisely in the facility with which the forms that compose them, without being very distant from a common type, have been able to adapt to the most varied biological conditions. It is thus important, consequently, to establish by numbers what we are going to say. The genera that can be considered as nearly cosmopolitan are *Asterias*, *Pentagonaster*, *Asterina* and *Astropecten*. The first has 82 species, the second as 34, the third 31, the fourth 63. In all, 210 species, i.e., nearly half the total number of 443 species. As the total number of genera is 51, we see that, for the 47 remaining genera, there are more than 235 species, i.e. an average of five species per genus while the four first have, to the contrary, an average of 52, five species per genus, more than ten-fold.

It is obvious that in these cosmopolitan genera, the effect of climate, of the average temperature has little effect on the distribution of the species, although it is, however, possible to emphasize it. Other species show, to the contrary, the influence in a very marked fashion. Within certain limits of latitude, they are encountered all around the globe. There are some genera whose *resistance* is considerable as certain conditions of temperature and light occur. It should be noted they come immediately after the four that we just discussed relative to the number of species that indicate their degree of *plasticity*. They are the genera *Echinaster*, *Linckia*, *Ophidiaster*, *Pentaceros*, *Culcita* and *Luidia* that have the following number of species:

Echinaster	15
Linckia	16
Ophidiaster	19
Culcita	7
Pentaceros	31
Luidia	<u>14</u>
Total	<u>102</u>

There is an average of seventeen species per genus. But these six genera added to the four preceding make in all only ten genera. There remains consequently 41, among which are distributed 133 species. That makes only 3.2 species per genus, although those of the first series contain nearly 53 and those of the second, seventeen. This average would decrease again if one confused, as could be done easily, *Archaster* with *Astropecten*. These remaining genera are made up in general of species that are only few in number but also extremely regional. There are, however, some exceptions that must be studied in the genera *Acanthaster*, *Mithrodia* and *Gymnasteria*, exceptions to which we cannot call too much attention but which do not invalidate

the generality of the law that, in asteroids: *the genera have in general a greater geographical extension as they increase in number of species.*

The richest genera and the most invasive are nearly indifferent to climatic conditions. Next come genera that require an average high temperature but that seem indifferent to the greatest number of biological conditions. Finally, genera that are very poor in species are also, as a rule, very circumscribed and seem to be able to adapt to only to specific biological conditions. It is interesting to see very frequently forms belonging to these genera correspond at the same latitude in the two hemispheres, such occurs for cribrellids, *Porania*, *Palmipes* and *Ctenodiscus*.

Among those genera whose geographical distribution is limited, only one can be considered restricted to the Atlantic, *Hippasteria* so close, moreover, to *Pentagonaster*. The genera *Heliaster*, *Labidiaster*, *Demasterias*, *Asteropsis*, *Amphiaster*, and *Nodorellia* are restricted to the west coast of the Americas while the east coast has only a single genus that is restricted to it. *Calvasterias* and *Anasterias*, unimportant varieties of the type of the genus *Asterias*. *Acanthaster*, *Mithrodia*, *Fromia*, *Metrodira*, *Ferdina*, *Asterodiscus*, *Culcita*, *Nectria*, *Goniodiscus*, *Anthenea*, *Gymnasteria*, *Disasterna*, *Patiria*, and *Nepanthia* are restricted to the Pacific and to their adjacent seas (sixteen genera). This is sufficient to show how much greater is the variety of types in this region than in the Atlantic. This variety coincides precisely with the very much greater extension of the warm regions and a variety also is also very much greater in the biological conditions, a variety that is related to the large number of islands and archipelagos, of gulfs and arms of the seas that are part of the Grand Ocean.

These are the striking coincidences. We cannot go back further in our search for the causes that led to the geographic distribution of these groups that we call genera. What is the basis of these groups, themselves? We do not know. These two questions are connected, are perhaps susceptible to clarification, the one by the other. But their solution, which we still do not know how to solve, far from it, is lost in the distant past.

GEOGRAPHICAL DISTRIBUTION OF SPECIES

In spite of the large number of definitions given for species, we still have no criterion, applicable in all cases, how to recognize with certainty, the individuals that belong to the same species. I.e., those that are descended from a common ancestor and that, reproducing, are apt to provide fertile offspring. On the other hand, the criterion of unlimited fertilization is very often inapplicable. On the other hand, the genealogical criterion is no less. It is impossible to clearly limit the degree of similarity or dissimilarity that individuals coming from the same parents can have, and it is no less embarrassing when it is necessary to distinguish between individual characters and truly specific characters.

This is one of the greatest difficulties encountered when one wants to define the area inhabited by a species. This difficulty for little studied asteroids, often described insufficiently, shows itself to the highest degree. Our European species even are still from being well known. No one has dared to decide whether, for example, if *Asterias rubens* and *Asterias violacea*, are the same species or not. *Pentagonaster granularis*, *P. aculeatus*, and *P. borealis* perhaps are perhaps only a single species, and the fact seems certain for *Hippasteria plana*, *H. Europaea* and *H. Abbensis*. Likewise, the exact number of species of the west coast of the Americas is still to be established. If this is so for the species that eminent naturalists have frequently studied, one understands that it doubtful for most others. This is especially true for the species that have a vast distribution and in which local varieties frequently occur. Finally, several inadequately described

species have only a doubtful validity. We must remember all these facts in order to show that we cannot consider the results we are going to show as having a definitive value. These results are given in the lists given above that include the names of all species that have provisionally accepted.

We have been able to examine many of these species but I have not seen everything and we realize there are many that new study will lead to their non-acceptance. Other names, to the contrary, are not there because we are sure they are duplicates used with older names. We review these in *Révisions des Stellérides du Muséum (Archives de Zool. Expérimentale, IV and V)* and the table of concordance that ends the latter work.

As it is, this lists represents the present state of our knowledge on the species names of asteroids and the localities where each is found. The number of nominal species is 445.

Here are the general observations that the reading of this list suggests.

Between the east coast of North America and the European coast of the Atlantic, we find common species like the hyperboreal species or those of deep waters, i.e., *Cribrella oculata*, *Hippasteria plana* and *Pteraster militaris*. von Martens thought he found *Cribrella oculata* at Java and Isle de Flores. There is indeed a cribrellid at the Cape of Good Hope, Campbell Island and New Zealand., but we will consider it as distinct from *C. oculata*. We have described it under the name *C. ornata*, and it is probable that the specimens observed by von Martens should be referred to it. With this reservation, we can say that the three species just discussed do not reach into America below the Bay of Funday. In Europe, they barely reach the Channel, where *Cribrella oculata* is the only one encountered. No *Asterias*, no *Echinaster*, no *Asterina*, and no *Astropecten* are common to the two coasts. In summary, from the Bay of Funday to Florida, no American species is found on the opposite coast of the Atlantic. We will soon see that things are modified a little below Florida. But we return to European seas.

A theory, although the facts have long been invalidated, requires that no sedentary animal is common to the Mediterranean and the Atlantic. The starfish contradict this. Truthfully, *Asterias rubens* that is found on the entire European coast of the Atlantic and descends to Senegal, does not appear in our great interior sea. But *A. glacialis*, which extends however to Finland, is abundant there and has many varieties, to each of which Valenciennes has given a name in the collection in the Museum. *Asterias glacialis* descends, moreover, very low in the Atlantic and I would not be far from considering, as simple local varieties of this species, the *A. madeirensis* Stimpson that inhabits Madeira in spite of the very clear but unimportant characters that it has, and even *A. Webbiana* d'Orbigny collected by Webb and Berthelot at the Canary Islands.

Another Mediterranean asteroid species surely penetrates into the Atlantic. This is *A. tenuispina*, collected at Madeira by de Castelneau, now vice-consul of France at Melbourne (Australia), at the Canaries by Webb and Berthelot, at the Cape Verde Islands by Bouvier, and which has also been reported at the Bermudas by Dr. Lütken. These facts agree perfectly with the others we can report now. *Ophidiaster ophidianus* inhabits the Atlantic and is encountered in the Atlantic at the Canary Islands (Webb and Berthelot) and the Cape Verde Islands (Bouvier). *Echinaster sepositus* seems, to the contrary, goes north of the Strait of Gibraltar. It is in the Bay of Biscay (Fischer) and in the Channel, at Roscoff (Perrier) where it has been encountered. But we must receive, with an infinitely greater reserve, indications that *A. tenuispina* inhabits Mauritius, Java, the Mollucas, Australia, and finally on the coast of China and Hong Kong. It should be noted that *Asterias calamaria* inhabits this same region and perhaps by other species, whose young have a very great resemblance with adult *A. tenuispina*, could be confused easily with it.

von Martens again indicated that *Asterias rubens* is found in Japan. But no other fact has confirmed this.

Here is another analogous geographic distribution, to which I have reservations. In the family Asterinidæ, there are two species known in the Mediterranean and the Atlantic: *Palmipes membranaceus* and *Asterina gibbosa*. The first has not been found elsewhere but, according to Michelin, Peters, and von Martens, *A. gibbosa* is also found in the Red Sea, the Mozambique Strait, Mauritius, Flores Island, the Philippines, and finally the Moluccas. I am very astonished to have encountered no specimens from these locations either in the collection of the Jardin des Plantes or in that of the British Museum, which contains, however, many other *Asterina* from these locations. The collection of Michelin itself has none. Michelin has recorded the *Ophidiaster ophidianus* as inhabiting Mauritius, but he apparently confused it with *O. Leachii* in his collection. On the other hand, a figure of Savigny, that Müller and Troschel referred to *A. gibbosa*, that they named *Asteriscus verruculatus*, is really in the most recognizable fashion *A. cephea* Valenciennes, which is abundant in all collections. What is this species that has been taken by the authors in question for a true *A. gibbosa*? We can respond that these same authors also report *A. cephea*, but we never find a remarkable and however very common species, *A. wega*, that is not without some relation with *A. cephea*. Is it to it that the latter names has been used? These of the questions that must be resolved and that we would like to see examined again.

It should be noted, indeed, that *A. tenuispina* and *A. gibbosa* are the only common species that have been reported between the Mediterranean and the Red Sea or in the Pacific. If the observations just presented lead to the recognition that the two Mediterranean species are really distinct from those of the Red Sea and the Pacific to which their names have been applied, we arrive at this important rule that *no asteroid is common to the Mediterranean and the Red Sea*, whose fauna has, moreover, from this point of view, characters absolutely different, that the presence of some common species does not suffice to erase. And yet some species of mollusks are common to the Red Sea and the Mediterranean. Ehrenberg and Hemprich cites no less the 74 out of 408, nearly a sixth.

If all the species of asteroids common to the Mediterranean and the Red Sea are still doubtful, we have had, to the contrary, to mention several species common to the Mediterranean and the warm and temperate parts of the Atlantic. We can now increase this number to at least one species of *Astropecten*, *A. serratus* Valenciennes, which is found at Marseille, in the Bay of Biscay and at Rochelle. *Luidia ciliaris* should also be part of this list, making a total of seven species. On the other hand, we have seen that one of these species, *A. tenuispina*, reaches as far as Bermuda. It has not been reported further. But it is not the same for some species that coexist with it at the Cape Verde Islands or on the African coast of the Atlantic. I want to speak of *Lickia Guildingii* Gray, *Pentagonaster semilunatus* Linck, *Aserina stellifera* Mobius, and finally *Luidia senegalensis* M. T. These species cross the Atlantic and are found on the coast of America: *L. Guildingii* at Bermuda, the Antilles, the Gulf of Mexico (Vera Cruz) and on the coast of Brazil (Bahia); *P. semilunatus* at the Antilles and on the coast of South Carolina (Charleston); *A. stellifera* at Brazil (Rio Janeiro); and finally *L. senegalensis*, likewise at Brazil.

These are the American specimens that have been described: *Ophidiaster ornithopus* Valenciennes, *Scytaster stella* Duchassaing, *Goniaster americanus* Verrill, *Asteriscus marginatus* Valenciennes (a name that should be retained), *Asteriscus brasiliensis* M. T., and *Luidia Marcgravii* Lütken. Even though some details can be used to support these species, the fact of the exact correspondence of some similar forms on the two coasts of the Atlantic is striking proof of their identity. This fact becomes even more important if we note that the different places where these forms are found are placed precisely on the path of the great current that leaves the Gulf of Guinea, runs along the north coast of Brazil, and goes along the coast of central America to the

base of the Gulf of Mexico, and is reflected to return to the African coast after forming the Gulf Stream that passes by the Azores and Madeira, and the great north equatorial current that ends at the Cape Verde Islands. Thanks to this current that constantly mixes the American waters with those of the African coasts, the species inhabiting these waters should be transported easily from one coast to the other of the Atlantic. It is thus quite natural that we find some of them entrained in its path and, moreover, the fact is not restricted to the asteroids.

Neritina viridis and *Columbella cribraria*, among the gastropod mollusks, is found in the Antilles, at Madeira, and the Canary Islands, and it is known that several species are considered as common to the Antilles and to Sicily. Even some terrestrial mollusks (*Helix advena*, *Bulimus bæicatus*, *B. badius*) are common to the Canaries and some islands of the Antilles. Although the fact of the existence of the some species on the east and west coasts of tropical part of the Atlantic is not very surprising in that it concerns starfish and we are led to the explanation of the fact by this other, that if in the circumpolar region there are common European and American species, that is that there are none in the average or temperate zone. The influence of the equatorial currents and the Gulf Stream emphasizes this as clearly as possible.

We have successively supported and rejected the existence of species common to the eastern and western coasts of America. We do not know a single species of starfish that shows this, not even a single species of one of the coasts that that can considered as near a species of the opposite coast. We have seen, to the contrary, that many genera are restricted to the west coast. We would not want to support, in regard to echinoderms, another proposition advanced by Darwin regarding mollusks, i.e., no species is common to the west coast of America and the Pacific islands. To make the phenomenon that we have reported more striking, we must study first the mode of distribution of species in the Red Sea and across the Pacific archipelagos.

If we do not find species that should surely be considered as occurring at the same time in the Mediterranean and the Red Sea, we see, to the contrary, a good number of these species descending the length of the African coast, reaching Madagascar, the Mascarene Islands, to extend over all of Malaysia and even to the northern coast of Australia and then passing to New Caledonia and the Fiji Islands. To the north they are found again in the Hawaiian Islands. It is from there that they reach Central American in the region of Panama, that has some analogies in detail with the Indo-Pacific region.

This is certainly the case for *Gymnasteria carinifera* that we have been able to examine authentic individuals coming from the Red Sea, Mauritius, Amboine, New Caledonia, the Fiji Islands, the Hawaiian Islands, and Panama.

Considering the reports of the genera *Linckia*, *Acanthaster*, and *Mithrodia*, we are struck by the coincidence of the following species:

<i>Lickia diplax</i>	Mascarenes, Madagascar, New Caledonia, California
<i>Acanthaster echinites</i>	Philippine Islands (Mindanao), Moluccas (Ternate, Amboine) Sunda Islands (Java, Sumatra), Fiji Islands
<i>Acanthaster Ellisii</i>	La Paz, Ecuador, Galapagos Islands
<i>Mithrodia clavigera</i>	Mascarenes, Java, Flores, Moluccas, Tahiti, Hawaiian Islands
<i>Mithrodia Bradleyi</i>	Panama

If one accepts that the two *Acanthaster* species and the two *Mithrodia* species are one and the same species, we find that the geographical distribution of *Acanthaster* and that of *Mithrodia* in question are identical to that of the well authenticated *Gymnasteria carinifera*.

It is mostly because of the difference in habitat that Doctor Lütken has proposed to distinguish the *Acanthaster* of the Pacific from that of Panama, and the individual that we ourselves have designated *A. Eellisi*, because of certain zoological characters, not considering provenance. The question remains and the probabilities are to the contrary that the *Acanthaster* of America and that of the Pacific are the same species.

Regarding *Mithrodia*, we find two very distinct forms in the collections. One has narrow arms, elongated spines covering their entire length except at the top, small scales forming five rows of which the dorsal median one and the two adjacent ones are in general very incomplete. Tubercles covered with a very small number of granules are scattered on the skeletal ossicles, particularly on the nodes between the spines. — In the other form, the arms are more robust, the spines much shorter, and their three dorsal rows are less distinct. The spines that form them are not much different from the other tubercles on the skeletal ossicles. All are covered by a very large number of granules. All these give together a very different physiognomy. But, basically, these characters are the only differences in the development of the same parts. It should be noted that the essential characters, the identical number of spines of each interambulacral plate remains the same. Several specimens recently received from the Hawaiian Islands at the museum of Paris belong to the second type. Some analogous individuals have been considered a distinct species under the name *M. clavigera* by Horace Mann, who kept for Asiatic individuals of the first type, the name of *M. spinulosa* Gray. Now, these *M. clavigera* do not differ from a Panamanian individual whose label I have seen at the British Museum, *Mithrodia Bradleyi* Verrill. If we stopped at these identifications, we would thus have three species of *Mithrodia*. But I must remark that *M. Bradleyi* and *M. clavigera* must have been confused. The latter and *M. spinuola* occur together at several localities. Will we not find intermediate forms and that these three nominal species must be combined into one whose geographical distribution would be the same as that of *Acanthaster echinites* and *Gymnasteria carinifera*? This manner of seeing is not improbable and, moreover, it is not accepted. It remains no less interesting, from the point of view of the idea of the species, to see forms so very close replace each other in an area of distribution that can be completely occupied by one species of another genus. Inevitably, it raises the question of a genealogical relationship between these forms.

Other species occupy a less vast area but that coincides partially with the preceding.

We have not spoken here of the family Asteriadæ of which the Pacific Ocean has only rare forms; but in the other families we find the following distributions.

<i>Echinaster fallax</i>	Red Sea, Zanzibar, Timor, Philippines, Querimba, New Zealand
<i>Fromia milleporella</i>	Red Sea, Reunion Island, Madagascar, Moluccas
<i>Linckia miliaris</i>	Red Sea, Mozambique, Mauritius, Flores, Timor, Celebes, Philippines, north of Australia, New Caledonia
<i>Linckia multifora</i>	Red Sea, Mozambique, Mauritius, Larentuka, Celebes, Moluccas, New Caledonia, Hawaiian Islands
<i>Linckia pacifica</i>	Nicobar Islands, Samoan Islands, Tahiti

<i>Ophidiaster pusillus</i>	Flores, Moluccas, Philippines, New Caledonia
<i>Culcita pentagularis</i>	Mozambique, Torres Strait, Fiji Islands
<i>Pentaceros muricatus</i>	Zanzibar, Madagascar, Seychelles Islands, Mascarenes, Timor, Larentuka, near Flores, Moluccas
---- <i>turritus</i>	Zanzibar, Mascarenes, Moluccas, New guinea, New Caledonia
<i>Asterina cephea</i>	Red Sea, Zanzibar, Mozambique, Iho, Java, Philippines, New Caledonia
<i>Archaster typicus</i>	Japan, Moluccas, Flores, Timor, Australia, New Caledonia, Tonga island
<i>Astropecten polyacanthus</i>	Japan, Ceylon, Red Sea, Australia, New Zealand

It is all one fauna of starfish that characterizes a well determined region of the globe, and to which can be added some species of less extended regions, species characterizing secondary regions.

One species seems to escape the rules, which stands out from the preceding. Its geographical distribution seems to justify what has been attributed to *Asterias rubens* and *A. tenuispina*. I want to speak of *Pentagonaster semilunatus*. We have already encountered it at the Cape Verde Islands, Bissagos Islands, and at Senegal and on the east coast of America. Its distribution conforms to that of the preceding species. But we find this same *Pentagonaster* at Zanzibar, the Malaysian islands and finally in China. I.e., that it has as extensive a distribution in the great region of the Pacific that we have just outlined, that in the tropical region of the Atlantic. It is a fact unique in the history of starfish. It would be surprising if one of the groups of echinoderms that have been better studied show analogous facts. Here is distribution of an echinid reported by Alexander Agassiz:

<i>Diadema setosum</i>	Cape Verde Islands, Indian Ocean, Fiji Island, Hawaiian Islands, Japan
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It is equally isolated in this group, where we find, moreover, the grand general facts that we have reported for starfish. In the tropical region of the Atlantic, we see indeed the following species of urchins passing from the African coast to the American coast of this ocean.

<i>Arbacia pustulosa</i>
<i>Diadema setosum</i>
<i>Echinometra subangularis</i>
<i>Echinocardium cordatum</i>
<i>Brissus unicolor</i>

We also see *Echinanthus testudinarius* and *Metalia maculosa* common the Pacific islands and the west coast of America. As to the species common to the largest part of the islands of the Asiatic archipelago, they are just as numerous as in the starfish families and can, like them, go up to the Red Sea and extend to New Caledonia or to the Hawaiian Islands.

Such are the general fact on the geographical distribution of the species. As to specific facts, the extensiveness of each species, this is easily seen in the following list that summarizes all the

information that we have been able to obtain. The bathymetric information is so little that we do not believe it is useful to mention it.

List of known asteroid species and information on the principal locations where they have been found up to this day.

ASTERIADÆ

I. GENUS ASTERIAS LINNÉ

1	Asterias	acervata Stimpson	Behring Strait
2	----	acutispina Stimpson	Ousima Island
3	----	æqualis Stimpson	Monterey (California)
4	----	africana Müller and Troschel	Cape of Good Hope
5	----	amurensis Lütken	Tartary Channel
6	----	antarctica Lütken	Strait of Magellan
7	----	arenicola Stimpson	Long Island, Carolina, Georgia
8	----	aster Gray	?
9	----	borealis E. Perrier	Labrador
10	----	bootes Müller and Troschel	?
11	----	borbonica E. Perrier	Reunion Island
12	----	brevispina Stimpson	San Francisco
13	----	brachiata E. Perrier	Gulf of Georgia
14	----	calamaria Gray	Mauritius, Australia, New Zealand
15	----	capensis Stimpson	South Africa
16	----	capitate Stimpson	San Diego, California
17	----	clavata Philippi	Chile
18	----	compta Stimpson	New Jersey (deep water)
19	----	conferta Stimpson	Puget Strait
20	----	Cunninghami E. Perrier	Punta Arenas (Strait of Magellan)
21	----	cribraria Stimpson	Behring Strait
22	----	echinata Gray	Valparaiso
23	----	disticha Brandt	Kamschatka
24	----	epichlora Brandt	Sitka Island, Puget Strait, mouth of the Oregon
25	----	Farbricii Al. Agassiz	Labrador
26	----	fissispina Stimpson	Shoal-water Bay, Oregon
27	----	Forbesii Desor	Grand Menan, Eastport (Maine), Chelsea, Beverly
28	----	fulva Philippi	Chili
29	----	fungifera E. Perrier	Australia
30	----	gelatinosa Meyen	Chili, Bolivia (Mejillones)
31	----	gemmafer Valenciennes	Chile

32	----	Germani Philippi	Chile
33	----	gigantea Stimpson	Oregon
34	----	glacialis Linné	Finland, Iceland, the entire Atlantic coast of Europe, Mediterranean, Canary Islands, Cape Verde Islands
35	----	globifera Gray	Tasmania
36	----	granifera Lamarck	Australia, Tasmania
37	----	grønlandica Steenstrup	Greenland
38	----	hexactis Stimpson	Strait of Puget
39	----	hispida Pennant	North of the Atlantic
40	----	japonica	Japan
41	----	janthina Brandt	Sitka Island
42	----	Jehennesii Valenciennes	Madagascar
43	----	Kamschatika Brandt	Kamschatka
44	----	Katherinæ Gray	Oregon? Labrador?
45	----	Linckii Müller and Troschel	?
46	----	littoralis Stimpson	Eastport (Maine)
47	----	lurida Philippi	Chile
48	----	Lütkeni Stimpson	Oregon
49	----	Madeirensis Stimpson	Madeira
50	----	margaritifer Müller and Troschel	?
51	----	meridionalis E. Perrier	Antarctic seas
52	----	mexicana Lütken	Mexico
53	----	mitis Philippi	Chile
54	----	mollis Hutton	New Zealand
55	----	Mülleri Sars	Finland, coasts of Norway
56	----	Ochotense Brandt	Kamschatka
57	----	ochracea Brandt	Sitka Island to San Francisco
58	----	pallida Al. Agassiz	Chelsea, New Jersey
59	----	paucispina Stimpson	Strait of Puget
60	----	pectinata Brandt	Kamschatka
61	----	polaris Müller and Troschel	Greenland
62	----	polyplax Müller and Troschel	Tasmania
63	----	rarispinus E. Perrier	Cape of Good Hope
64	----	Rodolphi E. Perrier	Kermadec Islands
65	----	rubens Linné	European coasts of the Atlantic, Senegal, Japan (von Martens <i>fide</i>)
66	----	rugispina Stimpson	Strait of Magellan, Tierra del Fuego
67	----	scaber Hutton	New Zealand
68	----	sertulifera Xanthus	Margarita Bay, Cape San Lucas (California)
69	----	sinusoida E. Perrier	Hobart Town, (Tasmania)

70	----	spectabilis Philippi	Chiloe Islands
71	----	stellionura Valenciennes	Spitzberg
72	----	Stimpsoni Verrill	Eastport (Maine)\
73	----	sulcifer Valenciennes	Tierra del Fuego
74	----	tenera Stimpson	Massachusetts Bay, Eastport (22 feet depth)
75	----	tenuispina Lamarck	Mediterranean, Madeira, Canaries, Cape Verde Islands, Bermudas, reefs of Abrohlos, Mauritius (Michelin <i>fide</i>) Java, Mollucas, Australia, Hong Kong (von Martens <i>fide</i>)
76	----	Troschelii Stimpson	Strait of Puget
77	----	Vancouveri E. Perrier	Vancouver Island
78	----	varia Philippi	Chili
79	----	violacea O.-F. Müller	North of the Atlantic to Finland
80	----	vulgaris Stimpson	Labrador (inclusive) to Cape Cod
81	----	Webbiana d'Orbigny	Canary Islands
82		Wilkinsoni Gray	North of Africa

II. GENUS ANASTERIAS E. PERRIER

83	Anasterias	nuda E. Perrier	?
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III. GENUS CALVASTERIIAS E. PERRIER

84	Calvasterias	asterinoides E. Perrier	Torres Strait
----	--------------	-------------------------	---------------

IV. GENUS HELIASTER GRAY

85	Heliaster	canopus Valenciennes	Juan Fernandez Islands
86	----	Cumingi Gray	Galapagos Islands
87	Asterias	helianthus Lamarck	Payta, Callao, Caldera, Valparaiso
88		Kubiniji Xantus	Margarita Bay, La Paz, Cape San Lucas, Mazatlan, Acapulco, Hawaiian Islands
89	----	microbrachia Xantus	Margarita Bay, Cape San Lucas, Pearl Island, Panama
90	----	multiradiata Gray	Galapagos Islands

V. GENUS PYCNOPODIA STIMPSON

- | | | | |
|----|------------|----------------------|---|
| 91 | Pycnopodia | helianthoides Bramdt | Sitka Island, Strait of
Puget, Gulf of Singio,
Tomales Bay (California) |
|----|------------|----------------------|---|

VI. GENUS LABIDIASTER LÜTKEN

- | | | | |
|----|-------------|----------------|-----------|
| 92 | Labidiaster | radiusus Lovén | Patagonia |
|----|-------------|----------------|-----------|

VII. GENUS PEDICELLASTER SARS

- | | | | |
|----|---------------|-------|--|
| 93 | Pedicellaster | | |
|----|---------------|-------|--|

VIII. GENUS STICHAETER MÜLLER AND TROSCHEL

- | | | | |
|----|------------|---------------------|---------------------------------|
| 94 | Stichaster | albulus Stimpson | Greenland |
| 95 | ----- | aurantiacus Meyen | Callao, Chile |
| 96 | ----- | australis Verrill | New Zealand |
| 97 | ----- | roseus O.-F; Müller | Coasts of England and
Norway |
-

ECHINASTERIDÆ

IX. GENUS ACANTHASTER PAUL GERVAIS

- | | | | |
|-----|-------------|----------------|--|
| 98 | Acanthaster | echinites Gray | Philippine Islands
(Mindanao), Moluccas
Islands (Ternate,
Amboine), Sunda Islands
(Java, Sumatra), Fiji
Islands |
| 99 | ----- | Ellisii Gray | La Paz, Ecuador,
Galapagos Islands |
| 100 | ----- | Solaris Ellis | Strait of Magellan |

X. GENUS CRIBRELLA AGASSIZ

- | | | | |
|-----|-----------|---------------------|---|
| 101 | Cribrella | lœviuscula Stimpson | Strait of Puget, Oregon |
| 102 | ----- | oculata Linck | Finland, coasts of
Norway and England, |

			Channel, Greenland, Labrador, Grand Menan, Bay of Fundy, Nantucket Island, Eastport (Maine), Java, Timor (von Martens <i>fide</i>)
103	-----	ornata E. Perrier	Cape of Good Hope, Campbell Island, New Zealand
104	-----	Sarsii Müller and Troschel	Bergen

XI. GENUS ECHINASTER MÜLLER AND TROSCHEL

105	Echinaster	brasiliensis Müller and Troschel	Rio Janeiro
106	-----	crassus Müller and Troschel	?
107	-----	cribrella Lütken	Chili
108	-----	deplantus Grube	?
109	-----	echinophora Lamarck	Virginia, Yucatan (Belize), Bahia, Rio Janeiro
110	-----	eridanella Valenciennes	New Ireland, New Caledonia
111	-----	fallax Müller and Troschel	Red Sea, Zabzibar, Tinnor, Philippines (Luzon), Querimba, New Zealand
112	-----	gracilis Müller and Troschel	Madagascar
113	-----	lacunosus Grube	?
114	-----	sentus Say	Florida
115	-----	sepositus Retzius	Coast of Brittany (Roscoff), Bay of Biscay, Mediterranean
116	-----	serpentarius Valenciennes	Vera Cruz
117	-----	spinulosus Verrill	Florida
118	-----	ternuispinus Verrill	La Paz
119	-----	vestitus E. Perrierm	Mayotte Island

XII. GENUS MITHRODIA GRAY

120	Mithrodia	Bradleyi Verrill	Panama
121	-----	clavigera Lamarck	Mascarene Islands, Java, Flores, Moluccas, Tahiti
122	-----	-----	Hawaiian Islands

XIII. GENUS SOLASTER FORBES

123	Solaster	alboverrucosus Brandt	Behring Strait
124	-----	affinis Brandt	Behring Strait
125	-----	decanus Müller and Troschel	Southeast of Australia
126	-----	decemradiatus Brandt	Sitka Island
127	-----	endeca Linck	Finland, coasts of Norway and England, Greenland, Labrador, Bay of Fundy, coast of Maine, Massachussets Bay
128	-----	furcifer Düben and Koren	Deep waters of the Atlantic
129	-----	gracilis Grube	Hong Kong
130	-----	papposus Linck	Finland, coasts of Norway and England, Channel (Roscoff), Greenland, Labrador, Bay of Fundy, Massachusetts Bay

LINCKIADÆ

XIV. GENUS FERDINA

131	Ferdina	Cumingii Gray	West coast of Colombia
132	-----	flavescens Gray	Mauritius

XV. GENUS FROMIA

133	Fromia	Balansæ E. Perrier	New Caledonia
134	----	indica E. Perrier	Indian Ocean
135	----	japonica E. Perrier	Japan
136	----	milleporella Lamarck	Red Sea, Reunion Islalnd, Madagascar, Moluccas
137	----	monilis Valenciennes	Amboine
138	----	(Metrodira) subtilis Lütken	Chinese seas
139	----	----- subulata Lamarck	Torres Strait, George Sound (Australia)

XVI. GENUS LINCKIA

140	Linckia	Bouvieri E. Perrier	Cape Verde Islalnds
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141	-----	diplax Müller and Troschel	Mauritius, Madagascar, New Caledonia, California (?)
142	----	Ehrenbergi Müller and Troschel	Red Sea, Mozambique
143	-----	erythræa Gray	Red Sea
144	-----	franciscus Nardo	?
145	-----	Guildingii Gray	Cape Verde Islands, Bermudas, reefs of Abrohlos, Antilles, Vera Cruz, Bahia
146	-----	intermedia Gray	?
147	-----	marmorata Michelin	Mauritius
148	-----	miliaris Linck	Red Sea, Mozambique, Zanzibar, Mauritius, Flores, Timor, Celebes, Batjan, Mindanao, Mondoro, north of Australia, New Caledonia
149	-----	mutifora Lamarck	Red Sea, Mozambique, Mauritius, Larentuka, Celebes, Amboine, New Caledonia, Hawaiian Islands
150	-----	nodosa E. Perrier	Antilles (?), Mauritius
151	-----	pacifica Gray	Nicobar Islands, Samoan archipelago, Tahiti
152	-----	pauciforis von Martens	Anenare Islalnd near Flores
153	-----	pulchella Gray	?
154	-----	Rosenbergi v. Martens	Amboine
155	-----	unifascialis Gray	Margarita Bay, Cape San Lucas, Acapuco, Pearl Island, Panama, Bay of Caracas (west Colombia, Zorritos, Realejo, Timor (von Martens <i>fide</i>)

XVII. GENUS LEPIDASTER

156	Lepidaster	teres Verrill	Panama
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XVIII. GENUS CISTINA

157	Cistina	Columbiae Gray	West coast of Colombia
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XIX.GENUS NECTRIA

158	Nectria	ocellifera Lamarck	Australian seas
159	----	ocellata E. Perrier	Bass Strait

XX. GENUS OPHIDIASTER

160	Ophidiaster	Agassizii E. Perrier	Juan Fernandez Island
161	-----	araenatus Lamarck	?
162	-----	attenuatus Gray	Mediterranean
163	-----	bicolor Lamarck	?
164	-----	chinensis E. Perrier	Canton (China)
165	-----	Cribrarius Lütken	Samoa Islands
166	-----	cylindricus Lamarck	Reunion Island, Moluccas
167	-----	Floridæ E. Perrier	Florida Strait
168	-----	fuscus Gray	Migupou
169	-----	Germani E. Perrier	New Caledonia
170	-----	glaber Peters	Mozambique
171	-----	gracilis Gray	West coast of Colombia
172	-----	Guildingii Gray	Saint Thomas (Antilles)
173	-----	Hemprichii Müller and Trochel	Red Sea
174	-----	Leachii Fray	Reunion Island, Mozambique
175	-----	ophidianus Lamarck	Mediterranean, Canary Islands, Cape Verde Islands, ? Mauritius (Michelin <i>fide</i>)
176	-----	purpureus E. Perrier	Mauritius, Seychelles
177	-----	pusillus Müller and Trochel	Flores, Amboine, Philippines, New Caledonia
178	-----	pyramidatus Gray	Margarita Bay, Cape San Lucas, Caracas (west Colombia)

XXI. SCYTASTER

(sic)	Scytaster	canariensis d'Orbigny	Canary Islands
	-----	ægyptiacus Gray	Red Sea, Mauritius, Fiji Islands, Hawaiian Islands
	-----	cancellatus Grube	?

-----	Kühlii M. T.	Java
-----	Galatheæ Lütken	Indian Sea
-----	Novæ Caledoniæ E. Perrier	New Caledonia
-----	semiregularis v. Martens	Malaysia
-----	tuberculatus, M. T.	Philippine Islands
-----	variolatus	Mauritius

GONIASTERIDÆ

XXII. GENUS ANTHENEA GRAY

179	Anthenea	acuta E. Perrier	West coast of Australia
180	-----	articulata Valenciennes	China, Seychelles
181	-----	flavescens Gray	?
182	-----	Grayi E. Perrier	?
183	-----	pentagonula Lamarck	Hong Kong
184	-----	tuberculosa Gray	Port Essington (Australia)
185	-----	scaber Möbius	

XXIII. GENUS ASTERODISCUS GRAY

186	Asterodiscus	elegans Gray	Northeast of China
-----	--------------	--------------	--------------------

XXIV. GENUS AMPHIASTER VERRILL

187	Amphiaster	insignis Verrill	La Paz
-----	------------	------------------	--------

XXV. GENUS ASTEROPSIS MÜLLER AND TROSCHEL

188	Asteropsis	vernicina Lamarck	Panama
-----	------------	-------------------	--------

XXVI. GENUS CHORIASTER LÜTKEN

189	Choriaster	granulatus Lütken	Fiji Islands
-----	------------	-------------------	--------------

XXVII. GENUS CULCITA AGASSIZ

190	Culcita	arenosa Valenciennes	Hawaiian Islands
191	-----	areolaa E. Perrier	
192	-----	coriacea Müller and Toschel	Red Sea, Mozambique Ibo
193	-----	grex Müller and Toschel	
194	-----	Novæ Guinæ Müller and Toschel	Mascarenes, New Guinea
195	-----	pentagularis Gray	

			Mozambique, reefs of Attagor (Torres Strait), Fiji Islands
196	-----	Schmideliana Retzius	Zanzibar, Mozambique, Madagascar, Mauritius Amboine, Indian seas (?), Galapagos Islands (Gray <i>fide</i>)
197	-----	Veneris E. Perrier	Saint Paul Island

XXVII (sic). GENUS DERMASTERIAS E. PERRIER

198	Dermasterias	imbrica Grube	Vancouver to San Francisco
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XXVIII. GENUS GONIASTER, SENS. NOV.

199	Goniaster	obtusangulus Lamarck	Indian Ocean (?)
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XXIX. GENUS GONIODISCUS MÜLLER AND TROSCHEL (EMEND.)

200	Goniodiscus	capella Müller and Toschel	China
201	-----	cuspidatus Lamarck	Moluccas
202	-----	forficulatus E. Perrier	Migupou
203	-----	gracilis Gray	Moluccas
204	-----	granuliferus Gray	China
205	-----	pencillatus Philippi	Chile
206	-----	pleyadella Lamarck	Moluccas
207	-----	Sebæ Müller and Toschel	Amboine, Ibo
208	-----	seriatus Müller and Toschel	Western Australia

XXX. GENUS GYMMASTERIA GRAY

209	Gymasteria	carinifera Lamarck	Red Sea, Mauritius, Amboine, New Caledonia, Fiji Islands, Hawaiian Islands, Panama
210	----	biserrata v. Martens	Larentuka Island, near Flores
211	----	imbricata Grube	Sitka Island
212	----	inernis Gray	Panama
213	----	valvulata E. Perrier	Galapagos Islands

XXXI. GENUS HIPPASTERIA GRAY

214	Hippasteria	plana Linck	Northern seas of Europe (Finland, coasts of Norway and England), northern America (Duck Island, Bay of Fundy), in zone of polypiers
-----	-------------	-------------	--

XXXII. GENUS MEDIASTER STIMPSON

215	Mediaster	æqualis Stimson	From Strait of Puget to San Francisco
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XXXIII. GENUS NIDORELLIA GRAY

216	Nidorellia	armata Gray	Margarita Bay, Cape San Lucas, Pearl Island, Panama, Nicaragua, Costa Rica, Ecuador, Zorritos, Punta Arenas, Realejo, Point Sainte Helene (Guayaquil)
217	----	horrida Gray	Guayaquil
218	----	Michelini E. Perrier	Mazatlan

XXXIV. GENUS PENTACEROS LINCK

219	Pentaceros	affinis Müller and Troschel	India
220	-----	alveolatus E. Perrier	New Caledonia
221	-----	australis Lütken	Australia
222	-----	Caledonicus E. Perrier	New Caledonia
223	-----	carinatus Müller and Troschel	? Adriatic
224	-----	Chinensis Gray	China
225	-----	Chinensis Müller and Troschel	China
226	-----	Cumingii Gray	Point Saint Helene (Guayaquil)
227	-----	dorsatus Linck	Cape Verde Islands
228	-----	forcipulosus Lütken	Guinea
229	-----	Franklini Gray	Australia
230	-----	gracilia Lütken	East Australia
231	-----	granulosus Gray	Australia
232	-----	Hedemanni Lütken	Billeton Island (between Sumatra and Borneo)
233	-----	hiulcus Linck	Zanzibar, Mauritius
234	-----	mammillatus Audouin	Red Sea, Mauritius

235	-----	<i>muricatus</i> Linck	Zanzibar, Madagascar, Seychelles, Mascarenes, Timor, Larentuka near Flores, Moluccas (Amboine)
236	-----	<i>nodosus</i> Gray	Zanzibar
237	-----	<i>nodulosus</i> E. Perrier	Australia
238	-----	<i>obtusatus</i> Lamarck	Mauritius, Philippine Islands
239	-----	<i>occidentalis</i> Verrill	Margarita Bay, Cape San Lucas, Panama, Guayaquil
240	-----	<i>orientalis</i> Müller and Troschel	China
241	-----	<i>regulus</i> Valenciennes	Pondichery
242	-----	<i>Reinhardti</i> Lütken	Nicobar Islands
243	-----	<i>reticulatus</i> Linck	Florida, Bahama, reefs of Abrohlos, Barbados, Antilles, Brazil
244	-----	<i>superbus</i> Möbius	Sumatra
245	-----	<i>tuberculatus</i> Müller and Troschel	Red Sea, east coast of Africa
246	-----	<i>turritus</i> Linck	Zanzibar, Mauritius, Moluccas (Amboine, Ceram, Banda, Donoa, Bouro), New Caledonia
247	-----	<i>valvulatus</i> Müller and Troschel	Australia
248	-----	<i>verrucosus</i> Müller and Troschel	Indian Sea
249	-----	<i>Westermanni</i> Lütken	Bengal

XXXV. GENUS PENTGONASTER

250	Pentagonaster (Astrogonium)	<i>aculeatus</i> Baret	North of the Atlantic
251	----	<i>acutus</i> Heller	Adriatic
252	----	<i>borealis</i> Baret	North of the Atlantic
253	----	<i>dilatatus</i> E. Perrier	New Zealand
254	----	<i>granularis</i> Retzius	Finland, coasts of Norway and England
255	----	<i>hispidus</i> Sars	Lofoden
256	----	<i>inæqualis</i> Gray	Amboine, New Guinea
257	----	<i>mammillatus</i> Valenciennes	?
258	----	<i>miliaris</i> Gray	New Zealand
259	----	<i>mirabilis</i> E. Perrier	Gulf of Smyrna
560	----	<i>paxillosus</i> Gray	Port Essington (Australia)

261	----	placenta Müller and Troschel	Adriatic
262	----	punctatus Lamarck	?
263	----	regularis Linck	?
264	----	rugosus Hutton	New Zealand
265	----	singularis Müller and Troschel	Chile, Strait of Magellan)
266	----	spinulosus Gray	Philippines, Fiji
267	----	tuberculatus Gray	Port Natal
268	Pentagonaster	verrucosus Philippi	Valparaiso
269	(Calliaster)	Childreni Gray	Japan
270	Pentagonaster (Calliderma)	Emma Gray	Japan
271	Pentagonaster (Dorigona)	longimana Möbius	Malacca
272	-----	Mülleri v. Martens	China, Japan
273	-----	abnormalis Gray	
274	-----	Dübeni Gray	East Australia
275	-----	Fonki Philippi	Chile
276	-----	Gunnii E. Perrier	Georgetown (Australia)
277	-----	Lamarcki Müller and Troschel	
278	-----	Luzonicus Gray	Philippines
	-----	pulchellus	Nouvelle Hollande (Iceland)
279	-----	semilunatus Linck	Cape Verde Island, Senegal, Antilles, Charleston (South Carolina), Zanzibar, islands of Maylasia, China
280	Pentagonaster (Stellaster)	Belcheri Gray	Amboine, New Guinea, north Australia
281	-----	Childreni Gray	China, Japan, Formosa, Australia
282	-----	granulosus E. Perrier	Australia
283	-----	Incei Gray	North Australia
284	-----	tuberculosis v. Martens	China
285	Pentagonaster (Tosia)	astrologorum M. T.	Australia
286	-----	auratus Gray	Australia
287	-----	australis Gray	Australia
288	-----	grandis Gray	Australia
289	-----	magnificus M T.	Tasmania
290	-----	nobilis Müller and Troschel	Australia

291	-----	ornatus M. T.	
292	-----	ruber Gray	Australia
293	-----	tubercularis Gray	Swan River (Australia)

XXXVI. GENUS PORANIA GRAY

294	Porania	patagonica E. Perrier	Patagonia
295	-----	pulvillus O.-F. Müller	Coasts of Norway and England

ASTERINIDÆ

XXXVII. GENUS ASTERINA NARDO

296	Asterina	Burtonii Grapy	Red Sea
297	----	calca Lamarck	Australia
298	----	calcarata Valenciennes	Chile
299	----	cephæa Valenciennes	Red Sea, Zanzibar, Mozambique, Ibo, Java, Philippines, New Caledonia
300	----	Chilensis Lütken	Peru, Chile
301	----	coccinea Müller and Troschel	Cape of Good Hope
302	----	coronata von Martens	Mozambique, Moluccas (Batjan, Amboine)
303	----	Diesingi Müller and Troschel	
304	----	exigua Lamarck	Cape of Good Hope, Natal, Mascarenes, Java (Palabuan), Moluccas (Bagtjan), Philippines, Australia, Saint Paul Island
305	----	fimbriata E. Perrier	Reunion Island
306	----	Gayi E. Perrier	Chili
307	----	gibbosa Pennant	European seas. — ? Red Sea, Mozambique, Mascarenes, Philippines Flores, Moluccas (Batjan)
308	----	granifera Gray	Cape of Good Hope
309	----	granulosa E. Perrier	Hawaiian Islands
310	----	Gunnii Gray	Australia, Tasmania
311	----	marginata Valenciennes	Brasil (Rio Janeiro), Senegal
312	----	miniata Brandt	Sitka Island, California (Monterey)

313	----	<i>minuta</i> Gray	Antilles
314	----	<i>modesta</i> Verrill	Panama, Pearl Island
315	----	<i>Novæ Zelandiæ</i> E. Perrier	New Zealand
316	----	<i>obtusa</i> Gray	Panama
317	----	<i>pectinifer</i> Müller and Troschel	Hakodadi (Japan)
318	----	<i>penicillaris</i> Lamarck	Red Sea, Java, Adenas near Flores, Moluccas
319	----	<i>pusilla</i> E. Perrier	Talcahuano (Chile)
320	----	<i>regularis</i> Verrill	Akaroa, Australia, Auckland Islands, New Zealand
321		<i>setacea</i> Valenciennes	?
322	----	<i>squamata</i> Valenciennes	Senegal
323	----	<i>stellaris</i> E. Perrier	
324	----	<i>trochiscus</i> Müller and Troschel	Indian Sea
325	----	<i>Wesseli</i> Lütken	Barbados
326	----	<i>Wega</i> Valenciennes	Red Sea, Mauritius

XXXVIII. GENUS DISASTERINA E. PERRIER

327	Disasterina	<i>abnormalis</i> E. Perrier	New Caledonia
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XXXIX. GENUS GANERIA GRAY

328	Ganeria	<i>Falklandica</i> Gray	Falkland Islands
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XL. GENUS NEPANTHIA GRAY

329	Nepanthia	<i>Belchderi</i> E. Perrier	?
330	----	<i>brevis</i> E. Perrier	Strait of Prince of Wales
331	----	<i>maculata</i> Gray	Migupou

XLI. GENUS PALMIPES LINCK

332	Palmipes	<i>inflatus</i> Hutton	New Zealand
333	----	<i>membranaceus</i> Linck	Coasts of England, Channel, Atlantic, Mediterranean
334	----	<i>rosaceus</i> Lamarck	Japan

XLII. GENUS PATIRIA GRAY (EMEND.)

335	Patiria	<i>crassa</i> Gray	Australia
336	----	<i>ocellifera</i> Gray	?

XLVIII. GENUS SOCOMIA

337 Socomia paradoxa Gray

PTERASTERIDÆ

XLIV. GENUS HYMENASTER WYVILLE THOMSON

338 Hymenaster pellucidus Wyville Thomson Deep waters of the Atlantic

XLV. GENUS PTERASTER MÜLLER AND TROSCHEL

339	Pteraster	capensis Gray	Cape of Good Hope
340	-----	caribœus E. Perrier	Florida (125 feet)
341	-----	cribrosus v. Martens	Zanzibar, Mozambique, Philippines
342	-----	Danæ Verrill	Rio Janeiro
343	-----	militaris Müller and Troschel	Finland, coasts of Norway and England, Greenland, Bay of Fundy, Spitzberg
344	-----	multipes Sars	Lofodon Islands
345	-----	pulvillus Sars	North of the Atlantic

ASTROPECTINIDÆ

XLVII. GENUS ARCHASTER MÜLLER AND TROSCHEL

346	Archaster	angulatus Müller and Troschel	Mascarenes, Java, Philippines, Australia
347	-----	arcticus Sars	Finland
348	-----	bifrons Wyville Thompson	Deep waters of the Atlantic
349	-----	Christi Düben and Koren	North Seas
350	-----	hesperus Müller and Troschel	Japan
351	-----	Parelii Düben and Koren	North seas of Europe
352	-----	subinermis Philippi	Mediterranean
353	-----	tenuispinus Düben and Koren	Deep waters of Norway
354	-----	typicus Müller and Troschel	Japan, Mollucas (Batjan, Amboine), Adnares by Flores, Timor, Australia,

355	-----	vexillifer Wyville Thomson	New Caledonia, Tonga Islands Deep waters of the Atlantic
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XLVIII. GENUS ASTROPECTEN LINCK

356	Astropecten	aciculares Norman	Coasts of England
357	----	alatus E. Perriner	?
358	----	antillensis Lütken	Antilles
359	----	armatus Gray	Puerto Portrero
360	----	articulatus Say	Florida, Georgia
361	----	aster Philippe	Adriatic, Mediterranean
362	----	aurantiacus Linné	Mediterranean, Canaries
363	----	bispinosus Philippe	Mediterranean
364	----	brasiliensis Müller and Troschel	Antilles (Saint Vincent, Brazil)
365	----	Buschii Phhlippe	
366		calcitraba Lamarck	
367	----	Chinensis Grube	China
368	----	ciliatus Grube	Puerto Cabello
369	----	cœlacanthus von Martens	
370	----	diplacanthus Gray	
371	----	duplicatus Gray	Florida, Vera Cruz, Antilles (Saint Vincent), Brazil
372	----	echinulatus Müller and Troschel	North of the Atlantic
373	----	Edwardsi Verrill	New Zealand, Auckland Islands
374	----	ensifer Grube	
375	----	erinaceus Gray	Guayquil
376	----	euryacanthus Lütke	Nicobar Islands
377	----	fimbriatus Linck	?
378	----	fragilis Verrill	Panama, Zorritos, Peru
379	----	gracilis Gray	?
380	----	granulatus Müller and Troschel	?
381	----	Hemprichi Müller and Troschel	Red Sea
382	----	hispidus Müller and Troschel	?
383	----	irregularis Pennant	Coasts of Norway and England
384	----	japonicus Müller and Troschel	Japan
385	----	javanicus Müller and Troschel	Java
386	----	Johnstoni Delle Chiaje	Mediterranean

387	----	latiradiatus Gray	Tehuantepec
388	----	longipes Gray	Mauritius
389	----	longispinus Müller and Troschel	Java
390	----	Lütkeni Barrett	
391	----	marginatus Müller and Troschel	?
392	----	Mauritianus Gray	Mauritius
393	----	mesodiscus Linck	?
394	----	Erstedii Lütke	Margarita Bay, Cape San Lucas, Panama, Realejo
395	----	Olfersi Grube	?
396	----	paleatus Grube	?
397	----	pentacanthus Philippi	Mediterranean
398	----	peruvianus Verrill	Peru (Payta)
399	----	platyacanthus Philippi	Mediterranean
400		polyacanthus Müller and Troschel	Red Sea, Australia, New Zealand, Ceylon, Japan
401	----	Pressii Müller and Troschel	Southwest coast of Australia
402	----	regalis Gray	San Blas
403	----	regularis Linck	?
404	----	Richardi Valenciennes	Guyana
405	----	Samoensis E. Perrier	Samoa
406	----	Schœnleinii Müller and Troschel	Goree
407	----	scoparius Valenciennes	Japan
408	----	serratus Valenciennes	Atlantic (Rochelle, Bay of Biscay), Mediterranean
409	----	spatuliger E. Perrier	?
410	----	spinulosus Philippi	Mediterranean
411	----	squamatus	Seas of the north
412	----	stellatus Gray	
413	----	Tiedemanni Müller and Troschel	
414		triseriatus Philippi	Southwest coast of Australia
415	----	umbrinus Grube	Japan
416	----	vappa Müller and Troschel	Australia
417	----	velitaris von Martens	China
418	----	vestita Say	Massachussetts

XLIX. GENUS CHÆTASTER

419	Chætaster	longipes Retzius	Mediterranean
420	----	californicus Grube	California
421	----	cylindratus Möbius	Manilla
422	----	Hermanni Müller and Troschel	?
423	----	nodosus E. Perrier	Antilles
424	----	Troscheli Valenciennes	(?) Antilles

L. CTENODISCUS

425	Ctenodiscus	australis Lovén	West Patagonia
426	----	corniculatus Linck	Finland (coast of Norway), Greenland, Frenchman's Bay (United States)

LI. GENUS LUIDIA FORBES

427	Luidia	alternata Say	Antilles (Saint Thomas, Tortugas)
428	----	brevispina Lütken	Mazatlan, Hawaiian Islands
429	----	Bellonæ Lütken	Panama, Guayaquil, Callao
430	----	californica E. Perrier	California
431	----	ciliaris Philippe	Mediterranean, Atlantic
432	----	clathrata Say	Beaufort, Charleston, Cayfort (40 feet), Antilles (Haiti), Rio Janeiro
433	----	Colombiæ Gray	San Blas
434	----	debilis Grube	?
435	----	elegans E. Perrier	United States
436	----	foliolata Grube	
437	----	Hardwickii Gray	Indian Ocean
438	----	maculata Müller and Troschel	Japan, Philippines (Manila), coast of Coromandel – Mozambique
439	----	Sarsii Düben and Koren	North of the Atlantic
440	----	Savignyi Audouin	Red Sea
441	----	Senegalensis Lamarck	Senegal, Antilles, Brazil
442	----	tessellata Lütken	West coast of America (Panama, Acajutla)
443	----	variegata E. Perrier	Cape Breton Island

BRISINGIDÆ

LI. GENUS ABSJORNSEN

444	Brisinga	coronata	Lofoden, Feroe, coast of Ireland
445	----	endecacnemos Absjornssen	Lofoden, Bergen, coast of Portugal

GEOGRAPHICAL ISLANDS

It is now easy to distinguish in the various parts of the world, the more or less extensive areas that are distinctive to certain groups of species and that have the same fauna of starfish at all localities.

The most northern part of the Atlantic has a small number of species, but these species are for the most part common to all the coasts of the circumpolar regions. We can name this region *arctic region*. There are:

Asterias stellionura
---- polaris
Stichaster albulus
Cribrella oculata
Solaster papposus
---- endeca
Ctenodiscus crispatus
Pteraster militaris

All these species except the first two are found again in the following European zone that we can call the *boreal region*, but some new species are added to it. These are:

Asterias glacialis
---- rubens
Stichaster roseus
Solaster furcifer
Hippasteria plana
Pentagonaster granularis
---- hispidus
---- borealis
---- aculeatus
Porania pulvillus
Archaster Parelii
---- Christi
---- tenuispina
---- arcticus

Astropecten irregularis
Luidia Sarsii
Brisinga coronata
---- endecacnemos

The southern part of the coasts of England and France are much less rich. However, some new species appear and this contrast merits forming a special region that has already been designated the *celtic region*. We find there:

Asterias glacialis
---- rubens
Solaster papposus
Echinaster sepositus
Cribrella oculata
Palmipes membranaceus
Asterina gibbosa
Astropecten serratus
Luidia ciliaris

This is a fauna of transition that leads to that of the *lusitanian region* that can include the Mediterranean as an addition. Here are the species that we have observed in this sea up to now:

Asterias glacialis
---- tenuispina
Echinaster sepositus
Ophidiaster ophidianus
---- attenuatus
Pentagonaster placenta
---- acutus
---- mirabilis
? Pentaceros carinatus
* Asterina gibbosa
Chætaster longipes
* Astropecten aurantiacus
---- bispinosus
---- platyacanthus
---- aster
---- subinermis
* Luidia ciliaris

The species marked with an asterisk are those that have up to this day been found in the Ocean and notably at the Madeira Islands, at the Azores and at the Canaries. Some species of these islands have not, to the contrary, been recorded in the Mediterranean. These are:

Asterias madeirensis³
---- Webbiana
Scytaster Canariensis

But it can happen that new investigations will notably decrease these differences.

The fauna of the Atlantic coast of America is interesting to compare with our European coasts. Cape Cope and Nantucket mark the extreme southern limit of a fauna that is not without analogy with the European boreal fauna. We find there:

Asterias Fabricii
---- borealis
---- Forbesii
---- compta
---- tenera
---- Stimpson
---- vulgaris
* Cribrella oculata
* Solaster endeca
---- papposus
* Hippasteria plana
* Pteraster militaris
* Ctenodoiscus corniculatus
* Luidia variegata

The species marked with an asterisk are common to the European and American coasts. There are six of them, with five genera. *Asterias* and *Luidia* alone are different. Again, it is necessary to note that *A. borealis* very clearly represents in this fauna our *A. polaris*; *A. Forbesii*, our *A. rubens*; *A. tenera*, our *A. Mülleri*' and, finally, *Luidia variegata*, our *L. sarsii*. It is thus appropriate to distinguish in the Atlantic a single boreal region that extends from the European coasts to those of America.

From Cape Cod to Florida, the fauna takes, to the contrary, a very special character, as the following list shows:

Asterias arenicola
---- compta
---- pallida
---- Stimpsoni
---- tenera
Echinaster echinophora
---- sentus
---- spinulosus
Astropecten articulatus
Luidia clathrata

³ *Asterias Madeirensis* and *Asterias Webbiana* are very close to *A. glacialis*.

Not one species is common with the coast of Europe. It is thus necessary to distinguish here a new region that is, strictly speaking, the *North American region of the Atlantic*.

Leaving Florida, the fauna takes a tropical character and we begin likewise to encounter species that are common with the African coast of the Atlantic, the Canary Islands and the Cape Verde Islands. This Caribbean fauna has the following constitution:

Asterias Mexicana
* ---- tenuispina
Echinaster serpentarius
---- echinophora
---- brasiliensis
Ophidiaster Guildingii
---- Floridæ
* Linckia Guildingii
---- nodosa
Pentaceros articulatus
* Pentagonaster semilunatus
---- Alexandri
Asterina minuta
---- marginata
---- Wesseli
Astropecten articulatus
---- antillensis
---- duplicatus
---- ciliatus
---- senegalensis
Chætster Troschelii
---- nodosus
Pteraster caribœus

This very rich fauna contains as can be seen species of the preceding region. Some species are special to it, but five of them are common with the opposite coast of the Atlantic. This latter is, it is very necessary to say, very little known and we will have exhausted what we know in reporting, in addition to the preceding, the following species from the Cape Verde Islands or of Senegal:

Cape Verde Islands	Ophidiaster ophidianus
	Linckia Bouvieri
	Pentaceros dorsatus
Senegal	Asterina squamata

The rest of the African coast down to the Cape of Good Hope is totally unknown and we can say almost as much for the coast of South America where we find presently mentioned only the following species:

Echinaster echinophora
---- brasiliensis
* Asterina marginata
Pteraster Danæ
Astropecten Richardi
---- brasiliensis
Luidia senegalensis

Two of these are also African. It is probable this list is very incomplete. It does not permit at the moment to characterize the fauna of this region and that will probably have to be distinguished later as the *brasilian region*.

The east coast (sic) of the American continent has been carefully studied from the point of view of the distribution of echinoderms by Verrill. He has reviewed, with special care, all the documents regarding it. Here are the regions that he adopts. We modify the names in his list only those names that are duplicates and those that do not have priority. We add a small number of species that have since been encountered in those regions.

1. Sitka Island

Asteropsis imbricata
Asterina miniata
Solaster decemradiatus
Pycnopodia helianthoides
Asterias ochracea
---- epichlora

2. From the Strait of Puget to Cape Mendocino

Mediaster æqualis
*Asterina miniata
Cribrella lævuscula
*Pycnopodia helianthoides
*Asterias epichlora
*---- ochracea
---- conferta
---- fissispina
---- gigantea
---- Lütkenii
---- paucispina
---- Troschellii
---- hexactis
---- Katherinæ

3. From Cape Mendocino to Cape San Lucas

Astropecten Erstedii
Nidorellia armata
Orcaster occidentalis
Linckia unifascialis
---- diplax
Ophidiaster pyramidatus
Heliaster microbrachia
Heliaster Kubiniji
Asterias sertulifera
----- æqualis
----- brevispina
----- capita

4. Coast of Mexico and Gulf of California

Luidia brevispina
*Nidorellia armata
----- Michelini
* Linckia unifascialis
Amphiaster insignis
* Heliaster Kubiniji

5. Panamanian region

Luidia Colombiae
Astropecten fragilis
---- regalis
---- erinacens
---- latiradiatus
Asterina obtusa
---- modesta
Gymnasteria carinifera
(?) ---- inermis
* Nidorellia armata
Pentaceros occidentalis
* Linckia unifascialis
* Ophidiaster pyramidatus
Lepidaster terres
Mithrodia Bradleyi
Echinaster tenuispinus
---- acuelatus
* Acanthaster Ellisii
* Heliaster microbrachia

6. Ecuador and Colombia

Luidiai Bellonæ

* Astropecten erinaceus

* ---- fragilis

Nidorellia horrida

* armata

Pentaceros Cumingii

* Linckia unifascialis

---- Colombiæ

Ophidiaster Colombiæ

---- gracilis

---- pyramidatus

Ferdina Cumingii

* Acanthaster Ellisii

7. Peru

* Luidia Bellonæ (Zorritos)

* Astropecten fragilis (Zorritos)

---- Peruvianus (Païta)

* Nidorellia armata (Zorritos)

* Linckia unifascialis (Zorritos)

* Ophidiaster pyramidatus (Zorritos)

Asterina Chilensis (Callao)

Stichaster aurantiacus (Callao)

Heliaster Cumingii (Zorritos, Payta)

---- heliaster (Payta, Callao)

8. Chile

Asterias clavata

---- echinata

---- fulva

---- gelatinosa

---- gemmifer

---- Germani

---- lurida

---- mitis

---- spectabilis

---- varia

Stichaster aurantiacus

Heliaster helianthus

Echinaster cribrella

Ophidiaster Agassizi

Pentagonaster Fonki

---- penicillatus
---- singularis
---- verrucosus
Asterina chilensis
---- calcarata
---- Gayi
---- fimbriata
---- pusilla

9. Southern point of America

Asterias antarctica
---- Cumminghami
---- meridionalis
---- rugispina
---- sulcifer
Labidiaster radiosus
? Acanthaster solaris
Porania patagonica
Pentagonaster singularis
Ganeria Falklandica
Ctenodiscus australis

The preceding lists indicate that one can distinguish four principal regions on the west coast of America. The first extends from Sitka Island to Cape Mendocino that can be called the *northwest American region*. The second begins at Cape Mendocino and extends to between Zorritos and Payta on the coast of Peru that can be called the *mexican-panamanian region*. The third contains the rest of Peru and Chile that can be called the *peruvian-chilean region*. The *patagonian region* follows the latter. These regions have few species in common. But one can, like Verrill, subdivide several of them taking into account not the species with the most extensive distribution (like *Pycnopodia helianthoides*, *Nidorellia armata*, *Linckia unifascialis*, *Ophidiaster prmidatus* etc.) but those that are less distributed. This is how one can distinguish the following districts that we have not stressed before: 1. Sitka Island District, 2. Oregonian District, 3. Californian District, 4. Panamanian District, 5. Peruvian District, 6. Chilian District, 7. Araucanian District, 8. Fuelgian District. One can also make another district for the Galapagos Islalnds whose very incompletely known fauna seems closely related to the Peruvian fauna.

We must also add that the regions accepted by Verrill appear a little too many to us, especially because further discoveries can modify notably the similarities of two adjacent districts of one of our regions.

It remains for us to consider the regions into which the Pacific can be divided. These regions can dbe divided in the following fashion;

1. The Red Sea and the west coast of Africa, including Madagascar, form a single large region with the archipelagos of the Pacific: Seychelles, Mascarenes, archipelagos of Malaysia, New Guinea, north of Australia, New Caledone and all of Polynesia except New Guinea.

2. The coasts of India and of Indo-China.

3. The coasts of China and Japan

4. Australia and New Zealand

Two of these regions (3 and 4) are very imperfectly known. The three others are much better known and the two first are not without having large analogies between them, particularly the distribution of genera.

Here are the species that have been collected at the principal points of these latter regions:

1. Red Sea

Acanthaster echinites

Echinaster fallax

Lincia Ehrenbergi

---- *multifora*

---- *erythræa*

Ophidiaster Hemprichii

Scytaster ægyptiacus

Fromia Milleporella

Pentaceros mammillatus

---- *tuberculatus*

Culcita coriacea

Gymnasteria carinifera

Asterina Burtoni

---- *Cephea*

---- *wega*

? ---- *gibbosa*

---- *pentagona*

---- *penicillaris*

Astropecten Hemprichii

----- *polyacanthus*

Luidia Savignyi

2. Mozambique and Zanzibar

* *Echinaster fallax*

Ophidiaster Leachii

----- *glaber*

* *Linckia miliaris*

* ---- *multiflora*

* ---- *Ehrenbergii*

Scytaster variolatus

* *Culcita coriacea*

---- *Schmideliana*

---- *pentagonalis*

* *Pentaceros tuberculatus*

---- *hiulcus*

---- *muricatus*

---- *nodosus*

---- turritus
Pentagonaster semilunatus
Goniodiscus Sebæ
* Gymnasterias carinifera
* Asterina cephea
---- coccinea
(?) ---- coronata
* gibbosa
Pteraster cribrosus
* Astropecten Hemprichii
Luidia maculata

3. Mascarenes

Asterias borbonica
---- calamaria
---- Jehennesii (Madagascar)
---- tenuispina
Valvasterias striata
Mithrodia clavigera
Ferdina flavescens
* Fromia milleporella
Linckia diplax
---- marmorata
* miliaris
* multifora
(?) ---- nodosa
Ophidiaster cylindricus
----- Leachii
---- purpureus
* Scytaster variolatus
* ---- ægyptiacus
Culcita Novæ-Guinæ
---- Schmideliana
* Gymnasteria carinifera
* Pentaceros hiulcus
* ---- mammillatus
* ---- muricatus
* ---- obtusatus
---- turritus
Asterina exigua
(?) ---- gibbosa
---- wega
Archaster angulatus
Astropecten Mauritianus

4. Indian archipelagos

- (?) *Asterias tenuispina*
- Calvasterias asterinoïdes*
- * *Aacanthaster echinites*
- Cribrella ornata*
- Echinaster eridanella*
 - *fallax*
- * *Mithrodia clavigera*
- * *Linckia diplax*
- * ---- *miliaris*
- * ---- *multifora*
 - *pacifica*
 - *pauciforis*
 - *Rosenbergi*
- * *Scytaster ægyptiaeus*
 - *tuberculatus*
- * ---- *variolatus*
- * *Culcita Novæ Guineæ*
- * ---- *pentagularis*
- * ---- *Schmideliana*
- Goniaster obtusangulus*
- Goniodiscus cuspidatus*
 - *gracilis*
 - *pleyadella*
- * ---- *Sebæ*
- * *Gymnasteria cariiifera*
 - *biserrata*
- * *Pentaceros muricatus*
- * ---- *obtusatus*
 - *superbus*
- * ---- *turritus*
- Pentagonaster inæqualis*
- * *semilunatus*
 - (*Stellaster*) *Belcheri*
- * *Asterina exigua*
- * ---- *gibbosa*
- * ---- *penicillaris*
- * *Archaster angulatus*
- * ---- *typicus*
- Astropecten javanicus*
 - *polyacanthus*
- * *Luidia maculata*
- * *Pteraster cribrosus*

As can be seen by the number of asterisks that indicate species in common, these diverse localities, in spite of some secondary differences, should be considered as forming a single and very vast region of zoological geography. The closest affinities unite the faunas they contain. This is what can be called the *Pacific region*.

The species of India itself are still less numerous.

Indian and Indo-China

(?) *Asterias rubens* (Sp. affin)

Fromia indica

Pentaceros affinis

---- *regulus*

---- *Reinhardti*

---- *verrucosus*

---- *Westermanni*

Dorigona longimana

Astropecten euryacanthus

Luidia Hardwickii

But it is sufficient to glance at this list and compare it with the preceding to see that we are in a completely different region. If the genera still appear very close, the species are absolutely distinct and it is necessary to make the same remark on the following very long list of species of China and Japan.

China and Japan

Asterias japonica

? ---- *rubens*

* *tenuispina*

Solaster (?) *gracilis*

Fromia japonica

Metrodira subtilis

Ophidiaster chinensis

Anthenea articulata

Asterodiscus elegans

Goniodiscus capella

---- *granuliferus*

Pentaceros chinensis

---- *orientalis*

Calliaster Childreni

Calliderma Emma

Dorigona Mülleri

Pentagonaster semilunatus

Stellaster Childreni

---- *tuberculosus*

Asterina pectinifer

Palmipes rosaceus
Archaster hesperus
Astropecten chinensis
---- japonicus
---- polyacanthus
---- scoparius
---- umbrinus
---- velitaris
* Luidia maculata

We are led in the same way to constitute two new regions, the coasts of Australia except the northern coast and neighboring islands, including New Zealand, not forming a less distinct region, as shown in the following list:

Australia — New Zealand

* Asterias calamaria (Australia and New Zealand)

---- fungifera
---- globifera
---- granifera
---- mollis (New Zealand)
---- polyplax
---- scaber (New Zealand)

* ? ---- tenuispina

Stichaster australis (New Zealand)

Cribrella ornata (New Zealand)

Echiinaster falax (New Zealand)

Stichaster decanus

Nectria ocellata

Anthenea acuta

---- tuberculosa

Goniodiscus seriatus

Pentaceros australis

----- Franklinii

----- gracilis

----- granulosis

----- nodulosus

Pentagonaster miliaris (New Zealand)

---- paxilloisus

---- rugosus (New Zealand)

---- Dübeni

---- pulchellus (Australia and New Zealand)

---- (Stellaster) granulosis

---- Incei

---- (Tosia) astrologorum

---- auratus

---- australis
---- grandis
---- magnificus
---- nobilis
---- Pentagonaster (Tosia) ruber
---- tubercularis
Asterina calcar
---- exigua
---- Gunnii
---- regularis (Australia and New Zealand)
Palmipes inflatus (New Zealand)
Patiria crassa
Astropecten Edwardsi (New Zealand)
---- polyacanthus
---- triseriatus
---- vappa

We thus have here a fauna totally distinct from those we have encountered up to here, and that has only distant affinities with the nearest faunas. A single species is common with the Cape of Good Hope.

New Zealand has three species common with Australia. All connect it with the Australian region but it is necessary to note that it is different from it in some regards. It is probable, moreover, that with a better study of the same fauna of the coast of Australia, we would be able to distinguish districts similar to those we have seen on the American coasts.

We have thus definitively distinguished the four following regions in the Pacific:

1. *Indo-Pacific Region*
2. *Indian Region*
3. *Chino-Japanese Region*
4. *Australian Region*

We know nothing of the southern and antarctic regions, which without doubt have their own special fauna.